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PETR TOPUCHKANOV

INDIA'S PROSPECTS IN THE AREA OF BALLISTIC MISSILE
DEFENSE: A REGIONAL SECURITY PERSPECTIVE

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The paper analyzes missile threats to India and the current state and prospects for development of India's air and missile defenses. It also assesses the reaction of India's potential adversaries to the country's growing capability to counter missile threats.

The material is intended for regional studies specialists and all those interested in problems of security, foreign affairs, and international military-technical cooperation.

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LIST OF ABBREVIATIONS AND ACRONYMS

AAD	Advanced Air Defense
AD	Air Defense
ALCM	Air-Launched Cruise Missile
BDL	Bharat Dynamics Limited
BEL	Bharat Electronics Limited
BMD	Ballistic Missile Defense
DRDO	Defense Research and Development Organization
GLCM	Ground-Launched Cruise Missile
IAI	Israel Aerospace Industries
ICBM	Intercontinental Ballistic Missile
IGMDP	Integrated Guided Missiles Development Program
JV	Joint Venture
MP	Member of Parliament
MRBM	Medium-Range Ballistic Missile
NCA	National Command Authority
PAD	Prithvi Air Defense
R&D	Research and Development
SADW	Shoulder-Fired Air Defense Weapon
SAGM	Surface-to-Air Guided Missile
SAMGS	Surface-to-Air Missile and Gun System
SAMS	Surface-to-Air Missile System
SIPRI	Stockholm International Peace Research Institute
SLBM	Submarine-Launched Ballistic Missile
SPAAW	Self-Propelled Anti-Aircraft Weapon
SSBN	Nuclear-Powered, Ballistic Missile-Carrying Submarine
TNW	Tactical Nuclear Weapon

INTRODUCTION

“In 2012, the unequal relationship between India and Pakistan is spinning sharply out of control. Terrorists attack the Indian parliament and kill two ministers and 12 MPs. There is no doubt that Pakistan had a hand in this, and in a month India goes to war. Pakistan threatens to use nuclear weapons if India does not stop the invasion. Indian troops close in on Lahore, and Pakistan launches Ghauri missiles with nuclear warheads aimed at Delhi... A long-range radar for missile defense detects the Ghauri missiles 30 seconds after their launch. Five minutes later... the missile defense system launches interceptor missiles. Four Pakistani Ghauri missiles explode in the sky and fall harmlessly to the ground in pieces... The city of Delhi is saved. India carries out a nuclear counterattack that, in the words of one military officer, ‘will put an end to Pakistan once and for all.’ Science fiction? Not entirely.”¹ This text was published by Raj Chengappa, a columnist for the Indian magazine *India Today*, in the official publication of the Indian Embassy in Moscow in 2008.

Setting aside for the moment an analysis of India’s possible use of a missile defense system, it is necessary to note that the initial stage of the author’s fictitious conflict repeats the course of many Pakistani-Indian conflicts. Among the most serious of these were the crises of 2001-2002 and 2008, which were characterized by a common development: an act of terrorism in India, followed by a reciprocal show of strength and a growth of mutual tensions in India and Pakistan. Further escalation has so far been avoided, in no small measure thanks to active steps taken by other states.²

Raj Chengappa’s text demonstrates the consequences that could result from further escalation, including large-scale military operations with the use of conventional – and possibly nuclear – forces. For many specialists in India and Pakistan, it is clear that in the event of nuclear war between two powers of such territorial proximity, there cannot be a winner. Significant areas of the South Asian region would be rendered uninhabitable. The entire ecological system of the region would change. The consequences of a nuclear exchange would be felt far beyond South Asia.

According to Raj Chengappa’s scenario, Indian missile defense could save Delhi from a nuclear attack, but it could not prevent a nuclear catastrophe. In fact, for the moment, it is difficult not only to consider Indian missile defense effective, but to see it as a system that really exists. India has not completed a missile defense system by 2012, in part due to its limited resources, scientific and technical difficulties, and obstacles encountered while obtaining the necessary technologies on the international market.

However, an important role was also played by the deficit of expert consensus in India in regard to the expediency of the substantial costs associated with developing missile defense, which, as it seems at the moment, cannot guarantee the country’s protection from missile and nuclear threats. Moreover, it is expected that India’s success in this area will provoke responses on the part of its potential rivals, Pakistan and China, that will require additional spending.³

Despite the deficit of consensus, India continues development in the area of missile

¹ R. Chengappa, “The New Missile Defense Shield,” *Indiiskii vestnik. Byulleten posolstva Indii v Rossii*, No. 1 (2008): P. 12.

² See, for example: P. Nayak and M. Krepon, “US Crisis Management in South Asia’s Twin Peaks Crisis” (Report 58, Washington: The Henry L. Stimson Center, November 2006).

