NUCLEAR DYNAMICS

In a Multipolar Strategic Ballistic Missile Defense World

by Charles D. Ferguson and Bruce W. MacDonald

July 2017

FAS Federation of American Scientists

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ABOUT THE AUTHORS

Charles D. Ferguson is the President of FAS and has worked on nuclear policy issues for almost 20 years. In addition, as a graduate of the U.S. Naval Academy and the Naval Nuclear Power School, he had served at the end of the Cold War as an officer on a ballistic missile submarine; after that service, he earned a Ph.D. in physics from Boston University.

Bruce W. MacDonald is the Adjunct Senior Fellow for National Security Technology at FAS and has more than 40 years of experience in governmental and nongovernmental positions working on defense and national security issues. He has a BSE degree and master's degree in aerospace engineering and master's degree in public affairs from Princeton University.

ACKNOWLEDGMENTS

This publication was developed under work supported by the Naval Postgraduate School (NPS) Project on Advanced Systems and Concepts for Countering WMD (PASCC), under assistance grant No. N00244-16-1-0028, awarded by the NAVSUP Fleet Logistics Center San Diego (NAVSUP FLC San Diego), with funding from the Defense Threat Reduction Agency (DTRA). This report has not been formally reviewed by NPS. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of NPS, NAVSUP FLC San Diego, or DTRA. The authors are also grateful to the more than 70 experts in China, India, and the United States who engaged in discussions regarding the complex issues addressed in this report. Moreover, the authors greatly appreciate the FAS staff support from Frankie Guarini and Pia Ulrich.

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Front & Back Cover Photo: Ground-based interceptor at Fort Greely, Alaska missile defense complex (by U.S. Army).

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report examines the nuclear dynamics and implications for strategic relations in a world where four nuclear-armed states are developing strategic ballistic missile defenses (BMD). These states are the United States, Russia, China, and India. Each state appears to have the common rationale of wanting at least limited protection against ballistic missile attacks, and all will respond with various countermeasures to ensure that their nuclear deterrents are viable as they react to missile defense developments in other countries. In addition, we have found that each state has differing motivations for strategic BMD.

The United States is primarily motivated to protect itself and its allies against missile threats from Iran and North Korea while also wanting to have the capability to shoot down a very limited number of ballistic missiles from any source due to unauthorized or inadvertent launches. The United States has the difficult balancing act of trying to assure Russia and China that U.S. strategic BMD programs are neither intended to defeat nor capable of defeating those countries' nuclear deterrents, while trying to deter or dissuade use of Iranian and North Korean ballistic missiles in armed conflict. However, Russia and China are not so much concerned about the present U.S. BMD systems, but what these systems could become in the next several years to couple of decades.

Russia's motivations for strategic BMD have largely been focused on having missile interceptors to protect Moscow, but several independent analysts have doubted the effectiveness of this system. While many Russian defense analysts have assessed that a nationwide missile defense is not possible, Russian defense engineers are still trying to develop improved missile interceptors based on hit-to-kill, kinetic technologies, while still considering keeping nuclear-tipped interceptors.

China, for decades, has vociferously expressed opposition to U.S. missile defenses, arguing that they are destabilizing. Nonetheless, Chinese technical researchers have been investigating BMD seriously since the mid-1980s in response to wanting to understand the U.S. Strategic Defense Initiative. Since 2010, China's activities in BMD have stepped up to include missile intercept tests and analytical assessments about the benefits for China of potential limited BMD deployments. The primary motivation for China is to ensure that it has a viable second-strike nuclear force. Effective Chinese strategic BMD could give Beijing the confidence it needs about its nuclear forces' survivability.

India began exploration of BMD about 20 years ago in response to New Delhi's concerns about Chinese transfer of ballistic missiles to Pakistan and further developments of Pakistani-produced ballistic missiles. Some Indian analysts have argued in favor of strategic BMD that would protect New Delhi (the national command authority) and Mumbai and its surrounding area (containing nuclear forces' storage facilities) as a way of buttressing the credibility of India's no-first-use policy of nuclear weapons in the face of Pakistan's first-strike policy. Also, India has appeared to be motivated to have some protection against China's ballistic missile threat. Conversely, China's defense experts say that they do not feel threatened by India's nuclear forces. But this assessment could change as India tests in the coming months and likely eventually deploys in the coming years the Agni-6 missile. With an estimated range of 6,000 to 7,500 km and reportedly able to carry multiple independently

targetable reentry vehicles (MIRVs), the Agni-6 missile poses a potentially serious threat to China, which could further motivate China to deploy BMD to guard against this new threat.

As these states pursue strategic BMD, the dynamics become even more complex because of security trilemmas, or nested security dilemmas, and because of security commitments between certain nuclear-armed states and their allies. For example, while the United States seeks to protect itself and its allies, Japan and South Korea, from North Korean ballistic missiles, China could feel threatened depending on the real or perceived capabilities of the missile defense systems. If China responds by building up its nuclear forces, India in turn could feel more vulnerable and then buildup its nuclear forces; this would adversely affect Pakistan, which could then be further aided by its ally China. Also, while the United States is focusing its missile defense efforts in Europe to provide protection to European NATO nations from potential Iranian missile threats, Russia expresses concern that the system could expand to eventually pose a threat to its nuclear deterrent. In sum, the action-reaction dynamics in this multipolar world likely result in more instability, but as this report discusses there are also BMD deployments that could be stabilizing under the proper conditions.

While several arms control and defense experts from China, India, and Russia have expressed interest during our discussions with them about potential multilateral arms control mechanisms, such as a multilateral Anti-Ballistic Missile Treaty, they have voiced skepticism that the United States is willing to accept any limits on its BMD system. During our discussions with numerous experts, we heard expressed interest in having Track 2 (nongovernmental level) dialogues on strategic stability and BMD. These forums could help support discussions at the level of the five permanent member states of the UN Security Council, or P5 (also the official nuclear weapon states), that could focus on developing a common understanding of what would be needed to achieve strategic stability in a world with multiple nuclear-armed states deploying strategic BMD systems.

PURPOSE AND SCOPE

We are focused on understanding the nuclear dynamics of a world in which more than one nation is developing and deploying ballistic missile defense systems for strategic purposes. Strategic purposes could mean for defense of a national territory, defending command and control centers, protecting nuclear-armed ballistic missiles to help ensure retaliatory forces, or providing political cover for development of anti-satellite weapons that could target strategic military communications as well as command and control satellites. Strategic BMD is distinguishable from theater missile defenses (TMD), which are designed for defending smaller areas or for providing "point" protection of military units. Strategic BMD is also typically designed to counter long-range ballistic missiles, such as intercontinental range ballistic missiles (ICBMs), especially in the context of the United States wanting protection against adversaries who are an ocean's distance away or farther. However, in the context of neighboring nuclear adversaries such as India and Pakistan, strategic BMD would target shorter-range ballistic missiles while India would also consider strategic BMD for protection against medium- to intermediate-range Chinese ballistic missiles. In sum, strategic BMD is not so much about the range of missile threats but rather the context of national security purposes.

Our study recognizes that the multipolar nature of the nuclear-armed world greatly complicates the strategic landscape and the decision-making tasks of deterrence and defense against multiple nations' nuclear forces. One can almost view the Cold War with nostalgia as a "simpler" time when the nuclear challenge was mainly about the bilateral relationship between the Soviet Union and the United States. Of course, the reality then was that most of the Cold War involved more than two nations with nuclear arms raising the stakes of strategic calculations. For example, the Sino-Soviet split eventually led to a rapprochement between China and the United States when President Richard Nixon and Secretary of State Henry Kissinger went to Beijing in 1972 to establish diplomatic ties between China and the United States. However, just a handful of years before, Secretary of Defense Robert McNamara pointed to China (with a nascent ballistic missile program) as the rationale for U.S. development of the Sentinel BMD system, while the underlying and unstated reason was for the United States to have some defense against the growing Soviet missile threat. There was hardly a time during the nuclear age when bilateral nuclear competition was the only consideration. The important point for our study is that during the Cold War only two nations, the United States and the Soviet Union, were developing strategic BMD systems.

Today, more than 25 years after the Cold War, what has changed is the number of states with more capable nuclear forces and with strategic BMD systems being developed. China, in particular, has been modernizing its nuclear forces and has since 2010 been conducting tests of ballistic missile interceptors as well as anti-satellite weapons since 2007. India, during the past 10 years, has been increasing its testing of a BMD system, though the origins of this program date back about 20 years in response to Pakistan's acquisition in the mid-1990s of Chinese supplied M-11 ballistic missiles. While Russia has had dozens of nuclear-tipped missile interceptors surrounding Moscow during and since the Cold War, it has been investing in modernizing this system, especially with the development of non-nuclear hit-to-kill interceptors. In 2002, the United States withdrew from the 1972 Anti-Ballistic Missile (ABM) Treaty with Russia and has been proceeding with the deployment of a limited

national missile defense (NMD) system with interceptors based in Alaska and California. Thus, the scope of our study is to try to understand the implications of strategic BMD developments in four nuclear-armed nations: China, India, Russia, and the United States. To assess implications, we examine in this report the dynamics among these states and the effects of strategic BMD on other states especially Pakistan and North Korea. Moreover, while we do not discuss TMD developments in detail, we do recognize the blurring between TMD and strategic BMD and consider the effects on other states such as China and North Korea of U.S. TMD activities with Japan and South Korea. We provide an overview of the BMD systems of China, India, Russia, and the United States and try to project what the potential capabilities of these systems could become in the coming years.

METHODOLOGY

Since this study began in late summer 2016, we have relied on multiple sources of information to perform our analysis. In particular, we have conducted an extensive literature review. Notably, the two authors collectively have about six decades of experience in strategic nuclear policy and missile defense policy analysis. During the course of almost one year, we have had discussions with numerous experts and officials in China, India, and the United States, as well as discussions with Russian officials and experts about Russia who are based in the United States and elsewhere. In addition, research travel in March 2017 included roundtable discussions with about 40 experts at three Indian think tanks (the National Institute of Advanced Studies, the Observer Research Foundation, and the Institute for Defence Studies and Analyses), as well as a few meetings with individual experts and officials in New Delhi. In addition, the study benefited from a roundtable discussion with about a dozen top analysts in Beijing as well as feedback from presentations at the Carnegie-Tsinghua Center and Fudan University, which collectively included a total audience of about 50 people. In Washington, D.C., on May 17, 2017, the authors convened 15 experts in a daylong workshop with presentations from several participants. These presentations and three additional working papers providing in-country perspectives on China, India, and Russia provided further input to our study. Moreover, we have had additional one-on-one conversations with several officials and experts.

RATIONALES FOR DEVELOPING AND DEPLOYING STRATEGIC BMD

Nuclear-armed ballistic missiles pose threats of raining down massive destruction on a targeted country. Once a ballistic missile is launched, there is no recalling it. Although there have been proposals to install mechanisms to signal missiles to destruct in flight, especially in the event of an accidental launch, none of these mechanisms have been installed on any ballistic missiles.[1] Thus, an accidental or inadvertent launch of a ballistic missile could result in unwarranted massive destruction without a means to intercept the warhead(s). This is one rationale for limited BMD. If this were the only concern, then a BMD system might need only about a dozen interceptors, assuming that accidental or inadvertent launches would at most involve a handful of missiles.

1 Sherman Frankel, "Aborting Unauthorized Launches of Nuclear-Armed Ballistic Missiles through Postlaunch Destruction," *Science & Global Security*, Volume 2, 1990, pp- 1-20.