³ Critical assessments of India’s missile defense system are collected in the work: R. Roy-Chaudhury, “Ballistic Missile Defence (BMD) Developments in South Asia – Implications for Regional Stability” (South Asian Strategic Stability Institute, July 2004), www.sassi.org/pdfs/Rahul_Chauthury.pdf.

defense. Prospects for its success are actively discussed in India and abroad. Concerns about the reaction from Pakistan and China are beginning to be substantiated. The persistent uncertainty regarding Indian missile defense continues to adversely affect regional security. As a result, the assessments of missile and nuclear threats in South Asia, the prospects for missile defense in India, and the reactions on the part of its potential adversaries all remain relevant.⁴

⁴ A number of works have been written about the problems with India's missile defense system. For example: R.M. Basrur, *Minimum Deterrence and India's Nuclear Security* (Singapore: NUS Press, 2009), PP. 102-121; Z.I. Cheema, *Indian Nuclear Deterrence. Its Evolution, Development, and Implications for South Asian Security* (Karachi: Oxford University Press, 2010), PP. 281-294; *The Impact of US Ballistic Missile Defense on Southern Asia*, ed. M. Krepon and Ch. Gagné (Washington: The Henry L. Stimson Center, 2002); G. Koblenz, "Theater Missile Defense and South Asia," *The Nonproliferation Review* (Spring-Summer 1997): PP. 54-62; M. Krepon, *Missile Defense and Asian Security* (Washington: The Henry L. Stimson Center, 2002); A.V. Kumar, "A Phased Approach to India's Missile Defence Planning," *Strategic Analysis* 32, Issue 2 (2008): PP. 171-195; G.V.C. Naidu, "Ballistic Missile Defence: Perspectives on India-Japan Cooperation," *Strategic Analysis* 31, Issue 1 (2007): PP. 155-177; H.V. Pant, "India Debates Missile Defense," *Defense Studies* 5, No. 2 (2005): PP. 228-246; M. Sultan, "Strategic Transitions in South Asia and the Impact of Ballistic Missile Defences," in *Ballistic Missiles and South Asian Security*, ed. P.I. Cheema and M. Mahmud, 17-52 (Islamabad: IPRI, 2007); M.D. Swaine and L.H. Runyon, "Ballistic Missiles and Missile Defense in Asia," *NBR Analysis* 13, No. 3 (Seattle, 2002); A.J. Tellis, "The Evolution of U.S.-Indian Ties: Missile Defense in an Emerging Strategic Relationship," *International Security* 30, No. 4 (2006): PP. 113-151; D.A. Wilkening, "The Strategic Impact of Indian Ballistic Missile Defence," in *The Future of War and Peace in Asia*, ed. N.S. Sisodia and S. Kalyanaraman, 211-238 (New Delhi: MAGNUM Books Pvt Ltd, 2010); Mian Zia, R. Rajaraman, and M.V. Ramana, "Early Warning in South Asia – Constraints and Implications," *Science and Global Security* 2 (2003): PP. 109-150, etc.

1. INDIA'S MISSILE THREATS

India's potential adversaries include China, Pakistan, and a number of other countries, as evidenced by the words of George Fernandes, defense minister of India from 1999 to 2004: "China with its vast nuclear arsenal, Pakistan with its nuclear weapons and delivery system capability, America perching in Diego Garcia and 8 other Asian countries possessing missiles is quite a grim security scenario."⁵ The unnamed Asian countries, presumably, may be Egypt, Iran, Iraq, Israel, North Korea, South Korea, Syria, and Taiwan, of which Iran and North Korea cause the greatest concern for India.

However, India sees Pakistan and China as the main sources of missile and nuclear threats. Quantitative and qualitative descriptions of these countries' missile arsenals are estimates, due to the lack of openly available official public data on these arsenals (see Table 1).

Table 1. Missile Arsenals in China and Pakistan, 2011					
China			Pakistan		
Name (quantity)	Range	Put into Service	Name (quantity)	Range	Put into Service
1. Intercontinental Ballistic Missiles					
Dong Feng 4 (12)	5500 km	1980	<i>This class of missile is not in service in Pakistan</i>		
Dong Feng 5A (20)	13000 km	1981			
Dong Feng 31 (10)	7200 km	2006			
Dong Feng 31A (15)	11200 km	2007			
2. Medium-Range Ballistic Missiles					
Dong Feng 3A (12)	3100 km	1971	Hatf-5/Ghauri-1 (12)	1100 km	1998
Dong Feng 21 (60)	2100 km	1991	Hatf-4/Shahen-1 (40)	750 km	1999
			Hatf-5A/Ghauri-2 (?)	1500 km	1999 (?)
			Hatf-6/Shahen-2 (12)	2500 km	2005 (?)
3. Short-Range Missiles					
Dong Feng 15 (400)	600 km	1990 (?)	Hatf-1 (50)	80 km	1992
Dong Feng 11 (350)	350 km	1992 (?)	Dong Feng 11 (40)	350 km	(?)
Dong Feng 11A (350)	500 km	1998 (?)	Hatf-1A (50)	100 km	1995
			Hatf-2/Abdali (40)	260 km	2005
			Hatf-3/Ghaznavi (80)	500 km	2004 (?)
			Hatf-4/Shahen-1 (40)	750 km	1999
4. Ground-Launched Cruise Missiles					
Dong Hai 10 (350)	1500 km	2007	<i>This class of missile is not in service in Pakistan</i>		
5. Submarine-Launched Ballistic Missiles					
Ju Lang 1 (12)	1770 km	1986	<i>This class of missile is not in service in Pakistan</i>		
Ju Lang 2 (24)	7200 km	2011 (?)			

Note: This table includes only the missiles put into service by 2011. Systems undergoing development are not considered, for example: China's Dong Feng 25 MRBM (range 2,500 km) and B-611 TNW (250 km), and Pakistan's Ghauri-3 ICBM (3,000 km), Hatf-9/Nasr TNW, Hatf-7/Babur GLCM (700 miles), Hatf-8/Raad ALCM (300 km), etc.