While it may seem tempting to develop defenses against attacks from large numbers of ballistic missiles, it is very technologically challenging, if not practically impossible, to protect against hundreds and up to thousands of nuclear warheads launched from ballistic missiles. In March 1983, President Ronald Reagan called on scientists and engineers to build such a defense under the Strategic Defense Initiative (SDI), but the huge economic cost, geopolitical concerns, and technological hurdles stopped SDI. Notably, one enduring outcome of SDI was the first demonstration of a prototypical hit-to-kill interception in the 1984 Homing Overlay Experiment. Since the late 1980s, the United States has scaled back its BMD efforts to provide more limited protection against adversaries with smaller numbers of nuclear-armed ballistic missiles. North Korea is the prime example of such a state. The additional concern is that North Korea might not be deterred from launching a nuclear attack against the United States or U.S. allies, especially in a crisis where the Kim Jong Un regime felt its survival were threatened and was thus willing to take a riskier stance than the United States. Thus, strategic BMD could serve as a means of deterrence by denial, thereby, blocking a limited North Korea missile strike and boosting U.S. resolution to counter North Korea.

Another rationale for strategic BMD goes back to the time of the 1972 ABM Treaty, when it was recognized that the Soviet Union and the United States could want to protect national command centers, such as national capitals or some intercontinental ballistic missiles, to provide additional assurance that there would be a secure second-strike nuclear force. Russia still has missile interceptors (using nuclear warheads) around Moscow, though it is questionable how effective they are; nevertheless, Russia is trying to modernize this defense system.[2] China might also be inclined to deploy a limited strategic BMD system for these purposes.[3] In addition, some Indian analysts have assessed that the Indian command authorities would likely favor such deployments when the BMD system is deemed ready for deployment.[4]

While it is politically difficult to object to development of BMD, it is generally considered objectionable to develop anti-satellite (ASAT) weapons. However, BMD interceptors can be adapted to kinetic-kill ASAT weapons. Thus, testing of BMD interceptors can provide useful political cover for states that want kinetic-kill ASAT weapons without raising the ire of other nations.

MOTIVATIONS FOR STATES TO DEVELOP STRATEGIC BMD

THE UNITED STATES

The United States has had several phases of missile defense since the first research and

2 Pavel Podvig, "Missile Defense in Russia," Working Paper for FAS Multipolar BMD Project, April 2017.

3 This assessment is based on discussions with several Chinese experts in February 2015 and March 2017 and located in Beijing and Shanghai.

4 R. Rajaraman, "Battlefield Weapons and Missile Defense: Worrisome Developments in Nuclear South Asia," *Bulletin of the Atomic Scientists*, Vol. 70(2), 2014, pp. 68-74.

development started in the 1950s.[5] Here, we provide a brief overview with emphasis on the underlying motivations for each phase. The 1950s were a period of initial investigations into air defenses and then later in the decade into defenses against the emerging threats of intercontinental ballistic missiles from the Soviet Union. The late 1950s were a time of deployment of the Nike Zeus missiles that had significant limitations and were followed in the early 1960s with the somewhat more capable Nike-X program. In 1967, the Johnson administration moved to deploy the Sentinel system with the expressed rationale of defense against the nascent Chinese ballistic missile threat. China had tested its first nuclear device in October 1964 and in parallel was investing in ballistic missile development. The concern was that China, in the throes of the Cultural Revolution, might not be deterred from launching a nuclear-armed missile attack. In effect, many U.S. politicians and defense planners then considered China to be a "rogue" state. But some U.S. analysts were expressing concern that a U.S. missile defense system designed for national protection would raise the stakes for the viability of the Soviet Union's nuclear forces and would likely spark an offense-defense arms race between the Soviet Union and the United States.[6]

By 1969, the Sentinel program was replaced by the Safeguard program with the rationale that instead of seeking to defend U.S. national territory, the missile defense system would support deterrence by shielding U.S. ICBMs against Soviet ballistic missile attacks. The 1972 ABM Treaty limited the United States and the Soviet Union to deploying at two sites with no more than 100 interceptors per site; the 1974 Protocol to the ABM Treaty further limited each country to one site with a maximum of 100 interceptors. Later that year, the United States shut down its one site because it was ineffective and costly. With this decision, the United States would thus rely exclusively on mutual assured destruction (MAD) as means of nuclear deterrence in the subsequent several years.

However, in 1983, another fundamental shift in policy took place with President Ronald Reagan's initiation of SDI, which sought to develop extensive defenses against a massive Soviet ballistic missile attack. President Reagan was unsettled by MAD and was seeking a way out of this dilemma. He viewed missile defenses as morally justified; but the technical and financial hurdles soon appeared too great to surmount for this ambitious program. Thus, by the end of the Reagan administration, SDI was scaled back. By the late 1980s, the policy shifted from providing comprehensive societal defense to creating uncertainties about whether Soviet counterforce planning would be effective.[7]

The George H.W. Bush administration reduced the scope of SDI by initiating a program

5 Rebecca Slayton, *Arguments that Count: Physics, Computing, and Missile Defense*, 1949-2012 (Cambridge, MA: MIT Press, 2013).

6 Bernard Brodie, "Missile Defense Against China?" *Los Angeles Times*, September 17, 1967; Matthew Evangelista, *Unarmed Forces: The Transnational Movement to End the Cold War* (Ithaca, NY: Cornell University Press, 1999), pp. 201-202.

7 Keith B. Payne, "A New Missile Defense Review," Essay 2 in Thomas Karako, editor, *Missile Defense and Defeat: Considerations for the New Policy Review*, A Report of the CSIS Missile Defense Project, March 2017.

called Global Protection Against Limited Strikes (GPALS). GPALS was intended to be no more than half the size of the Phase I SDI program, but was still an ambitious program in that it was intended to protect against attacks of up to a few hundred warheads. GPALS would have consisted of numerous space-based and ground-based sensors and missile interceptors. The range of coverage was truly intended to be global with the objective of protecting against missile attacks from any source.[8] It would also include theater missile defenses for protection of U.S. allies and deployed forces. In 1993, President Bill Clinton came into office and his administration decided to emphasize development of improved theater missile defenses (TMD), in part due to the experience and challenges of trying to intercept Iraqi SCUD missiles during the 1991 Gulf War. Thus, GPALS was not developed, but several TMD programs were underway in the 1990s.

Growing concerns in Congress about missile threats especially from North Korea and Iran led to the creation and enactment of the 1999 National Missile Defense Act, which stated: It is the policy of the United States to deploy an effective National Missile Defense system as soon as is technologically possible and that this system should be capable of defending the territory of the United States against limited ballistic missile attack (whether accidental, unauthorized, or deliberate) and that funding is subject to the annual authorization of appropriations in the National Defense Authorization Act (NDAA), as discussed by Thomas Karako, Director of the Missile Defense Project at the Center for Strategic and International Studies (CSIS).[9] President Clinton decided in late 2000 to defer the decision to deploy the first phase of NMD given concerns about cost, effectiveness, and the strategic reaction from Russia. The George W. Bush administration decided to move forward with deployment and recognized that it needed to notify Russia of withdrawal from the ABM Treaty because of the intent to defend the U.S. national territory, though the administration still envisioned a relatively limited size system.

In late 2016, Congress updated the NMD Act to underscore that the policy of the United States is to maintain and improve an effective, robust layered missile defense system capable of defending the territory of the United States, allies, deployed forces, and capabilities against the developing and increasing complex ballistic missile threat. Notably, the word "limited" was removed from the 1999 act. This deletion has raised some concern from opponents that the system could grow to an immense size and thus potentially have financially and strategically destabilizing effects. Proponents have argued that the new language of protection against "the developing and increasingly complex ballistic missile threat" is in line with policy statements since 2002 in the Bush administration and further mentioned in the 2010 Obama administration's Ballistic Missile Defense Review.[10]

8 Strategic Defense Initiative, *The President's New Focus for SDI: Global Protection Against Limited Strikes (GPALS)*, Department of Defense, June 6, 1991.

9 Thomas Karako, "The Missile Defeat Review in Context," Chapter 1 in Thomas Karako, editor, *Missile Defense and Defeat: Considerations for the New Policy Review*, A Report of the CSIS Missile Defense Project, March 2017.

10 Ibid.

The Trump administration announced on January 27, 2017 that it would conduct a new Ballistic Missile Defense Review and a new Nuclear Posture Review. The schedule is to complete these reviews by early 2018. The description in the Trump administration announcement is to "identify ways of strengthening missile-defense capabilities, rebalancing homeland and theater defense priorities, and highlighting priority funding areas."[11] Notably, the congressional language in the NDAA "requires the Defense Department to conduct a broad review of missile defense policy and strategy, including programs and capabilities to defeat ballistic missiles before and after launch, as well as to defeat cruise missiles and hypersonic glide vehicles."[12]

RUSSIA

Like the United States, Russia's research on missile defense dates back to the 1950s and had its first significant demonstration of missile intercept in the 1960s. On December 2, 1953, the Soviet Council of Ministers issued the order, "On the Development of Methods to Counter Long-Range Missiles," and assigned the study to Design Bureau 1 (KB-1) and the Radio Technical Laboratory of the USSR Academy of Sciences. The objective was to assess theoretically whether BMD appeared feasible. The reports were favorable and gave the technical support needed for the Central Committee to decide to devote substantial technical resources for BMD development. The main project was creation of the A-35 system for defense of Moscow. Even at the early stage of the project, it came under criticism from officials at the Ministry of Defense who said that the system was too complex and seemed too limited in effectiveness. In particular, it was designed to send as many as eight interceptors to destroy each incoming reentry vehicle and would require three high-precision tracking radars for each target. Although the system's developers achieved a successful intercept of an SS-4 ballistic missile in March 1961, they were unable to address the full suite of challenges posed by the changing threats from the large number of ballistic missiles being deployed by the United States. The A-35 system during that period was deemed capable of intercepting upwards of 18 incoming reentry vehicles, while by the end of 1960 the United States had already deployed about 70 ballistic missiles capable of striking the Soviet Union. Before the decade was over, the missile threat ballooned to several hundred U.S. ICBMs and SLBMs with multiple reentry vehicles being developed for these missiles. By the mid-1960s, Soviet defense planners realized that the task to counter the growing number of ballistic missiles was too complex.[13]

While the Soviet Union still proceeded with development of BMD systems, it invested even more financial and technical resources into the offense-offense arms race by a rapid build-up of its ICBMs. In 1967, an internal governmental review concluded that none of the BMD systems had been able to solve the problem of discriminating targets from decoys. Both the

11 The Office of the Press Secretary, "Presidential Memorandum on Rebuilding the Arms Forces," The White House, January 27, 2017.

12 Kingston Reif, "Missile Defense Review Begins," *Arms Control Today*, May 2017, p. 30.

13 Pavel Podvig, "The Development of Soviet and Russian Ballistic Missile Defense in the 20th Century," Chapter 2 in Alexei Arbatov and Vladimir Dvorkin, editors, *Missile Defense: Confrontation and Cooperation* (Moscow: Carnegie Moscow Center, 2013), pp. 34-36.