Sources: A. Arbatov, "China, Strategic Stability, and Disarmament," *Voenno-promyshlennyyi kurier*, No. 46(412) (November 23, 2011), <http://vpk-news.ru/articles/8379>; M.S. Barabanov, K.V. Makienko, R.N. Pukhov, and A.L. Rybas, *Russia's Military and Technical Cooperation with Foreign Countries: A Market Analysis*, ed. A.L. Rybas, 411-412 (Moscow: Nauka, 2008); "Ballistic Missiles of the World," *Missilethreat.com*: A Project of the Claremont Institute, <http://www.missilethreat.com/missiles-of-the-world/>; Z.I. Cheema, *Indian Nuclear Deterrence. Its Evolution, Development, and Implications for South Asian Security* (Karachi: Oxford University Press, 2010), pp. 196-198; *SIPRI Yearbook 2011. Armaments, Disarmament and International Security*, ed. B. Gill, 342, 348 (N.Y.: Oxford University Press, 2011).

⁵ Quoted from: A. Kumar and M. Vannoni, *Ballistic Missile Proliferation in Southern Asia: Options for Stabilization* (Albuquerque: Sandia National Laboratories, 2004), p. 22.

Only some of the systems in the substantial missile arsenals of China and Pakistan, which number more than 1600 and 360 missiles respectively, could pose a nuclear missile threat to India.⁶

1.1. China⁷

This country can launch a nuclear strike on India using all classes of missile. The only exception could be considered the class of tactical nuclear weapons (TNWs), the use of which against India is doubtful. This is because the most significant targets within India are not accessible to TNWs, and the appearance of large Indian military groups along the Indian-Chinese border or on Chinese territory, which could then become the target of TNWs, would be possible only in the unlikely event of a large-scale war. The use of ICBMs, MRBMs, SLBMs, and GLCMs is more likely. That being said, there are a number of significant limitations. First, with about 120 ICBMs and MRBMs, China would not plan to use them solely against India at a time when Japan, Taiwan, and the United States are of the greatest concern.⁸ According to some accounts, the importance of India in China's strategic planning decreased in the second half of the 1990s.⁹ Second, the current marine component of the Chinese nuclear forces can hardly be regarded as a threat to India. Since 1981 China has had one Type 092 SSBN with 12 Ju Lang 1 SLBM launchers in service and is building three Type 094 SSBNs with 12 Ju Lang 2 SLBM launchers on each.¹⁰

Third, there are only a limited number of launchers available for the missiles. According to data from the U.S. Department of Defense, China has only 40-55 launchers for about 350 Dong Hai 10 GLCMs.¹¹

At present, China can launch a limited nuclear attack on India using Dong Feng 5A, Dong Feng 31A, Dong Feng 31, and Dong Feng 4 ICBMs, which can hit targets throughout India, and the Dong Feng 21 MRBMs, which can hit targets in any part of the country except the extreme south.

According to several reports, India falls in the zone of responsibility of the 53rd and 56th missile bases in Kunming (Yunnan Province) and Xining (Qinghai Province) respectively.¹² The nuclear forces deployed in the 812th brigade in Delinghe (Qinghai Province), belonging to the 56th missile base, also present a threat to India.¹³ The

⁶ Such estimates have been criticized in the work of A. Khamchikhin, who believes that China could possess up to 1,000 ICBMs and 1,000 MRBMs, while the total number of nuclear warheads exceeds 10,000. (A.A. Khamchikhin, "The Phenomenon of Chinese Military Power is Still Undervalued," *Nezavisimoe voennoe obozrenie* [December 30, 2011], http://nvo.ng.ru/forces/2011-12-30/1_china.html. In some U.S. publications one can find estimates that put the size of the nuclear arsenal at more than 3,500 warheads. See, for example: P.A. Karber, "Strategic Implications of China's Underground Wall" (Federation of American Scientists, September 26, 2011), http://www.fas.org/nuke/guide/china/Karber_UndergroundFacilities-Full_2011_reduced.pdf. However, such estimates are questioned by several authoritative researchers, such as: H.M. Kristensen, "No, China Does Not Have 3,000 Nuclear Weapons," *FAS Strategic Security Blog* (December 3, 2011), <http://www.fas.org/blog/ssp/2011/12/chinanukes.php#more-5086>.

⁷ More about China's military strategy and the development of its nuclear forces can be found in the publications of Pavel Kamennov, the leading researcher at the Center for Economic and Social Research of the Institute of Far East Studies. For example: P.B. Kamennov, "China: the Principles of Active Defense," *Mezhdunarodnaya zhizn*, No. 4 (2010): PP. 40-56, http://www.ifes-ras.ru/attaches/Kamennov_China_Active_Defence.pdf.

⁸ L. Saalman, "China & the U.S. Nuclear Posture Review" (The Carnegie Papers, Washington: Carnegie Endowment for International Peace, Feb. 2011): P. 15.

⁹ Kumar and Vannoni, *Ballistic Missile Proliferation*, P. 17.

¹⁰ *SIPRI Yearbook 2011. Armaments, Disarmament and International Security*, ed. B. Gill, (N.Y.: Oxford University Press, 2011), P. 341.

¹¹ Office of Secretary of Defense, *Military and Security Developments Involving the People's Republic of China, 2011*, Annual Report to Congress (Washington, 2011) P. 78, http://www.defense.gov/pubs/pdfs/2011_cmpr_final.pdf.

¹² Kumar and Vannoni, *Ballistic Missile Proliferation*, P. 36.

¹³ H.M. Kristensen, R.S. Norris, and M.G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington: Federation of American Scientists, 2006), P. 60.

812th brigade, located 1,900 km from New Delhi, is equipped with 58 launch pads presumably for the Dong Feng 21.¹⁴ By some accounts, this brigade is of the greatest concern to India.¹⁵

Of the missiles that could be used in a nuclear strike on India, the Dong Feng 4 ICBMs, the Dong Feng 3A MRBMs, and the Dong Feng 21 (which has come to replace the Dong Feng 3A) are deployed on the 53rd and 56th bases.¹⁶ The first of these can be put into combat alert in 60-90 minutes, the second in 120-180 minutes,¹⁷ and the third in 10-15 minutes.¹⁸

The example of the Dong Feng 21, which has a flight time of 15-20 minutes depending on its trajectory¹⁹ (or, according to other estimates, 10-12 minutes²⁰), shows that India will have limited time to identify a nuclear missile threat and make a decision about how to respond. (Difficult weather conditions and the mountainous terrain in the region separating Chinese missile bases from India's territory reduce this time further.) Presumably, China views the possibility of a nuclear attack on India's administrative and industrial centers as a retaliation for the use of nuclear weapons by India first.²¹ This indicates a paradoxical situation. Both Beijing and New Delhi have committed themselves to no-first-use. In contrast to New Delhi, which has reserved the right to a nuclear response in the event of an attack on India or its "forces anywhere" using chemical or biological weapons,²² Beijing has pledged not to use nuclear weapons first under any circumstances.²³

According to the nuclear doctrines of China and India, these countries can inflict only retaliatory nuclear missile attacks on each other. However, the desire of New Delhi and Beijing to secure reliable nuclear capabilities may be indicative of their intention to acquire means of deterring each other, caused by doubts about each other's strict adherence to the commitment to no-first-use.

1.2. Pakistan²⁴

Unlike China, Pakistan has retained the right to mount a nuclear attack first. All of its missiles represent a threat to India. Out of about 360 missiles, approximately 100

¹⁴ H. Kristensen, "Extensive Nuclear Missile Deployment Area Discovered in Central China," *FAS Strategic Security Blog* (May 15, 2008), <http://www.fas.org/blog/ssp/2008/05/extensive-nuclear-deployment-area-discovered-in-central-china.php>.

¹⁵ "Massive Chinese Missile Site Uncovered," *Times of India*, May 16, 2008. This concern is further "stoked" by the activities of the People's Liberation Army that take place in relative proximity to the Indian border, and that are designed to enhance the combat effectiveness and coordination of Chinese military units in difficult high-altitude conditions. (For details, see: V. Kashin, "China Has Carried Out Exercises in Transferring Troops in a Mountainous Region with the Involvement of Mobilized Civil Aircraft," *Periskop.2: Novosti OPK i VTS Rossii*, April 12, 2012, <http://periscope2.ru/2012/04/12/5729/>).

¹⁶ K.L. Syroezhkin, *China: Military Security* (Almaty: Kazakhstan Institute of Strategic Studies Under the President of the Republic of Kazakhstan, 2008), P. 136; "China and Weapons of Mass Destruction: Implications for the United States" (National Intelligence Council, November 5, 1999), http://www.dni.gov/nic/confreports_chinawmd.html.

¹⁷ Swaine and Runyon, "Ballistic Missiles and Missile Defense," PP. 13-14.

¹⁸ "DF-21/CSS-5" (GlobalSecurity.org), <http://www.globalsecurity.org/wmd/world/china/df-21.htm>.

¹⁹ E. Hagt and M. Durbin, "China's Antiship Ballistic Missile," *Naval War College Review* 62, No. 4 (2009): P. 109.

²⁰ D. Wright and G. Kulacki, "Exaggerated Claims About China's Missile," *All Things Nuclear: Insights on Science and Security* (January 8, 2011), <http://allthingsnuclear.org/post/2652859551/exaggerated-claims-about-chinas-missiles>.

²¹ Swaine and Runyon, "Ballistic Missiles and Missile Defense," P. 48.

²² Ministry of External Affairs, *The Cabinet Committee on Security Reviews Operationalization of India's Nuclear Doctrine* (January 4, 2003), <http://www.mea.gov.in/mystart.php?id=530221>.

²³ Information Office of the State Council of the People's Republic of China, *China's National Defense in 2006: II. National Defense Policy* (December, 2006), [http://english.peopledaily.com.cn/whitepaper/defense2006/defense2006\(2\).html](http://english.peopledaily.com.cn/whitepaper/defense2006/defense2006(2).html).

²⁴ For details about the nuclear standoff between India and Pakistan, see: V.I. Sotnikov, *The Nuclear Problem in Indian-Pakistani Relations (Second Half of the Twentieth – First Half of the Twenty-First Century)* (Moscow: Nauchnaya kniga, 2003); *The Nuclear Standoff in South Asia*, ed. A.G. Arbatov and G.I. Chufirin (Moscow: Carnegie Moscow Center, 2005); P. Topychkanov, "Nuclear Weapons and Strategic Security in South Asia" (Working Paper No. 3, Moscow: Carnegie Moscow Center, 2011).

could have nuclear warheads, as Pakistan purportedly has 36-80 kg of weapons-grade plutonium and 1,100-1,400 kg of weapons-grade uranium – enough to produce twenty warheads from plutonium and 50-110 from uranium.²⁵

All of Pakistan's missiles can be equipped with either nuclear or conventional warheads, but, according to some reports, the country's military leaders have decided to use only conventional warheads on their Hatf-1 and Hatf-2/Abdali missiles (just as India has decided to use conventional warheads on their Prithvi-1 and Prithvi-2 short-range missiles).²⁶ In the absence of confidence-building measures between India and Pakistan in regard to their choice to equip missiles with either nuclear or conventional warheads, one party's launch of a missile with a conventional warhead could be mistakenly identified as a nuclear attack and cause a nuclear retaliation by the other party.