Soviet Union and the United States had been developing penetration aides for their ICBMs. Further studies in the late 1960s determined that the state of art of BMD development was ineffective against the increasingly sophisticated missile threat. The A-35 system, however, was placed into operation in 1974 but at less than its full initial planned deployment. In the late 1970s, upgrades were made to the interceptor and radars, but it still had significant limitations in its ability to counter more than a single ballistic missile. The main conclusion from the Soviet research and development from the late 1950s to the 1970s was that it was not possible to field an effective national BMD system.[14]

Nonetheless, the Soviet Union did not abandon development of BMD in the 1970s and beyond. In parallel to the scaled down deployment of the A-35 system in the mid-to-late 1970s, research was underway on the improved A-135 system, which was deployed in 1995. Like the A-35, the A-135 uses nuclear-tipped interceptors and also is intended for defense of Moscow and the command and control facilities in and near Moscow. However, "it has been reported that the interceptor missiles are normally deployed without nuclear warheads," and "this mode of operation, which clearly undermines the effectiveness of the missile defense system, suggests that the confidence in the system's performance is rather low."[15]

Russia is still moving forward with development of air defense and anti-missile systems. The defense philosophy since the 1950s has been that the Soviet Union during the Cold War and now Russia needs air defense systems to guard against another massive invasion as experienced in the Second World War. The S-300 family of air defense and anti-missile systems has demonstrated effectiveness against aircraft as well as short-range to medium-range missiles. In the anti-missile mode, the S-300 systems appear comparable to the U.S. Patriot Advanced Capability (PAC) systems, and the S-400 system reportedly has capabilities to counter intermediate-range ballistic missiles. In recent years, Russia has been investigating advanced hit-to-kill strategic BMD capabilities. One system is the A-235, which is intended as an upgrade to the A-135 and might also be equipped with nuclear warheads. The S-500 system is reportedly designed to provide capabilities more advanced than the U.S. Aegis SM-3 Block IIA missile, but few reliable details about the S-500 have been forthcoming.[16] An ongoing technical debate in Russia is whether to just emphasize development of hit-to-kill interceptors or to still keep the option of nuclear interceptors.[17]

CHINA

For decades, the Chinese government has objected to U.S. development of missile defenses because it views this activity as destabilizing to China's and international security. Chinese Foreign Ministry officials have used international platforms, such as the Conference on Disarmament and the United Nations, to argue vociferously against withdrawal from the ABM Treaty, warning that withdrawal would undermine strategic stability. Beijing has also

14 Ibid., pp. 37-39.
15 Podvig, Working Paper, April 2017, op. cit.
16 Keir Giles, *Russian Ballistic Missile Defense: Rhetoric and Reality*, Report, Strategic Studies Institute, U.S. Army War College, June 2015.
17 Comment by two experts at the FAS BMD workshop, May 17, 2017.

been strongly opposed to the U.S. provision of missile defenses to Taiwan, Japan, and South Korea, fearing encirclement from neighboring states and perhaps increasing the prospects that Taiwan, considered by Beijing a part of the People's Republic of China, could declare independence or could at least remain apart from the PRC for the foreseeable future. Thus, even TMD presents a strategic dilemma for Beijing.

China, however, has not been content to just voice disapproval. For decades, several of its defense engineers have been researching BMD, and seven years ago China performed its first BMD intercept test, though its demonstrated ASAT capability occurred three years before in January 2007. Based on our study from two years ago, we learned from discussions with numerous Chinese experts that China has followed the pattern of first denouncing ABM systems as destabilizing to international security.[18] But in case these protestations do not have the desired effect, Chinese researchers, in parallel, have studied these systems. The main rationale at that stage has been to understand the adversary's capabilities so as to better counter them. In the early 1980s, as the United States was researching SDI, Chinese authorities ordered studies of missile defense. These initial studies led to a more formal program in March 1986 known as the 863 Program, which was directed toward research to allow China "to achieve the same level of scientific and technical development as advanced countries" but not necessarily to lead to deployment of Chinese BMD.[19]

If and when the adversary proceeds with deployment of BMD, China would move to the next stage of conducting its own tests. While our previous study in 2015 identified numerous potential rationales, foremost among them are: (1) providing political cover for continued development of ASAT weapons because ASAT capabilities have sparked international opprobrium, unlike more subdued reactions to BMD, (2) developing improved understanding of adversaries' BMD systems through actual operating experience, (3) signaling to the United States and other nuclear-armed adversaries that China is prepared to better counter them, (4) directing messaging to regional states that China has improved military capability, (5) taking steps toward potential deployment of a limited BMD system, and (6) giving China leverage in possible future arms control or other bilateral or multilateral control regimes.

Chinese security analysts and defense planners have long feared the possibility of a disarming first-strike given the disparity between the relatively large U.S. nuclear arsenal and the relatively small Chinese nuclear arsenal, but they have recognized that it is a highly uncertain scenario. In the words of Wu Riqiang, a physicist with training in political science and now an associate professor at Renmin University in Beijing, "Instead, the Chinese arsenal provides only 'first strike uncertainty.' That is, the United States lacks full confidence that it could destroy all Chinese nuclear weapons, while China lacks full confidence that at least

18 Bruce W. MacDonald and Charles D. Ferguson, *Understanding the Dragon Shield: Likelihood and Implications of Chinese Strategic Ballistic Missile Defense*, Special Report, Federation of American Scientists, September 2015.

19 Li Bin, "What China's Missile Intercept Test Means," Issue Brief, Carnegie Endowment for International Peace, February 4, 2013.

one of its warheads would survive an attack."[20] A mechanism to reduce first-strike uncertainty would be to deploy a limited BMD system to protect some Chinese ICBMs. During discussions in Beijing and Shanghai in early March 2017, some Chinese experts mentioned this limited deployment option but cautioned that China would have to be careful to constrain expenditures on such a BMD program. One Chinese scholar emphasized: "For the major nuclear powers not to invest in some missile defenses would be a political problem."[21]

INDIA

The trigger for India to develop BMD was when China transferred the M-11 missile to Pakistan. The initial transfer of perhaps as many as two dozen M-11 missiles reportedly took place in November 1992.[22] By 1994, further transfers had taken place. The M-11 posed a significant threat because it is a solid-fueled, short-range ballistic missile, which is also quicker to launch and more mobile than the SCUDs used by Iraq in the 1991 Gulf War. Pakistan has further adapted this missile to make additional indigenously built missiles. Feeling threatened in the mid-1990s, India's Defence Research and Development Organisation took the first research steps that would lead to BMD testing about a decade later. Because the Indian government did not make a public announcement during the 1990s about this program, it is unclear exactly when the program started. During the research travel to New Delhi, two defense analysts said that *India Today* broke the story, and that the official start of the program was in 2000 with the "Defense for Delhi" policy, which also included defense of Mumbai due to the significant number of nuclear facilities near there, though BMD research had started some years earlier.[23]

To protect large metropolitan areas, India will need area defense BMD rather than point defense BMD. Moreover, because the survivability of India's nuclear forces depends in part on not revealing the exact locations where they are stored, area BMD is preferable to point BMD.[24] In particular, the scientific advisor for the DRDO, Vijay Kumar Saraswat, has assessed that two missile defense regiments can protect a total area of 400 sq. km, which would be sufficient to defend the national capital region.[25] Additional regiments would be needed for defense of Mumbai and the nuclear storage facilities. However, "a pan-national missile interception capability is beyond India's economic means."[26]

Pakistan's growing arsenal of ballistic missiles is not the only rationale for India's BMD.

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20 Wu Riqiang, "Certainty of Uncertainty: Nuclear Strategy with Chinese Characteristics," *Journal of Strategic Studies*, 36(4), 579-614, (2013).

21 Remarks by Chinese academic during discussion, March 14, 2017.

22 Jim Mann, "China Said to Sell Pakistan Dangerous New Missiles," *Los Angeles Times*, December 4, 1992.

23 Discussion at Observer Research Foundation, New Delhi, March 10, 2017

24 Dean Wilkening and Kenneth Watman, *Strategic Defenses and First-Strike Stability*, Report for the Ford Foundation, RAND, November 1986.

25 "Major Cities to Get Missile Defense Shield," *Tribune News Service*, New Delhi, December 12, 2007.

26 Frank O'Donnell and Yogesh Joshi, "India's Missile Defense: Is the Game Worth the Candle?" *The Diplomat*, August 2, 2013.

China's nuclear capable ballistic missiles and Indian nuclear doctrinal issues have also influenced India's decision to develop BMD. Facing ballistic missiles from both Pakistan and China spurs India to want a two-tiered BMD system due to the geographical placements of these two countries with respect to India. While a later section discusses the capabilities of this system, here we note that the Pakistani missile threats are short-to-medium range, while the Chinese missile threats are up to intermediate-range. These range disparities pose the need for endo- and exo-atmospheric missile interceptors. Countering Pakistani ballistic missiles are particularly challenging because Pakistan borders India and the reaction time is on the order of a few to at most several minutes. Thus, India may have only one chance to shoot an interceptor at a short-range Pakistani ballistic missile.

The doctrinal issue relates to India's no-first-use (NFU) policy of not initiating the use of nuclear weapons. Indian officials have viewed NFU as branding India as a responsible nuclear-armed state that requires nuclear weapons for deterrent purposes only. This policy carries with it significant risk that a surprise first-strike attack against India's nuclear forces might destroy them. With a relatively small nuclear force of an estimated 120 warheads, India has been developing a variety of nuclear weapon systems such as a nuclear-armed submarine, various ballistic missiles, and aircraft to improve the likelihood of having surviving nuclear forces in the event of a disarming attack against them.[27] An effective BMD system offers extra assurance of having sufficient survivable nuclear forces. Some Indian analysts have thus argued that BMD can be stabilizing. However, Pakistan's development of nuclear-armed cruise missiles appears to be driven in part by Islamabad's desire to counter India's eventual BMD system.

In the past year, a new debate has arisen about whether India is shifting its NFU policy. The 2003 official Indian doctrine states that India reserves the right to use nuclear weapons if India is attacked by weapons of mass destruction, including chemical and biological weapons, or if such weapons are used against Indian forces deployed outside Indian territory. Some former Indian officials have made comments in recent years to the press and in published memoirs that appear to suggest that "India would consider nuclear first use in a third circumstance, as a preemptive counterforce attack if India has reason to believe that Pakistan is preparing a first strike against it."[28] Vipin Narang, a professor at the Massachusetts Institute of Technology, triggered the debate when he raised this issue at the Carnegie Nuclear Policy Conference in Washington, D.C. on March 20, 2017. Other analysts have supported Prof. Narang's assessment, while some have cast doubt that there has been an official policy change. In particular, Professor Rajesh Rajagopalan of Jawaharlal Nehru University told *Arms Control Today*: "India does not have the surveillance capacities needed to monitor Pakistan's nuclear forces after they are dispersed, as they presumably would be in a crisis."[29]

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27 Hans Kristensen and Robert S. Norris, "Indian Nuclear Forces, 2017," Nuclear Notebook, *Bulletin of the Atomic Scientists*, July/August 2017.

28 Alicia Sanders-Zakre and Kelsey Davenport, "Is India Shifting Nuclear Doctrine?" *Arms Control Today*, May 2017, p. 28.

29 Ibid., p. 29.

Prestige is an additional rationale for BMD development. As the world's largest democracy, the second most populated nation, and home to one of the world's oldest civilizations, India has sought ways to demonstrate its technological prowess. Development of BMD, a complex military technology, would show that India is a member of an elite club.[30] Indeed, after the first BMD flight tests on November 27, 2006, Raj Chengappa, a prominent columnist for the magazine *India Today*, wrote: "India has become the youngest member of a select band of nations – the U.S., Russia, and Israel – who have the capability of developing missile defence systems."[31]

India has sought and received significant foreign assistance for its BMD program. As to complete BMD systems, India has tried to acquire the Israeli Arrow-2, the U.S. PAC-3, and the Russian S-300V. According to Indian experts during discussions in March 2017, the U.S. conditions on the PAC-3 system were too much for New Delhi, especially the request for India to invest money in this system. Nonetheless, the George W. Bush administration did assist India by approving the sale of the Arrow-2, which is very similar to PAC-2. In addition, the Israeli Green Pine radar system came with this deal. India has further enhanced its surveillance capabilities with the acquisition of the Phalcon Airborne Warning and Control System (AWACS).