In peacetime, when both India and Pakistan maintain their nuclear forces in reduced combat readiness, such a scenario seems unlikely, since the amount of time it takes one side to bring its nuclear forces to high operational readiness is sufficient for the other side to evaluate the impact of the preceding missile attack. But in a state of conflict, when the parties may raise the level of readiness of their nuclear forces, such a scenario becomes more likely.

Only the Hatf-6/Shahen-2 MRBMs can hit targets throughout India. Presumably, all missiles of this class, of which there are about a dozen, are equipped with missile launchers.²⁷ The range of other missiles also allows Pakistan to threaten important military, administrative, and industrial centers in India, including the capital, New Delhi.

For example, the distance from the Pakistani Mushaf air base in Sargodha (Punjab) – where, according to some reports, Hatf-6/Shahen-2 and Hatf-3/Ghaznavi missiles are deployed²⁸ – to New Delhi is 581 km. According to rough estimates, the total flight time of a ballistic missile from the Pakistani air base to the Indian capital is eight minutes. In the event of a missile attack on Mumbai, the financial capital of India (Maharashtra), the flight time from the territory of the Mushaf air base is eleven minutes (over a distance of 553 km), while in the event of a strike on the Indian naval base in Thiruvananthapuram (Kerala), the duration is thirteen minutes (over a distance of 645 km).²⁹

Countering the Pakistani missile threat is complicated by the fact that their missiles can be launched from a number of bases – from four to eight – and from the surrounding areas. At the same time, India has a limited ability to determine the locations of missile launches in real time (see below).

In contrast to China, which aims its missiles only at the administrative and industrial centers of India, Pakistan also plans attacks on the Indian armed forces, including

²⁵ V. Moskalenko and P. Topychkanov, "Nuclear Pakistan: Possibilities of Neutralizing the Threats to the NPT Regime," *Russia: Arms Control, Disarmament and International Security*, IMEMO Supplement to the Russian Edition of the *SIPRI Yearbook 2009*, ed. A. Kaliadine and A. Arbatov (Moscow: IMEMO, 2010), P. 135.

²⁶ Kumar and Vannoni, *Ballistic Missile Proliferation*, P. 42.

²⁷ H. Kristensen, "Pakistani Nuclear Forces, 2007," *FAS Strategic Security Blog* (May 9, 2007), http://www.fas.org/blog/ssp/2007/05/article_pakistani_nuclear_forc.php. In 2007 Hans Kristensen suggested that Pakistan was preparing to deploy Hatf-6/Shahen-2 missiles, to which Tasnim Aslam, official representative of the Ministry of Foreign Affairs of Pakistan, said, "this is speculation, which contains some truth and some fiction." (Quoted from: "A Day Later, Pak Plays Down Report on GeNext N-Missile," *Times of India*, May 11, 2007).

²⁸ H. Kristensen, "Concern Over Pakistan's Nuclear Weapons," *FAS Strategic Security Blog* (April 25, 2009), <http://www.fas.org/blog/ssp/2009/04/pakistannukes.php>.

²⁹ Mian, Rajaraman, and Ramana, "Early Warning in South Asia," P. 115.

within its own territory in the event of an invasion.³⁰ A number of missiles are used for this, including the Hatf-9/Nasr currently undergoing development. According to official data, this missile has a range of 60 km, high accuracy, a multi tube launcher, and a “shoot and scoot” system.³¹

³⁰ Author’s interview with a government representative of Pakistan, who wished to remain anonymous. (Islamabad, October 27, 2010).

³¹ ISPR – Inter Services Public Relations, Press Release No. PR94/2011-ISPR, April 19, 2011, http://www.ispr.gov.pk/front/main.asp?o=t-press_release&id=1721.

2. THE MILITARY AND POLITICAL RATIONALE FOR MISSILE DEFENSE IN INDIA

After it conducted nuclear tests in 1998, India accelerated the pace of development of ballistic missile defense technologies, relying on its own resources and trying to obtain any lacking technologies through military and technical cooperation with other countries. According to estimates by SIPRI, in recent years Indian activity on the world market for arms and military equipment has been characterized by an increased interest in systems for the Air Force, air defense, and BMD.³² In the absence of an officially sanctioned long-term strategy for BMD, it is difficult to assess the end result sought by India. Despite its incomplete nature, India's nuclear doctrine makes it possible to determine the role that BMD should play in the system of national security.³³

For India, which has made a commitment of no-first-use, the ability to survive a nuclear attack is paramount. In order to gain a reliable retaliatory capability, India, as stated in its military doctrine, seeks to ensure the survivability of the nuclear arsenal and the effectiveness of command control, communications, computing, information and intelligence, and ground- and space-based missile early warning systems.³⁴