The important point concerning motivations to develop BMD is that the Indian defense establishment recognized that it could only do so by leveraging relationships with the United States. A U.S.-India agreement in 2005 mentions a commitment to collaborate in missile defense. During the Cold War, New Delhi was opposed to SDI mostly due to the perception that it blocked progress to global nuclear disarmament. Moreover, this opposition was rooted in the concern that India's security could become weakened because the Soviet Union would likely respond to U.S. missile defense by building up its nuclear forces, thereby precipitating a Chinese buildup, which could increase the nuclear threat felt by India.[32] India's opposition to U.S. missile defense did a 180-degree shift during the George W. Bush administration. While the Indian government was concerned about the demise of the ABM Treaty, the Bharatiya Janata Party (BJP)-led government "was determined to forge the new relationship with the United States that had eluded both sides during the Cold War."[33] Also, Prime Minister Atal Bihari Vajpayee wanted India to help shape the new international nuclear order presented by the end of the ABM Treaty and the Bush administration's nuclear posture. Importantly, President Bush clearly expressed a desire to form a partnership with India. In addition, "a quintessential attraction of President Bush's new strategic framework was the promise of technological cooperation."[34] The Obama administration also expressed

30 Petr Topychkanov, "India's Prospects in the Area of Ballistic Missile Defense: A Regional Security Perspective," Working Papers No. 3, Carnegie Moscow Center, 2012.
31 Raj Chengappa, "The New Guardian," *India Today*, December 11, 2006.
32 Ashley J. Tellis, "The Evolution of U.S.-Indian Ties: Missile Defense in an Emerging Relationship," *International Security*, Vol. 30, No. 4, Spring 2006, p. 120.
33 Ibid., p. 132.
34 Ibid., p. 133.

support for technical cooperation with India on missile defense while not finalizing a specific deal. The June 26, 2017 summit between President Donald Trump and Prime Minister Narendra Modi covered an extensive discussion on defense cooperation and arms deals with India elevated to the position of "major defense partner."[35]

OTHER STATES' RATIONALES FOR WANTING BMD

JAPAN

In response to the increasing threats from North Korean ballistic missiles, the Japanese Self-Defense Force has partnered with the United States in developing missile defense capabilities. This cooperation has been ongoing for about 20 years since North Korea began testing of long-range ballistic missiles in the late 1990s. Japan's decision to invest heavily in defensive cooperation with the United States fits within the constitutional constraints on its allowable ability to project military force. As a condition of its defeat in World War Two, Japan had to renounce use of military force – other than for defensive purposes – in Article 9 of its constitution. As a consequence, Japan does not have offensive missiles but is permitted to have defensive missile systems. Japan and the United States have worked very closely together in development of the latest generation of Aegis-equipped SM-3 Block IIA missiles. To date, Japan also has purchased six Aegis systems for destroyers in its Maritime Self-Defense Force.

In recent months, the Japanese government, under Prime Minister Shinzo Abe, has reportedly been considering acquisition of Tomahawk cruise missiles to be based on its Maritime Self-Defense Force's ships.[36] While many view this potential action as a departure from the Article 9 restriction, Prime Minister Abe said "a decision to strike enemy launch sites when there is no alternative would fall under the category of self-defense under the reinterpreted war-renouncing constitution," according to the Kyodo news service in January 2017. Japan's partnership with the United States on missile defense helps buttress extended deterrence by further showing U.S. commitment to Japan's defense. Importantly, missile defense does not replace the need for U.S. nuclear deterrence but complements it. Thus, this TMD system also has a strategic dimension.

SOUTH KOREA

Unlike Japan, South Korea does not have constitutional restrictions against the use of military force to counter threats such as North Korea – but it does have an agreement with the United States to limit the range of its offensive missiles. In 1972, the United States permitted South Korea to reverse engineer the Nike Hercules surface-to-air missile in exchange for South Korea's agreement to limit the range to 180 km and the payload to no more than 500 kg. A further agreement in 1979 codified the range and payload limitations to allow U.S. assistance for South Korea's development of more advanced ballistic and cruise missiles. By

35 Prashanth Parameswaran, "What's Next for US-India Defense Ties Under Trump and Modi?" *The Diplomat*, June 27, 2017.

36 Sam LaGrone, "Report: Japan Considering Buying Tomahawks for Destroyer Fleet to Deter North Korea," *USNI News*, May 10, 2017.

the 1990s, South Korean governmental concerns about the increasing range and capabilities of North Korean ballistic missiles led to requests for renegotiation of the missile range limitation agreement. By the time South Korea joined the Missile Technology Control Regime (MTCR) in 2001, the two countries had revised the agreement to allow South Korea to acquire or develop missiles up to 300 km in range and up to 500 kg in payload in line with MTCR guidelines. A further revision occurred in 2012 to permit missiles up to 800 km (so as to be able to cover almost all of North Korea from many launching sites in South Korea) with a payload of up to 500 kg. In addition, the new agreement gives South Korea flexibility in increasing the payload beyond this limit in inverse proportion to the range.[37] Most recently in late July 2017, the South Korean government called for new discussions with the United States on further extending its missiles' ranges and payloads. In sum, the Republic of Korea's defense forces have wanted to ensure that it had offensive missile capabilities that would be commensurate with countering North Korea.

As to missile defense, it has been a somewhat lower priority for South Korea. For much of South Korea's defenses, there has been a tension between investing in indigenous systems versus receiving outside assistance. Regarding indigenous missile defense, the emphasis has been on the creation of the Korean Air and Missile Defense program, which notably recognizes the need for improved air defenses. The short flight times of missiles launched from North Korea has in part resulted in skepticism in the South Korean military that missile defense would be effective. Nonetheless, in recent years, South Korea has stepped up its procurement of missile defense systems from the United States. In 2015, South Korea's Defense Acquisition Program Administration moved forward with a decision to buy the PAC-3 system so as to upgrade the PAC-2 system. In 2016, South Korea and the United States reached a decision to deploy the THAAD system, which was a much more controversial decision because of China's concern. The Chinese government has protested the THAAD deployment to South Korea due to its concern that the X-band radar associated with THAAD could penetrate into Chinese territory and be used with X-band radars in Japan to triangulate Chinese missile launches. In response, China has slapped economic sanctions on South Korea.

As President Moon Jae-in took office in May 2017, he ordered a slowdown of THAAD deployments pending an environmental review. However, on July 28, 2017, he called for discussions with the United States on deploying more THAAD units in response to new estimates about the advancing missile threat from North Korea.[38,39] Nonetheless, President Moon is still trying to strike a balance between patching up economic and diplomatic relations with China and convincing the Trump administration to follow a dual track in dealing with North Korea. On the one hand, President Moon reportedly told President Trump when they met in late June that South Korea would resume full deployment of THAAD after the environmen-

37 "South Korea: Missile," Issue Brief, Nuclear Threat Initiative, April 2016.
38 Jack Kim, "South Korea's Moon orders talks with U.S. to deploy more THAAD units after North Korea ICBM test," Reuters, July 28, 2017.
39 Anna Fifield, "North Korea fires another missile, its latest step toward putting the U.S. within reach," *The Washington Post*, July 28, 2017.

tal review and would partner with the United States military in having a stronger military response to North Korea. On the other hand, President Moon wants to open a channel for talks with North Korea. While President Moon has a somewhat dovish reputation, he has served as an army paratrooper and his parents were refugees from North Korea.[40]

NATO NATIONS

In November 2010 at the Lisbon Summit, NATO member nations agreed that missile defense is a top objective for the alliance and committed to integrating existing BMD systems and planned systems. This decision will allow the United States to integrate its Phased Adaptive Approach system with other European BMD efforts.[41] U.S. missile defense plans for Europe began in the George W. Bush administration. The Obama administration decided to continue with missile defense deployments to Europe but with some significant changes. In 2009, the Obama administration announced that the system would be named the European Phased Adaptive Approach (EPAA) and would consist of four phases based on continuing improvements to the SM-3 missile interceptors and the Aegis defense system. The system is based on naval warships and is in addition being located at land-based sites in some eastern European countries for Aegis-Ashore.

In March 2013, the Obama administration decided to suspend the fourth phase of the EPAA, which would have consisted of the SM-3 Block IIB interceptors. The administration's announcement cited congressional funding cuts in this program as having caused substantial delays and mentioned that redirecting funding to field an additional 14 ground-based interceptors in Alaska would allow addressing the threats faster than with the delayed SM-3 Block IIB program. While the SM-3 Block IIB interceptors were considered by Russian defense analysts to be potentially disruptive to Russian ballistic missile systems, the Obama administration stated that its decision was about effective use of funding in addressing the threats.[42] Whether or not directed at Russia, however, this decision still did not placate Russian concerns about the future pathway of this missile defense system, though technical studies have shown that the planned EPAA system will not adversely affect Russia's deterrent.[43] From the standpoint of Romania and Poland, which are designated as sites for deployment of Aegis-Ashore, the EPAA deployment represents a concrete U.S. commitment to their defense. Moscow is concerned about U.S. influence on Poland and Romania. (A deployment of SM-3 Block IB interceptors occurred in Romania in 2016, and a deployment to Poland is slated for 2018.) Thus, while the EPAA is focused ostensibly on a regional missile threat, it has had significant effects on strategic relations among NATO, the United States, and Russia.

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40 S. Nathan Park, "South Korea's President could be Just the Man to Solve the North Korea Crisis," *The Atlantic* online, July 18, 2017.

41 Steven A. Hildreth and Carl Ek, "Missile Defense and NATO's Lisbon Summit," Congressional Research Service Report, January 11, 2011.

42 Tom Z. Collina, "Pentagon Shifts Gears on Missile Defense," *Arms Control Today*, April 2013.

43 Jaganath Sankaran, *The United States' European Phased Adaptive Approach Missile Defense System: Defending Against Iranian Threats Without Diluting the Russian Deterrent*, Report, (Santa Monica: RAND, 2015).

STRATEGIC BMD'S STABILIZING AND DESTABILIZING EFFECTS

Whole book-length reports have been written about strategic stability because there are many ways to define this concept.[44] Different nations have different conceptions. For example, Pan Zhenqiang, a Chinese nuclear arms control expert at the China Institute of International Studies, defined strategic stability as "an enduring situation" in which nations with strategic forces "have an adequate sense of security" usually based on "some military and security arrangements through certain legally binding mechanisms or other institutions." He further broadened the definition by stating "strategic stability must take into consideration the legitimate request of all the other countries for ensuring their sovereignty and security. It is therefore a process of joint participation and mutual interactions by all the members of the international community."[45] Dr. Pan's 2002 presentation explicated the "two scorpions locked in a bottle" nature of the Cold War's conception of the strategic balance of nuclear deterrence, which resulted eventually in arms control mechanisms and agreements to try to stabilize mutual assured destruction.

In comparison, the strategic world after the Cold War has much more complex dynamics around a single superpower in the United States, a still formidable Russia, and several smaller and medium-sized nuclear powers. Consequently, the seeming strategic stability (which changed continually) between the Soviet Union and the United States has been replaced by a more uncertain and unstable multipolar world that has constrained the United States, the remaining superpower. In 2013, the late Dr. Thomas Schelling, one of the leading thinkers on strategic stability and arms control, explained the complex nature of strategic stability in the contemporary multipolar world.

> Now we are in a different world, a world so much more complex than the world of the East-West Cold War … Now the world is so much changed, so much more complicated, so multivariate, so unpredictable, involving so many nations and cultures and languages in nuclear relationships … that it is even difficult to know how many meanings there are for 'strategic stability,' or how many different kinds of such stability there may be among so many different international relationships, or what 'stable deterrence' is supposed to deter in a world of proliferated weapons.[46]

In this report, we focus on aspects of strategic stability concerning incentives or disincentives to use nuclear weapons and confidence in possessing an effective and reliable nuclear

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44 Elbridge A. Colby and Michael S. Gerson, editors, *Strategic Stability: Contending Interpretations* (Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, 2013).

45 Pan Zhenqiang, "Strategic Stability in a Changing World," Presentation prepared for the fourth China-U.S. Conference on Arms Control, Nonproliferation and Disarmament, Washington, D.C., March 4-5, 2002.

46 Thomas Schelling, "Foreword," in Elbridge A. Colby and Michael S. Gerson, eds., *Strategic Stability: Contending Interpretations* (Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, 2013), pp. vii-viii.

deterrent. Thus, a fundamental aspect of strategic stability is having assured second-strike, retaliatory nuclear forces that could survive a first-strike. This type of stability is the foundation of MAD, assuming both nuclear-armed adversaries have assured second-strike forces. BMD can stabilize or destabilize this situation, and the presence of more countries with strategic BMD capabilities can complicate decision-making in a crisis, particularly for those countries whose offensive nuclear forces are small or modest in size.

Here, we call attention to a particularly useful model for understanding decision-making and risk-taking under conditions of confrontations between nuclear-armed states, with one or two having national missile defenses and scenarios of significant uncertainties as to the willingness of such states to move up the escalation ladder in a crisis. In 2003, Robert Powell, a professor of political science at the University California, Berkeley, examined these effects by applying nuclear deterrence theory and developing a model that allowed quantifying the resolve (in terms of a probability) of a nuclear-armed state to engage in a crisis with a nuclear-armed adversary and specifying the uncertainties in each state's belief system about the other's resolve.[47] In the case where there is no uncertainty as to what the other's resolve is, there should be no movement up the escalation ladder. That is, the state with the greatest resolve will dominate the other, which knows that its state's resolve is weaker. But when the resolves of each player are uncertain to their opponents, the game displays interesting dynamics.

A highly dynamic and precarious case is where the adversary is a state with a willingness to press a crisis because it believes that backing down would risk loss of state power or an existential demise. The opponent is a nuclear-armed state with a limited NMD system that has a level of effectiveness that can be dialed up or down within the model. Each side is uncertain as to the resolve of the other. To give a real world example, imagine the Kim Jong Un regime in North Korea wanting to hold onto power and facing the United States with a limited NMD system that has an improving (but still unknown) level of effectiveness. It is also unknown how willing the North Korean supreme leader is to go to the brink and what is the resolve of President Trump. Prof. Powell's model can also be used to examine the dynamics between two relatively evenly nuclear matched opponents, such as India and Pakistan, assuming that there are significant uncertainties about their decision-making resolves in a crisis.

The overall conclusions of Prof. Powell's study are:

> First, although nuclear deterrence theory remains useful, its implications vary with the conditions in which it is applied. Therefore, the relative stability between the United States and the Soviet Union during the second half of the Cold War following the 1962 Cuban missile crisis may provide a poor guide to the stability of a crisis between the United States and a new nuclear state (or, for that matter, between two new nuclear states such as India and Paki-

47 Robert Powell, "Nuclear Deterrence Theory, Nuclear Proliferation, and National Missile Defense," *International Security*, Vol. 27, No. 4, Spring 2003, pp. 86-118.

> stan). Second, NMD would give the United States somewhat more freedom of action and make a rogue state more likely to back down in a crisis. But these effects will be modest unless the defenses are very good. Finally, NMD, unless it is extremely effective, is likely to raise the risk of both a nuclear attack on the United States and of nuclear weapons striking the United States. These greater risks, moreover, are not the result of a mistaken overconfidence in the effectiveness of NMD. They are the direct consequences of a greater U.S. willingness to press its interests in a crisis harder.[48]

More recent scholarship has explored a central feature of the second nuclear age that most nuclear weapon states face threats from two or more potential adversaries. As Gregory Koblentz, a professor at George Mason University, writes: "This gives rise to a security trilemma where actions taken by a state to defend against another state have the effect of making a third state feel insecure."[49] U.S. homeland BMD is a prime example of the "security trilemma." U.S. defenses are designed against "limited" regional threats (e.g., Iran and North Korea), but Russia and China see BMD as a potential threat to their strategic deterrents. Thus, the fundamental problem for U.S. policy is: how does the United States reassure both Russia and China while meeting its important and legitimate strategic BMD needs to protect against Iran and North Korea? As one Chinese analyst has bluntly put it: "No matter how much the U.S. explains that such U.S. plans are not against China, *nobody believes it in China*" [emphasis added].[50] While most Chinese experts we talked to believe that the missile threat from North Korea against the United States and U.S. allies is serious, some Chinese defense experts expressed incredulity about this threat and believe that the United States is inflating it as an excuse to further encircle China.[51] During the discussions in mid-March, a couple of other Chinese analysts expressed interest in returning to the strict limits of the 1972 ABM Treaty.

Indeed, many defense experts have considered the ABM Treaty as a cornerstone of strategic stability, though others have disagreed. On the one hand, the ABM Treaty provided some stability to the U.S.-Russia strategic relationship through codified limitations to ABM systems in each country. Also, Chinese officials have often argued for decades that this treaty was stabilizing because it helped pave the way for significant arms reductions between the United States and Russia and thus China benefited from potentially having fewer nuclear

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48 Ibid., pp. 87-88.

49 Gregory D. Koblentz, *Strategic Stability in the Second Nuclear Age*, Council Special Report No. 71, Council on Foreign Relations, November 2014. Prof. Koblentz acknowledges the scholarship of Ambassador Linton Brooks and Dr. Mira Rapp-Hooper, who examined security dilemmas giving rise to trilemmas within the context of East Asian nuclear dynamics. Linton Brooks and Mira Rapp-Hooper, "Extended Deterrence, Assurance, and Reassurance in the Pacific during the Second Nuclear Age," in Ashley J. Tellis, Abraham M. Denmark, and Travis Tanner, *Strategic Asia 2013-14: Asia in the Second Nuclear Age* (Seattle and Washington, D.C.: The National Bureau of Asian Research, 2013).

50 Discussion with Chinese defense expert, Beijing, February 5, 2015.

51 Comments during a roundtable discussion with Chinese defense experts, Beijing, March 13, 2017.

weapons capable of being targeted from these two countries to China. On the other hand, some analysts have argued that the ABM Treaty was almost anachronistic soon after it was ratified given the relative ineffectiveness of the ABM systems of the 1970s, as mentioned in a previous section of this report.

The question of stability in a multipolar BMD world depends on a number of important factors, including:

1. The size of a given country's offensive nuclear forces. In this regard, Russia and the United States have less to worry about in the strategic realm because their nuclear forces are more numerous than, say, China, with a much smaller number of forces.

2. The ratio of offensive warheads to strategic BMD interceptors. The prime test case for stability is what number of interceptors such offensive forces would face after an attempted disarming first-strike that would destroy a significant number of offensive forces.

3. The effectiveness of the BMD system, especially given likely offensive countermeasures it would face. This will also depend on the BMD technology, for example, whether or not a BMD system could discriminate effectively between decoys and reentry vehicles.

4. The potential BMD challenges the offense may face in the future. Both Russia and China have voiced concerns about U.S. missile defense plans, theater level as well as strategic BMD. At both unofficial and official levels, they maintain that it is not the current level of U.S. strategic BMD deployments that concerns them, but rather what the United States may do in the future, both quantitatively and especially qualitatively. The absence of any limitations, even modest ones, is unsettling to them, and U.S. assurances that it has no plans to develop a thick BMD defense has not quelled these concerns. Further increasing this challenge is the fact that it will likely be particularly hard to design steps that will address new technology developments.

5. Countries with smaller nuclear offensive forces such as China and North Korea will likely feel more at risk from an adversary's strategic BMD programs than countries with larger strategic forces. But countries with smaller nuclear forces may believe that they are facing existential threats, and this belief may make them more likely to climb the escalation ladder while the adversary with an NMD system might be more willing to press harder during a crisis.

WAYS TO COUNTER STRATEGIC BMD

Numerous options are available to counter BMD. Countermeasures in the payload of ballistic missiles, such as penetration aids, decoys, and chaff, as well as multiple independently targeted reentry vehicles (MIRVs) – which could also be maneuverable reentry vehicles (MaRVs) where not ruled out or limited by arms control agreements – are just two technical sets of options for a given number of ballistic missiles. Of course, building and deploying more ballistic missiles, again where not prohibited or limited by arms control agreements,

is a straightforward option, assuming the country has adequate industrial capacity. This action may already be playing out with China, which is increasing its strategic warhead totals, possibly in response to U.S. BMD plans.[52] Concerning the particular action-reaction dyad of China and the United States, one prominent Chinese analyst wrote two years ago: "I fear the worst possible outcome: that the United States steadily and unilaterally deploys greater missile defense capabilities and China responds by constructing more nuclear weapons."[53] In response to any country's deployment of strategic BMD, an offensive build-up is one obvious option, as well as adding penetration aids.

Building and deploying cruise missiles and other "air-breathing" weapon systems are additional offensive options because they are not vulnerable to BMD systems. Pakistan's development and deployment of nuclear capable cruise missiles appears in part motivated by its security need to counter India's steps toward BMD, though the BMD system is not yet fully deployed. This action by Pakistan also illustrates that it can be easier and faster for a state to deploy offensive missiles than to field defensive systems, potentially resulting in instability.[54]

But developing effective and reliable ballistic missiles is no easy matter, as Iran and North Korea have found out. In these cases, defense could stay ahead of offense for a significant period of time. However, as a nascent nuclear-armed state matures in its nuclear weapons mastery, it will be unclear whether defense can continue to keep the edge on offense, especially as the offense learns how to make penetration aids, multiple reentry vehicles, or many more ballistic missiles.[55]

BMD CAPABILITIES OF THE UNITED STATES, RUSSIA, CHINA, AND INDIA

THE UNITED STATES

The United States deploys layered missile defenses for homeland defense and defense of U.S. forces and allies. The defenses are designed to protect against short-, medium-, intermediate-, and intercontinental-range ballistic missiles. The Ground-Based Midcourse Defense (GMD) against ICBMs is based on 40 interceptors at Fort Greely, Alaska – the last four of which are to be deployed in late 2017 – and four at Vandenberg AFB in California for a total of 44. Under discussion is a possible East Coast site to provide better protection

52 Congressional Commission on the Strategic Posture of the United States, William J. Perry, Chairman, and James R. Schlesinger, Vice Chairman, *America's Strategic Posture* (Washington, D.C.: United States Institute of Peace, 2009), p. 32.

53 Wu Riqiang, "Limit Missile Defense—or Expand it? A Chinese Response," *Bulletin of the Atomic Scientists*, Vol. 71(2), 2015, p. 11.

54 Zafar Nawaz Jaspal, "The Introduction of Ballistic Missile Defense in South Asia: Implications on Strategic Stability," in Feroz Hassan Khan, Ryan Jacobs, and Emily Burke, editors, *Nuclear Learning in South Asia: The Next Decade* (Monterey, CA: Naval Post Graduate School, June 2014).

55 Andrew M. Sessler et al., *Countermeasures: A Technical Evaluation of the Operational Effectiveness of the Planned US National Missile Defense System* (Cambridge, MA: Union of Concerned Scientists and MIT Security Studies Program, April 2000).

for that part of the country, which could involve another 20 to 40 interceptors. The first 20 interceptors are of the first generation Exo-atmospheric Kill Vehicle (EKV). The latest interceptor deployments have been of the improved EKV, CE-II.

While slightly more than half of the tests of these two generations of EKVs have been deemed successful, concerns have been raised that the testing conditions have been too artificial and not against the types of threats or countermeasures likely to be faced in real battle conditions.[56] Positively, the first test of the GMD against an ICBM-class target successfully took place on May 30, 2017. This success led the Pentagon's testing office to upgrade the status of the GMD from "only a limited capability" against simple launches from Iran or North Korea to "demonstrated capability" to defend against a small number of long-range ballistic missiles using "simple countermeasures."[57]

The Missile Defense Agency (MDA) is pursuing further improvements for the GMD by investing in the Redesigned Kill Vehicle (RKV) and wants to deploy it in 2022. However, the Government Accountability Office in a May 2017 report cautioned about the RKV and both the U.S. Northern Command and the U.S. Strategic Command have questioned whether the seeker will be able "to detect and track threats in the ICBM-range environment."[58]

In addition to GMD (the U.S. strategic BMD system) the United States has three other functioning BMD systems: the Aegis system, the Terminal High Altitude Area Defense (THAAD) system, and the Patriot Advanced Capability-3 system. None of these three systems are designed to intercept ICBMs. However, it is worth noting their main characteristics because TMD systems can have strategic impact depending on the security concerns raised by major nuclear powers such as China and Russia.

The Aegis system is mostly ship-based on the Navy's cruisers and destroyers but also adaptable to land in the Aegis-Ashore mode as being deployed in Romania and Poland and perhaps in other land-based sites. The Aegis system's interceptor is the Standard Missile-3, which is hit-to-kill, with three variations: Block IA, Block IB, and Block IIA. The latter is being jointly developed with Japan. Japan has Kongo-class destroyers fitted with the Aegis system. Also as mentioned earlier, Block IIB was cancelled. The three variations of SM-3 are for defending against short-, medium-, and intermediate-range ballistic missiles during the midcourse phase with an emphasis on the ascent stage. MDA has announced a test record of 33 intercepts in 40 attempts. The SM-3 Block IIA had its first intercept test in February 2017 and successfully hit the target but the second test in June 2017 failed to destroy the target.