Major efforts in the early 2000s were directed at acquiring and developing technology specifically in these areas, as indicated, for example, by the purchase in 2001 of two Israeli Elta Green Pine multi-functional radars, part of the Arrow-2 BMD system.³⁵ At the same time, India began to study the feasibility of establishing BMD and cooperating with other countries in this area. Thus, since 2001 India has regularly discussed these issues within the framework of the U.S.-India Defense Policy Group.³⁶

In the mid 2000s, India's plans to build a comprehensive defense system against missile threats began to take shape. In November 2006, India successfully conducted the "Prithvi Air Defense Exercise," during which time an extra-atmospheric interceptor missile hit its target, a liquid-fuelled Prithvi-2 short-range missile, at an altitude of 50 km. After the tests, Vijay Kumar Saraswat, scientific adviser at the Defense Research and Development Organization (hereafter referred to as the DRDO), said, "We have successfully developed technology for [an] anti-ballistic missile defense system. As and when the country needs it, we can have our anti-missile defense system but it may take at least three to five years."³⁷ Since that time, the development of BMD technology has become a priority, which is confirmed by the words of A. P. J. Abdul Kalam, president of India from 2002 to 2007: "In the next two decades, antiballistic missile defense systems are going to [become] a major force, after which space systems and strategic military satellites will come in a big way, to guard against nuclear weapons attack[s]."³⁸

³² P. Holtom, M. Bromley, P. Wezeman, and S. Wezeman, "International Arms Transfers," *SIPRI Yearbook 2011* (Oxford: Oxford University Press), P. 281.

³³ For more regarding India's nuclear doctrine, see: R. Basrur, "On the Question of India's Nuclear Doctrine," *Perspektivy* (Moscow: Fond istoricheskoi perspektivy, January 1, 2007), http://www.perspektivy.info/oykumena/azia/k_voprosu_o_jadernoj_doktrine_indii_2007-01-01.htm#16; G.I. Chufirin, V.Ya. Belokrenitskii, V.N. Moskalenko, and T.L. Shaumyan, "South Asia," in *Nuclear Weapons After the Cold War*, ed. A.G. Arbatov and V.Z. Dvorkin 369-383 (Moscow: Rossiiskaya politicheskaya entsiklopediya, 2006); Sotnikov, *The Nuclear Problem in Indian-Pakistani Relations*, PP. 176-191; Arbatov and Chufirin, ed., *The Nuclear Standoff in South Asia*, PP. 13-16.

³⁴ "Draft Report of National Security Advisory Board on Indian Nuclear Doctrine, Released on August 17, 1999" (Pugwash Conferences on Science and World Affairs), <http://www.pugwash.org/reports/nw/nw7a.htm>; Ministry of External Affairs, *Cabinet Committee on Security Reviews Operationalization*.

³⁵ M.S. Barabanov, K.V. Makienko, R.N. Pukhov, and A.L. Rybas, *Russia's Military and Technical Cooperation with Foreign Countries: A Market Analysis*; ed. A.L. Rybas, 349 (Moscow: Nauka, 2008).

³⁶ Ministry of External Affairs, *Q. 433 Inclusion of India in US Missile Defense Programme* (July 15, 2004), <http://www.mea.gov.in/mystart.php?id=10058087>.

³⁷ "India Plans for Operational Missile Defense System Within 5 Years," *India Defence*, New Delhi, Dec. 3, 2006, <http://aeroindia.org/reports-2716>.

³⁸ "President Kalam Stresses Need for Missile Defense System," *India Defence*, New Delhi, Feb. 24, 2007, <http://aeroindia.org/reports-2902>.

In general, the military and political rationale for India's development of a missile defense system includes the following factors:

- The need to improve its nuclear forces' ability to survive a nuclear attack and create the potential for retaliation.
- The perceived vulnerability of administrative centers and military facilities to missile threats from potential adversaries, exacerbated by the unsatisfactory state of the country's air defense forces (see below).
- The authorities' desire to emphasize their ability to protect the population from external threats, which has an impact on the role of weapons. The weapons appear not only in the form of military capability, but also as a political symbol. This is confirmed by the fact that many Indian weapons systems are named based on references to religious or historical symbols (for example, Trishul, the name of a short-range air defense system, is a trident of Shiva.) The political context makes it possible to positively resolve the issues of the effectiveness and cost of BMD, even if from the military, technological, and economic perspectives these issues have no clear answer.
- India's desire to take a place among the world's leading countries, which explains its willingness to take on considerable expenses to bolster its military. Possessing BMD technology, along with nuclear missile technology, is perceived in India as being one of the attributes of these leading countries. By demonstrating success in developing these technologies, India is laying claim to membership in this small circle of states. For example, after the first PAD flight tests on November 27, 2006, Raj Chengappa, a columnist for the magazine *India Today*, wrote, "India has become the youngest member of a select band of nations – the US, Russia and Israel – who have the capability of developing missile defence systems."³⁹ And after testing the Agni-5 ballistic missile on April 19, 2012, officials stressed that India had joined the "elite club" of states possessing missiles with intercontinental range.⁴⁰
- The intention to use defense technologies for peaceful purposes. According to Apathukatha Pillai, head of the Russian-Indian joint venture BrahMos Aerospace, the Indian tradition has always focused on the fact that any scientific and technical programs should be aimed at the country's social and economic development.⁴¹

³⁹ R. Chengappa, "The New Guardian," *India Today*, December 11, 2006.

⁴⁰ "India Test-Fires Agni-V; Joins Elite Missile Club," *Deccan Herald*, April 19, 2012.