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56 Laura Grego, George N. Lewis, and David Wright, *Shielded from Oversight: The Disastrous US Approach to Strategic Missile Defense*, Union of Concerned Scientists, July 2016.

57 Helene Cooper and David E. Sanger, "Missile Defense Test Succeeds, Pentagon Says, Amid Tensions with North Korea," *New York Times*, May 30, 2017.

58 U.S. Government Accountability Office, *Missile Defense: Some Progress Delivering Capabilities, but Challenges with Testing Transparency and Requirements Development Need to be Addressed*, GAO-17-381, May 30, 2017.

The THAAD system uses a rocket booster with a separating kill-vehicle that then seeks its target with the aid of THAAD's radar. Each THAAD battery can carry 48 to 72 interceptors, and the missiles are fired from a truck-mounted launcher. THAAD is intended to intercept short-, medium-, and intermediate-range ballistic missiles at the end of their midcourse phase and in the terminal descent phase. The intercepts can be endo- or exo-atmospheric. During the 1990s, THAAD experienced numerous technical challenges, but since 2006 THAAD has had an exceptional testing record of 100 percent (14 successful intercepts out of 14 attempts). The first test of THAAD against an IRBM target occurred very recently in July 2017. The first THAAD battery to South Korea began operating in April 2017.

A PAC-3 mobile launching station can carry 16 missiles. An independent radar guides the missiles and sends tracking information to them via a mobile engagement control station. PAC-3 is intended to protect against short- and medium-range ballistic missiles in their terminal phase at lower altitudes than THAAD. PAC-3 has been deployed to many countries, including Bahrain, Egypt, Germany, Greece, Israel, Japan, Jordan, Kuwait, the Netherlands, Saudi Arabia, South Korea, Spain, and the UAE.

The Missile Defense Agency has some next generation BMD efforts in the R&D phase. Boeing, Lockheed Martin, and Raytheon are developing concepts for the multiple-object kill vehicle. It is intended to be launched from one booster and destroy decoys and warheads in order to surmount the decoy discrimination problem. MDA wants to start a full development program by fiscal year 2022. MDA is also revisiting the use of lasers to destroy missiles in their boost phase. (The Airborne Laser program was cancelled in 2012 because the laser's limited range would have made the Boeing 747 carrying it vulnerable to anti-aircraft missiles and would have needed a laser 20 to 30 times more powerful to extend the 747's range.) The new program is seeking to develop a more powerful laser that would be mated to drones, or unmanned aerial vehicles. MDA wants to have a demonstration of the laser in 2020 or 2021 and have a deployment by 2025.[59]

RUSSIA

Russia is developing a new BMD system to protect the Moscow area. It has both nuclear and conventional (non-nuclear hit-to-kill, or HTK) interceptor defenses.[60] Missile defense is a difficult technical challenge, but Russia is technologically advanced. Russia appears to believe that it is in its interest to develop and likely deploy such a system, at least on a modest scale for Moscow, likely seeking to preserve its command and control capabilities. The workshop discussion suggested that the threat Moscow perceives would be on the order of 80 to 100 warheads, which could suggest a need for as many as 160 interceptors or more if true.[61] Russia might well want to do this, though it would be expensive, and they would face the challenge of addressing U.S. offensive countermeasures.

59 Kingston Reif, "U.S. Missile Defense Programs at a Glance," Fact Sheet, Arms Control Association, June 2017.

60 Podvig, April 2017, op. cit.

61 Comments by two participants at the FAS Workshop on Multipolar BMD World, May 17, 2017.

The next generation BMD system designated "Nudol," or A-235, will likely use HTK interceptors. (The Nudol interceptor could also perform in an ASAT role.) But while the United States has ruled out a nuclear-armed BMD interceptor, Russia is not as firmly committed to this decision as is the United States.[62] Some in Russia believe that using a nuclear warhead would give higher confidence in their BMD by relaxing the demanding accuracy required by conventional HTK technology.[63] Such a Russian nuclear BMD would introduce an additional uncertainty wrinkle in the dynamics of a multipolar BMD world if Russia either retained its older A-135 nuclear BMD interceptors or developed a modified nuclear-capable version of the A-235.

The Russian S-400 air defense system has a certain level of defense capability against theater-range ballistic missiles, though no capability against ICBMs, whose higher speeds are too fast for the S-400 system to handle.

The S-500 is a more advanced longer-range system than the S-400. Roughly comparable to the U.S. THAAD system, it is under development and may have some capability against ICBMs, though this capability is uncertain. The system remains under development as of mid-2017.[64]

Russia is actively involved in BMD development work and clearly has interest in exporting its shorter-range tactical ballistic missile defenses and air defense capabilities. However, Russia does not seem to have a clearly articulated strategy for its missile defense at the national strategic level. Other than limited protection for Moscow's command and control, it is difficult to identify a scenario in which deployment of a missile defense system would contribute to Russia's security or would make a difference in its ability to manage a conflict. Also, as mentioned in a previous section, Russian analysts many years ago assessed that a nationwide missile defense system is too technically difficult and expensive.

Russia's strategic BMD capability would be limited by the lack of a network of sensors, especially satellites and forward-deployed radars, which would be essential elements of an effective missile defense system. As a result, the current program is unlikely to produce a system that would affect the existing balance between Russia and the United States or between Russia and China.[65]

In mid-June 2017, the United States and Russia agreed in principle to resume strategic stability talks. While many strategic stability issues are clamoring for attention on the strategic stability agenda, strategic BMD may well be one of the issues that will be discussed.[66]

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62 Podvig, April 2017, op. cit.
63 Giles, op. cit.
64 See Giles, op. cit., and references therein.
65 Podvig, April 2017, op. cit.
66 Steven Pifer, "Taking the Edge off U.S. Russia Strategic Relations," Blog, Brookings.edu, June 19, 2017.

CHINA

China has conducted strategic BMD tests in 2010, 2013, and 2014, though the 2014 test was assessed by the United States to be an ASAT test. In keeping with past practice in almost all nuclear-related matters, Chinese authorities have said little about their program. Due to the distinct lack of transparency into Chinese BMD systems and capabilities, China answers most inquiries with the statement that its program is defensive in nature and not directed at any country. After the January 28, 2013 test, a Chinese Ministry of Defense official also stated that the test achieved "the pre-set goal" but did not specify that goal.[67] According to Chinese arms control analyst Li Bin, the test was intended to develop an understanding of missile-intercept technology instead of measuring the performance of a deployable system.[68] In February 2013, David Shlapak, a senior policy analyst at RAND, told *Arms Control Today* that the development paths of BMD and ASAT have differences in the "engagement dynamics" and the targeting of satellites "are much easier to manage than those associated with large-scale missile defense." He further stated: "I don't think that the testing we've seen to date reveals much about China's intentions. China could be experimenting with technology, seeking to develop a real capability, or sending a message. Unless and until we see more activity, it's going to be hard to make a conclusive determination."[69]

China's BMD program appears closely linked to its anti-satellite program. After the July 2014 Chinese test, then Deputy Assistant Secretary of State for Space and Defense Policy Frank Rose said: "Despite China's claims that this was not an ASAT test; let me assure you the United States has high confidence in its assessment, that the event was indeed an ASAT test."[70] Soon after this test, Jeffrey Lewis, director of the East Asia Nonproliferation Program for the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International Studies at Monterey, wrote: "This is the third so-called missile defense test that China has conducted. More importantly, it is at least the fourth test of something called the 'SC-19' – China's direct-ascent interceptor, first tested against a satellite in 2007. There is a big debate about whether the SC-19 is intended to shoot down missiles or satellites."[71] (SC-19 is the U.S. designation, which is sometimes called the HQ-19.)

It is unclear at this point how far China will proceed with development of strategic BMD or whether it is mostly interested in furthering the capability to hit space assets via ASAT weapons. The United States and Russia likely will have sufficient strategic capabilities to penetrate any Chinese BMD system in the near- to mid-term.

INDIA

67 Timothy Farnsworth, "China Conducts Missile Defense Test," *Arms Control Today*, March 2013, p. 22.
68 Ibid, p. 22.
69 Ibid, p. 23.
70 Mike Gruss, "Senior U.S. Official Insists China Tested ASAT Weapon," *Space News*, August 25, 2014.
71 Jeffrey Lewis, "They Shoot Satellites, Don't They," *Foreign Policy*, August 9, 2014.

India's Defence Research and Development Organisation (DRDO) is developing a two-layer BMD system: exo-atmospheric for intercepts outside the atmosphere and endo-atmospheric for intercepts inside the atmosphere. Missile intercept tests started in November 2006 for the exo-atmospheric domain with a second test in December 2007 for the endo-atmospheric domain. DRDO claimed that these two tests demonstrated a successful intercept capability for both endo-atmospheric and exo-atmospheric modes. A third test on March 8, 2009, resulted in an assessment that DRDO's BMD program "has reached a sufficient maturity level to engage IRBMs up to 2,000 km."[72] The Prithvi Air Defence missile is used for exo-atmospheric intercepts as part of the Prithvi Defense Vehicle (PVD) upper-tier system, and the Advanced Air Defence (AAD) missile is for endo-atmospheric intercepts. DRDO has stated that the AAD interceptor uses an explosive warhead to destroy targeted missiles. DRDO's announcement of its November 2012 test claimed that it now has the capability to intercept multiple missiles.[73]

While India has an ambitious BMD program, its plans do not always materialize as fast as claimed. In 2010, India's Integrated Defense Staff stated that India has "an urgent need to enlarge the scope of the R&D program … to include advanced space surveillance, space-based infrared systems, boost-phase intercept lasers, interceptor discrimination, advanced endo-atmospheric interceptors and airborne lasers."[74] In 2014, Sumit Ganguly, a professor of political science at Indiana University and a longtime analyst of South Asian defense issues, assessed that India still lacks a deployable BMD system.[75] More recent discussions in New Delhi with several analysts in March 2017 have further called into question when India's BMD systems will be deployed.[76] But India has been making recent progress on both its PVD (DRDO reported a successful test on February 12, 2017) and AAD (DRDO reported a successful test on March 1, 2017) systems.[77]

In sum, India focuses most of its BMD efforts on the ballistic missile threat from Pakistan, which would involve mostly shorter-range missiles. If Indian strategic BMD were to have an impact on strategic stability beyond South Asia, it likely would only come through a combination of serious worsening of Sino-Indian relations and a major Indian effort on strategic BMD that would have significant effects against Chinese ballistic missiles, neither of which appear to be in the offing for the foreseeable future.

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72 Wg Cdr Anand Sharma, "Ballistic Missile Defence for India: Necessity, Imperatives and Implications," Issue Brief, National Defence and Aerospace Power, 15 April 2009.

73 Eric Auner, "Indian Missile Defense Program Advances," *Arms Control Today*, January/February 2013, p. 33.

74 Asia-Pacific Staff, "Indian Missile Defense Ambitions Expand," *Aviation Week and Space Technology*, August 2, 2010, p. 30.

75 Sumit Ganguly, "India's Pursuit of Ballistic Missile Defense," *The Nonproliferation Review*, Vol. 21, Issue 3-4, 2014.

76 Discussions with Indian analysts, New Delhi, March 9-10, 2017.

77 Franz-Stefan Gady, "India Successfully Tests Prithvi Defense Vehicle: A New Missile Killer System," The Diplomat, February 15, 2017; Franz-Stefan Gady, "India Successfully Tests Supersonic Intercept Missile," *The Diplomat*, March 2, 2017.

IMPACT OF STRATEGIC BMD ON OTHER BMD AND NUCLEAR-ARMED STATES

Here, we outline in a matrix the dual dynamics among the four nuclear-armed states developing BMD for strategic purposes.

Nuclear-Armed State's Offensive Response	BMD Challenger			
	U.S.	**Russia**	**China**	**India**
U.S.	N/A	+	+	0
Russia	+	N/A	0/+	0
China	+	0/+	N/A	0/+
India	0	0	0/+	N/A

An "N/A" means that the same state will not build up nuclear arms or take counter measures against itself. The "+" signs indicate that a state will build up nuclear forces or find some effective ways to counter the BMD system of a challenger state. A "0" indicates that there should be no adverse impact between those two states when one or even both of them develops BMD. For example, the United States and India are not in an adversarial nuclear relationship; indeed, these two states have expressed an interest in government statements of wanting to cooperate on BMD technologies. The "0/+" indicates that we expect some reaction but most likely a weaker response than between two states locked in an intense nuclear deterrent relationship.

Where we have the "+" signs in the matrix, we assess that the biggest impact is among the United States, China, and Russia. These three major powers have a multi-decade history of nuclear deterrence among them and want to preserve their deterrence relationships. They form a triangular relationship that can be thought of as "nested security dilemmas."[78] That is, Russia and the United States have been in a dual nuclear relationship for more than 60 years, and China and the United States have had to counter each other's nuclear forces for more than 50 years. China and Russia have also been in a dual deterrent relationship for as long as China and the United States but arguably not as strongly. One major difference among these states is whether there is a desire to have parity – even if not on a warhead-to-warhead matching basis – between their nuclear forces. The U.S.-Russia strategic nuclear relationship, as codified in arms control treaties, has had an overarching philosophy of maintaining rough parity for strategic balance. However, China has so far opted to emphasize having much smaller sized nuclear forces with the guiding philosophy that as long as it can have confidence of having even a small number of surviving nuclear forces in the event of a first strike it would be content not to reach parity with the two bigger nuclear powers. Nonetheless, China would feel pressure to respond with various countermeasures to U.S. plans to improve or increase its BMD systems.

78 Chapter Six in Eric Heginbotham et al., *China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States* (Santa Monica, CA: RAND, 2017).

The China-India nuclear dynamic presents interesting disparities in strategic thinking between the two countries, and we label this dyad with a "0/+" symbol to indicate the so far lesser coupling than with the China-U.S. relationship, for example. Discussions with experts during the research travel to China and India and at the Washington, D.C. workshop suggest that an Indian BMD system would have little impact on China's strategic thinking. A main reason is that China does not formally recognize India as a nuclear-armed state due to India having developed these weapons outside of the Non-Proliferation Treaty and in opposition to UN Security Council resolutions against such development.[79] Another reason is that Chinese defense planners have not assessed Indian nuclear forces as that threatening to China.

Despite these assurances, we retain a modest level of skepticism and think that China's threat assessment concerning India's nuclear forces could change over time. If India moves ahead with development and deployment of the Agni-6 ICBM, putting all of China within reach of this multiple warhead ICBM, this could aggravate other tensions between India and China and could lead to some Chinese BMD response or Chinese buildup of nuclear capable ballistic missiles dedicated to deterring India. For the time being, however, India is primarily concerned about Pakistani nuclear capability and is devoting the great majority of its BMD resources in this direction, which does not pose a direct threat to China. China could assist Pakistan by offering BMD systems or technical advice about BMD to Islamabad.[80] However, recent defense acquisitions signal that India is beginning to factor in China in its missile defense calculations. In 2014, India and Israel decided to partner in developing and deploying an anti-missile system ostensibly against China's conventional and nuclear missiles.[81]

Discussions among some Indian analysts brought out the views that India is in prestige race with China as to which state is ahead in the technologically challenging endeavor to develop BMD. One Indian analyst whose graduate studies were focused on the implications of Indian BMD believed that China has not really demonstrated a functioning BMD system but instead has just shown that it has some capability to intercept satellites and ballistic missiles under scripted conditions. This same expert was also skeptical about DRDO's claims of having developed a BMD capability for India. Other experts underscored the rivalry between China and India for the position of top Asian political and military power.[82]

A major spur to unwelcome dynamics in such a multipolar world is the understandable tendency to plan against worse-than-expected outcomes, given that such outcomes occur from time-to-time. One example of the willingness of a country to defend the credibility of its nuclear deterrent is found in China's 2016 long-term modernization plans to enhance its "strategic deterrence capability," a theme President Xi Jinping echoed during a visit to People's Liberation Army Rocket Forces (PLARF) headquarters in September 2016. "The service is developing and testing several new variants of missiles … *and developing methods to*

79 Comment by Chinese international relations scholar, Shanghai, March 15, 2017.
80 Several Indian experts raised this concern during discussions in Bangalore and New Delhi, March 9-11, 2017.
81 Vivek Raghuvanshi, "India, Israel to Build Anti-Missile System," *Defense News*, February 6, 2014.
82 Discussions at the Observer Research Foundation, New Delhi, March 9. 2017.

counter ballistic missile defenses" [emphasis added].[83] In addition, the Office of the Secretary of Defense notes: "The PLA is developing a range of technologies in an attempt to counter U.S. and other countries' ballistic missile defense systems, including MaRV, MIRVs, decoys, chaff, jamming, and thermal shielding. For example, China acknowledged a hypersonic glide vehicle test in 2014."[84]

Without some kind of coordinated action self-interest will plausibly lead to a deteriorating, less stable strategic environment. The challenge for the United States is to address this problem while preserving important U.S. BMD requirements to protect the United States and allies against growing and emerging missile threats from states such as Iran and North Korea. We do not underestimate the difficulty of this challenge but believe it needs to be addressed as an issue in some forum.

Russia has demanded "legally-binding" limitations on U.S. BMD capabilities. While the United States has not wanted to provide such an agreement, numerous U.S. officials have tried explaining to their Russian counterparts that the U.S. BMD systems are neither directed against Russia nor effective in shooting down Russian ballistic missiles.[85] Despite these clear U.S. political statements and "limited" deployments, Russia and China remain concerned about the impact of U.S. BMD on their strategic deterrents. Their main concerns are not current U.S. BMD systems, but the development of "game changing" technologies in the future and advanced systems in the future, as we discuss below. But even with the current type of hit-to-kill kinetic interceptors, which the United States has deployed only 44 strategic BMD interceptors over the last 13 years, Russia and China are concerned that there is nothing to stop the United States from deploying far more than this modest number in the coming years to decades. As we have noted previously, this possibility pressures China more than Russia because of China's much smaller sized nuclear arsenal.

At least two fields of game changing BMD technology could exacerbate strategic and crisis instability among the United States, Russia, and China:

1. The development of non-kinetic, high-energy weapons would allow both rapid and low-cost, multi-shot capabilities. This could enable higher kill capability against incoming warheads, as opposed to relying upon slower-moving interceptor missiles with kinetic kill vehicles. Solid-state lasers are already finding some important tactical applications and may be relevant to BMD, as well. Development of tactical high-energy lasers is already well along, and adaptive optics and related technologies could be used to apply them to strategic BMD, for example. Boost-phase intercepts might be possible using high-energy laser systems carried on unmanned aerial vehicles.[86]

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83 Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China*, *Report to Congress*, May 2017, p. 31.

84 Ibid., page 60.

85 Frank Rose, former Assistant Secretary of State for Arms Control, Verification, and Compliance, Presentation at FAS Workshop on Multipolar Strategic BMD World, May 17, 2017.

86 David C. Walsh, "Directed Energy Weapons Making a Great Leap Forward," *Defense Systems*,

2. The set of concepts referred to as "left-of-launch" techniques could prevent missiles from even being launched by disrupting, disabling, or destroying them. Cyber options are examples of these techniques, where a cyberattack could seriously compromise an adversary's ability to launch its ballistic missiles. This type of action was reportedly already used against North Korean missile launches.[87]

A particular challenge of the second approach is that it would likely be exceptionally difficult for a country to determine how effective such a left-of-launch technique would be, as such capabilities would be very difficult to even qualitatively estimate, much less quantitatively estimate. Furthermore, it would be hard to design a regime that would limit or control such an approach if successfully developed, as verification would be extremely challenging if accomplished through cyber means. Chinese experts during discussions about this new development commented that they believed that left-of-launch techniques would be destabilizing.[88] One American expert argued that it could place China in a dilemma of use or lose during a crisis.[89] Also, there would be substantial uncertainty about whether all missiles could be destroyed or disabled prior to launch.

In conclusion of this section, we underscore that even if the United States were to agree to some modest limits to traditional BMD deployments, Russian and Chinese anxieties would likely remain. To hedge against this major uncertainty, countries could either increase their offensive missile forces or diversify their offenses to put more emphasis on bombers and cruise missiles, though a left-of-launch breakthrough could potentially affect such air-breathing capabilities as well as ballistic missiles.

ARMS CONTROL AND OTHER COOPERATIVE MECHANISMS

Is a multilateral ABM Treaty feasible or desirable? During discussions in the first half of 2017 with defense and arms control experts, we posed this question. The overarching view from experts whether American, Russian, Chinese, or Indian was to focus on maintaining strategic stability. No one argued against performing research and development on limited strategic BMD. However, no one argued for a massively extensive or "thick" BMD system due to serious concerns about the great expense and the adverse effects on strategic stability.

Some Russian and Chinese experts believed that if some limits on BMD were formally agreed upon, this could reassure their countries. But several analysts cautioned that the political will is missing, especially in Washington. Concerning political perceptions, several experts recognized that having some BMD helps reassure each country's citizens that their govern-

June 30, 2016; Marcus Weisgerber, "Pentagon: We're Closer than Ever to Lasers that Can Stop Iranian, North Korea Missiles," Defense One, August 17, 2016.

87 William J. Broad and David E. Sanger, "U.S. Strategy to Hobble North Korea was Hidden in Plain Sight," *New York Times*, March 4, 2017.

88 Comments from two Chinese defense scholars, Carnegie-Tsinghua Center, Beijing, March 13, 2017.

89 Discussion with an American nonproliferation scholar, National Defense University, Symposium for PASCC, April 8, 2017.

ment is doing something to protect them. A number of Chinese and Russian experts also expressed support for protections against decapitating strikes against key command and control centers as well as the communication network for nuclear forces. This type of BMD protection would likely be stabilizing in their view.

During the discussions in March, some Chinese arms control experts in Beijing and Shanghai explored in some detail their concerns about the U.S. BMD systems and conceptions about how to work toward a treaty or an agreement that would codify limitations, though all expressed skepticism about the political will in the United States at this time.

A senior professor first emphasized: "China just needs a window for retaliation. But as BMD increases, that window closes." He expressed concern that BMD is part of the U.S. drive to keep and maintain superiority. He also stated that the United States already seems to have nuclear supremacy; his concern was that a U.S. first strike could destroy almost all of China's land-based nuclear-armed missile force and that BMD then could intercept the remaining few missiles that China could launch. He said: "U.S. congressmen do not accept U.S. vulnerability. Thus, they want more BMD."

As to a multilateral ABM Treaty, he said that would require a change in thinking. He thought that China and India as well as Russia would support it, but not the United States: "For China, a very limited ABM system would be sufficient such as to protect command and control in Beijing and/or an ICBM site."

Another senior professor assessed:

> The consortium of major powers should work on missile defense control, but not a total ban. Zero defense is not good. But too much is also not good. So, we need a ceiling for stability purposes. The United States could lead the consortium by declaring and setting a ceiling and then invite others to join. This could reach a balance of power. But the United States would likely not want to do this because it wants superiority. So, the United States should change its strategic thinking if it wants to achieve stability.

He went on to argue for a gradual buildup of Chinese nuclear forces to the level of just under 1,000 warheads, going no further than about 900: "This would not reach parity with the United States so as not to stimulate the U.S. and China in an arms race …[He presumed the United States would still be significantly above 1,000 warheads in its arsenal in the coming decades.] … But this level could open up arms control between China and the United States. China would then be a 'normal' country."

He and another senior professor of international relations considered BMD issues in the context of U.S.-China cooperation in dealing with the North Korean missile threat. One of them said: "As to North Korea, the keys are in the hands of both China and the United States. China has an interest in keeping U.S. forces pinned down in Korea so as not to free up more U.S. forces for a potential crisis over Taiwan." The other noted: "When Obama pivoted the U.S. military to Asia, Pres. Xi Jinping lost face. However, a Pax Americana is in China's inter-

ests if the United States keeps quelling Japan and South Korea and Taiwan."