⁴¹ A.S. Pillai, *Technological Leadership: A Revolution in Management*, editorial, glossary, index, and layout B.A. Zagorulko and N.N. Samsonova 51 (New Delhi: Pentagon Press, 2011).

3. INDIA'S BMD AND AD: REQUIREMENTS AND CAPABILITIES

In assessing the prospects for missile and air defense in India, it is necessary to consider the principles of its organization: in what proportion should it combine the resources of area and point defense?

In India, both areas (Vulnerable Areas) and facilities (Vulnerable Points) are notable for their need to be covered by missile and air defense systems. According to Air Marshal Raghuram Rajan, in 1983, there were 101 such facilities and areas; in 1992, there were 122; in 1997, there were 133;⁴² and now there may be as many as 200.

The number of Vulnerable Areas undoubtedly includes the capital, New Delhi, where the country's political leadership resides – in particular, the prime minister, who heads the Political Committee of the National Command Authority (NCA), which is responsible for making the decision to use nuclear weapons. The NCA itself was originally located in the capital, but was then moved, presumably to a neighboring area.

An underground command post of the NCA is also located in the capital or in its suburbs. An auxiliary command post is possibly located in the south of the country.⁴³

If this is true, then it could be located close to the 333rd, 334th, and 335th missile groups, in which the Prithvi-1 and 2 (of the 333rd group) and the Agni-2 (of the 334th and 335th groups) are deployed. These groups are based near Secunderabad (in the state of Andhra Pradesh).⁴⁴

It is clear that these missile groups should also be included in the list of Vulnerable Points. According to Dean Wilkening, because the survivability of India's nuclear weapons is predicated upon an absence of information about the exact locations of the storage facilities that contain the nuclear warheads and delivery systems, area BMD is preferable to point BMD, as it makes it possible to avoid the precise localization of the protected facilities.⁴⁵

The same reasoning applies to the choice of area BMD to protect the capital and its surrounding suburban areas, where the NCA command post is located. According to Vijay Kumar Saraswat, two missile defense regiments that can protect a total area of 400 sq. km will be required to defend the capital region.⁴⁶ In addition, he says that BMD will be necessary to protect India's major cities (Mumbai, Kolkata, and Chennai) and other priority targets of potential adversaries.

Missile and air defense in border areas seems to complement area and point BMD, as evidenced by India's plans to deploy eight divisions by 2015 equipped with Akash medium-range SAMS, of which six will be deployed in the northeast of the country (in the direction of China), and two, most likely, in the country's western region (in the direction of Pakistan).⁴⁷

The realization of plans to develop missile and air defense by 2015 will require India to make significant capital investments in addition to exploring and developing new technologies (particularly in the area of missile early warning). Solving the last problem is complicated by the fact that it is difficult for India to obtain a number of mis-

⁴² A. Shukla, "First Akash Missile System to Fill Gap in Air Defence," *Business Standard*, November 23, 2010.

⁴³ J. Joseph, "The Retaliation Will Be Within Minutes," *Rediff India Abroad*, May 12, 2003, <http://www.rediff.com/news/2003/may/12spec.htm>; R. Kumar, *Indian Nuclear Command and Control Dilemma* (Monterey: Naval Postgraduate School, September 2006), P. 94; D. Mannan, "A Study of the Indian National Command Authority," *Bharat Rakshak Monitor* 6(2) (September-October 2003).

⁴⁴ P.V. Topychkanov, "The Bharat Dynamics Limited Corporation," *Eksport vooruzhenii*, No. 1(95) (2012): P. 53.

⁴⁵ Wilkening, "The Strategic Impact," PP. 214-215.

⁴⁶ "Major Cities to Get Missile Defense Shield," *Tribune*, December 12, 2007.

⁴⁷ "India Equips Itself with Akash Missiles through 2015," *Informatsionnyi portal PRO-PVO.RU*, February 17, 2010, <http://www.pro-pvo.ru/2010/02/17/akash.aspx>.

sile and air defense technologies through its military and technical cooperation with other countries. According to Apathukatha Pillai, in the name of maintaining control (over the weapons – *P.T.*), very often countries that really need technologies for self-defense or development are denied access to these technologies.⁴⁸

Examples of such restrictions are common to all of India's key partners in military and technical cooperation. For example, according to V. Komardin, head of the Russian delegation of the company Rosoboronexport at the Indian exhibition Defexpo India-2012, Russia offers India short- and medium-range air defense systems (such as the Buk-M2E and Tor-M2E SAMS, the Pantsir-S1 SAMGS, and the Igla-S SADW).⁴⁹ Contrary to the opinion of several Pakistani researchers,⁵⁰ Russia did not lease India an S-300 surface-to-air missile system (SAMS) under open military and technical cooperation. According to publications in the media, the issue of cooperation between Moscow and New Delhi on BMD has not been discussed at the highest level.