He further assessed that it could take many years for China and the United States to reach agreement on missile defense and stability: "At this time, Track 2 dialogue is possible and needed, but Track 1 seems to be not possible now." Nonetheless, he added that it was worth starting even if the Track 2 dialogue would need to continue for ten or more years before Track 1 is ready to start.

A mid-career Chinese arms control analyst pointed out: "China would be concerned about including India in a formal arms control agreement on BMD because Beijing does not want to recognize India as a nuclear weapon state. But one could consider two triangular arms control arrangements: U.S.-China-Russia and U.S.-Russia-India."

Several Indian analysts in New Delhi expressed interest in multi-lateralizing the ABM Treaty believing that well-defined limits could support strategic stability. Some of them also stated that India's NFU policy would be further credible if there were limited Indian BMD capability to protect the command and control center as well as land-based Indian nuclear forces. Thus, national authorities would be more confident in surviving a nuclear first-strike. Other Indian missile experts in Bangalore were less interested in multilateral BMD controls and instead discussed their idea of all nuclear-armed states agreeing to eliminate tactical nuclear weapons. This proposal is driven by their concerns about Pakistan's development and deployment of the Nasr, a solid-fueled, tactical ballistic missile.

FINDINGS

1. **Preservation of Nuclear Deterrents and the Security Trilemma:** Discussions in China, India, and the United States, our literature review, the working papers by in-country experts, and the FAS workshop have reconfirmed the elemental reality that nuclear states are willing to go to extraordinary lengths to preserve the credibility of their offensive nuclear forces. They will not sit by and allow another country to blunt the effectiveness of their offensive nuclear deterrents. As a result, when a country deploys BMD to protect against the threat from another country, as the United States has done toward North Korea, countries like China and Russia can easily become concerned about the implications for their own forces even if they are not the intended "targets" of the BMD deployment. Linton Brooks and Mira Rapp-Hooper have dubbed this phenomenon a security trilemma.[90]

2. **Complicated Security Effects When Multiple Countries Develop Even Very Limited Strategic BMD:** If and when more countries develop even very limited strategic BMD capabilities, such a multipolar BMD world would create an even more complicated strategic picture, with cautious countries tempted to take more actions to reassure themselves about the viability of their deterrent capabilities. Such a "polylemma" sit-

90 Brooks and Rapp-Hooper, op. cit.

uation poses a complex analytic challenge, though in some cases the complexity may be reduced to a series of "nested security dilemmas," in the words of the authors of RAND's 2017 study on the Chinese nuclear posture.[91]

3. **Strategic Complexity Dependent on the Nature of Political Relationships:** The degree of complexity will broadly depend upon the nature of the political relationship with the country in question, whether it is a friend, a foe, or a neutral; for example, India does not appear to worry about U.S. BMD, and the U.S. does not appear to worry about India's nascent ICBM force. Neither does the United States worry about Great Britain's nuclear-armed SLBMs, but Russia has to calibrate its strategic posture and BMD in light of the UK's nuclear force. This complexity will also depend on the status of BMD technology for the timeframe under consideration.

4. **Budgetary Constraints Significantly Limit Size of Strategic BMD:** Given current strategic BMD technology, budgetary considerations are a major constraint on a country's ability or willingness to deploy significant levels of strategic BMD. As stated by some Chinese experts in our previous study, China wants to avoid fueling a "money-burning [BMD] program."

5. **Exceptionally Challenging for the United States to Develop Effective BMD Against Russia or China:** Given the capabilities of Russian and Chinese nuclear forces and their technological sophistication to make BMD countermeasures, it would be exceptionally difficult for the United States to seek an effective defense against these forces. Such a defense would not only need to be effective against current adversary offensive forces, but also against such forces upgraded with countermeasures seeking to thwart U.S. defenses.

6. **Unease from Non-Allied Nuclear Powers Even if They Are Not the Rationale for Strategic BMD Deployments:** Given finding #1, non-allied nuclear powers will be at least somewhat uneasy about strategic BMD developments and deployments even if they logically know their forces are neither the reason nor the target for the BMD.

7. **Uncertainties about BMD Effectiveness Could Be Stabilizing Under Proper Circumstances:** A thin strategic defense to counter either a minor nuclear power such as North Korea or an accidental or unauthorized launch from a major nuclear power not only does not have to be destabilizing, it can actually be stabilizing under the proper circumstances. The country with missile defense cannot be assured that its highly complex system will be effective, while the other country cannot be assured that it will not be effective. Each side then has reason to be cautious in a crisis situation. This uncertainty effect is tempered by the fact that there will also be uncertainty by each country over the degree of uncertainty the other country has. On balance, we believe that the first effect is greater than the second one, but the second cannot be ignored.

91 Heginbotham et al., op. cit.

8. **Demonstrated Effectiveness is Important for Deterrence or Dissuasion:** Strategic BMD effectiveness will likely play a strong role in the event of an outbreak in nuclear hostilities if the initial stage is a small attack. If the BMD is effective against such a small initial attack, this effectiveness could deter or dissuade the other country from following up with a follow-on attack, assuming there were sufficient numbers of interceptors available. Conversely, if the BMD is not very effective, this could embolden the country to make a follow-on attack. Thus, it is important for the United States or any country developing strategic BMD to show that it is developing a significantly effective system.

9. **One or More States' Offensive Arms Buildups Could Occur Due to Concerns About BMD's Role in a Possible Disarming First-Strike:** As a corollary to Findings #7 and #8, strategic BMD will also play a significant role in a scenario where a nuclear-armed state launches a disarming first-strike attack on a relatively smaller sized nuclear force and then uses its strategic BMD system to shoot down the few ballistic missiles that the adversary could launch in retaliation. While this capability would allow potential dominance over the smaller nuclear power, it would likely trigger serious concern and a potential arms racing response from other nuclear-armed states that have smaller to mid-sized nuclear forces. This is another example of a security trilemma.

10. **Boost-Phase Intercept Systems Could be Stabilizing But Would be Very Technically Challenging:** Boost-Phase Intercept (BPI) concepts would not be easy to develop and implement but could be stabilizing under certain circumstances and have the potential of reducing security trilemma anxieties by offering a potential way to defend effectively against a North Korean ICBM without posing a significant threat to Russian or Chinese ICBMs, which would be based far inland and out of range of BPI interceptors. However, casting significant technical doubt on the feasibility of BPI, the independent American Physical Society's Study Group on Boost-Phase Intercept Systems for National Missile Defense assessed, in a July 2003 report, from a technical standpoint that ground-based boost-phase interceptors would require extremely fast interceptors to have any chance of intercepting solid-propellant ballistic missiles (which have relatively quick boost times) even when the interceptors are located relatively close (within several tens of kilometers) to the adversary's territory. Airborne laser intercept systems would face the challenge of the difficulty of burning through heat-resistant solid-propellant missiles as compared to more heat-sensitive liquid-propellant missiles.[92] North Korea, in particular, has been recently demonstrating advances in developing rapid firing, solid-propellant ballistic missiles. Additionally, for example, some Congress members this year have expressed interest in pursuing space-based boost phase intercepts.[93]

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92 APS Study Group, *Report of the* APS *Study Group on Boost-Phase Intercept Systems for National Missile Defense* (Washington, D.C.: American Physical Society, July 2003).

93 "S.1196 - Advancing America's Missile Defense Act of 2017," 115th Congress (2017-2018). https://

11. **Strategic Nuclear Arms Control is Knotted in Part Due to No Resolution on the Question of Limits on Strategic BMD:** Strategic nuclear arms control becomes harder in a world where there are no limits on strategic BMD, and likewise where strategic BMD has proliferated to more than one country. For at least the time being, further New START reductions appear unlikely until this knotty problem with Russia can be resolved. With New Start due to expire in 2021, the United States will want to address the treaty's value for U.S. security interests and what would be needed to maintain it if it is seen as important for these interests.

12. **China is Confirmed as Moving Forward with BMD Developments but There is Still Uncertainty About Deployment:** Earlier indications that China is developing its own strategic BMD capabilities have now been confirmed in the recent Office of the Secretary of Defense's China Military Power report: "China is taking steps to develop a BMD capability. It is developing a missile defense umbrella consisting of kinetic-energy intercept at exo-atmospheric altitudes (greater than 80 km), as well as intercepts of ballistic missiles and other aerospace vehicles within the upper atmosphere. In July 2016, Chinese official media confirmed China's intent to go forward with mid-course missile defense capabilities on both land and sea assets, reflecting work on BMD dating back several decades."[94]

13. **No Easy Technological Fixes Are Available and New Technologies Could Potentially Be Strategic Game-Changers:** While there might be a technologically based way to resolve the nuclear trilemma involving BMD, such as with the BPI concepts mentioned in Finding #10, technology does not seem to offer an easy way out of this situation. Also, some technological developments might adversely affect strategic stability, such as low-cost, rapidly repeatable, speed-of-light strategic BMD weapons that could potentially make BMD more effective. This game-changer would give more incentive for nuclear-armed states to increase their nuclear forces and to consideration in a crisis of striking before one's adversary can strike first.

14. **Concessions Will Be Needed from Russia, China, and the United States to Resolve Impasses While Taking Into Account All Three Countries' Strategic Interests:** The diplomatic and technical challenge is to find an approach that reassures Russia and China about the continued viability of their nuclear deterrents while allowing the United States to defend against threats like that posed by North Korea. To achieve this outcome, the United States would need to be willing to accept some significant concessions from Russia and China in return for which the United States would agree to some BMD restrictions that would not significantly impinge on its planned BMD programs. Cutting this Gordian Knot would be difficult for all sides.

15. **Need for Common and Mutually Compatible Philosophy Among States Developing**

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www.congress.gov/bill/115th-congress/senate-bill/1196/text

94 OSD's *China report*, op. cit., p. 49.

Strategic BMD: Given the important role that offensive nuclear weapons play in the security posture of nuclear powers, it appears unlikely that the addition of more countries that become capable of intercepting or thwarting the offensive nuclear potential of other countries could have a positive effect on strategic stability. The best that can be hoped for, absent a credible regime that placed at least some limits on strategic BMD, would be a regime where all had a common and mutually compatible philosophy on the issue, e.g., a thin BMD defense against rogue, inadvertent, or unauthorized launches. Otherwise, with no such compatibility, and an absence of any kind of BMD restraint regime, however informal, the strategic environment of the future, certainly for the next decade, will likely be characterized by continuing and at least gradually growing uneasiness and strategic instability, as countries take what seem to them to be prudent steps to preserve the credibility of their offensive nuclear deterrent capabilities.

16. **Several Forums – Especially Among the P5 – Can Be Used for Dialogues on BMD and Strategic Stability:** The fundamental problem is assuring strategic stability in a changing security environment. In recent years, efforts have been underway to begin discussion on global strategic stability in the Permanent-5 members of the UN Security Council (P5), who are also the five official nuclear weapon states. An October 2016, P5 seminar on nuclear policy and doctrine raised the question: Is there a role for the P5 on BMD?[95] While the P5 might not be the optimum forum, the international character of the problem suggests that discussions could usefully at least start in the P5. Should India deploy its own strategic BMD, this forum should be expanded to include India, which is not an official nuclear weapon state. Even if such discussions do not lead to breakthrough agreements, there is value in conducting and maintaining a dialogue on these issues, as they go to the heart of strategic stability considerations. Track 2 and Track 1.5 discussions have been useful, and Track 1 BMD discussions could likewise be worthwhile, even if only for the sidebar conversations that would take place. BMD has been a persistent unresolved issue for the last 15 years, and the technological, strategic, and programmatic trends strongly suggest these issues will only become more difficult in the coming years. Issues need to be addressed at Track 1, 1.5, and 2 levels, with supporting study work. The stakes involved are simply too high not to have continuing dialogues.

95 Rose, May 17, 2017, op. cit.

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