However, these limitations in Russian-Indian military technology cooperation may be reviewed in Russia, which is interested in maintaining solid positions on the Indian market. In Russian expert circles, there exists a view that there is a need to extend cooperation with India to technologies that cannot be sourced from any other country, including missile and air defense technologies. According to K. V. Makienko, deputy director of the Center for the Analysis of Strategies and Technologies, "the development of cooperation in the area of multipurpose nuclear submarines is very promising, as is the provision of assistance to India to improve the quality of their various ballistic missiles."⁵¹

India's cooperation with Israel extends to air defense, but not missile defense, due to U.S. opposition.⁵² The United States itself also restricts India's access to sensitive technologies, which is recognized by both parties. For example, former Minister of Defense Robert Gates admitted during his visit to India in January 2010 that there exist a number of regulations in his country that restrict the transfer of military technology to India. This was confirmed by Indian Minister of Defense Arackaparambil Antony after several cases in which U.S. authorities banned the export of military technology to India (these cases occurred after the signing of an agreement between India and the United States on July 20, 2009.)⁵³

Considering the limited resources and particularities of military defense cooperation with other countries in the field of missile and air defense, the most accessible option for India, according to Sanjay Badri-Maharaj, would be to create India's missile defense system on the basis of its existing air defense system.⁵⁴

The air defense forces, formed on January 10, 1994, were originally part of the Air Force, but on April 18, 2005, they were reassigned to the Army. Organizationally, they are divided into the Air Defense Ground Environment System (ADGES) and Base Air Defense Zones (BADZ). The basis of the latter consists of two anti-aircraft missile

⁴⁸ Pillai, *Technological Leadership*, P. 8.

⁴⁹ "Russia Will Help India Build BMD," *IA ROSBALT*, March 27, 2012, <http://www.rosbalt.ru/main/2012/03/27/961889.html>.

⁵⁰ Cheema, *Indian Nuclear Deterrence*, P. 291; Sultan, "Strategic Transitions," P. 31.

⁵¹ "Russia May Lose its Position on the Indian Arms Market if it Does Not Guarantee its Strict Compliance with Contracts – Expert," *Periskop.2: Novosti OPK i VTS Rossii*, <http://periscope2.ru/2011/10/04/4830/>. See also: V. Shukla, "Russia Should Help India in Developing N-Triad: Expert," *Indian Defence*, October 5, 2010, <http://www.indiandefence.com/forums/strategic-geopolitical-issues/1990-russia-should-help-india-developing-n-triad-expert.html>.

⁵² Author's interview with a former senior officer of Israel's Ministry of Defense (Tel Aviv, May 1, 2012).

⁵³ "Antony conveys India's concern over listing of defence firms by US," *Asian News International*, January 20, 2010.

⁵⁴ S. Badri-Maharaj, *Ballistic Missile Defence for India*, Bharat Rakshak, <http://web.archive.org/web/20071112050607/http://www.bharat-rakshak.com/IAF/Info/BMD.html>.

groups equipped with the 2K12 Kub SAMS (twelve regiments), 30 regiments with Bofors L40/70 anti-aircraft guns, four regiments with a 23-4 Shilka SPAAW, etc. These systems provide area air defense. Point air defense is provided by regiments equipped with such systems as the 9K35 Strela-10 SAMS and the 9K33 Osa SAMS. In addition, 30-40 squadrons are attached to the Air Force (see Table 2).

Table 2. Air Defense of India in 2011		
<i>Name of System (English Name)</i>	<i>Quantity</i>	<i>Notes</i>
Army		
Bofors L40/70 Anti-aircraft gun	>1900	30 regiments
SAM 2K12 <i>Kub</i> (SA-6 Gainful)	180	12 regiments
SAM 9K31 <i>Strela-1</i> (SA-9 Gaskin)	200	
SADW 9K32 <i>Strela-2</i> (SA-7 Grail)	620	Removed from service
SAM 9K35 <i>Strela-10</i> (SA-13 Gopher)	250	
SAM 9K33 <i>Osa</i> (SA-8A/B Gecko)	50	
SAMGS 2K22M <i>Tunguska-M</i> 2K22M1 <i>Tunguska-M1</i> (SA-19 Grison)	20 - >60	
SPAAW 23-4 <i>Shilka</i> (Zu 23-4)	75-100	4 regiments
AAI 23-2 (Zu 23-2)	320	5 regiments
SADW 9K38 <i>Igla</i> (SA-16 Gimlet)	>2000	
SAMS S-300 (SA-10 Grumble)	Unknown	There are reports that several squadrons are deployed next to the Homi Bhabha Nuclear Research Center in Mumbai (Russian sources do not confirm this)
SAMS 9K37M1 <i>Buk-M1</i> (SA-11 Gadfly)	50	According to Russian sources, India has not acquired this system, preferring Akash
AAI Oerlikon GDF	Unknown	
Army Reserve		
Bofors L40/60 Anti-aircraft gun	>1200	20 regiments
Air Force		
SAMS 9K33 <i>Osa</i> (SA-8B Gecko)		6-8 squadrons
SAMS S-125 <i>Pechora</i> (SA-3B Goa)		25-30 squadrons
SADW 9K38 <i>Igla</i> (SA-16 Gimlet)		4-10 flights

Note: This table includes only those systems that entered into service by 2011.

Sources: M.S. Barabanov, K.V. Makienko, R.N. Pukhov, and A.L. Rybas, *Russia's Military and Technical Cooperation with Foreign Countries: A Market Analysis*, ed. A.L. Rybas, 338, 351-352 (Moscow: Nauka, 2008); "Corps of Air Defence Artillery," *Bharat Rakshak*, <http://www.bharat-rakshak.com/LAND-FORCES/Units/Other/229-Air-Defence-Artillery.html>; *Indian Defence Yearbook*, ed. J. Singh, 230, 232 (New Delhi: Natraj Publishers, 2006); *The Military Balance 2012*, ed. J. Hackett, 244, 246 (London: The International Institute for Strategic Studies, 2012); "Missile Squadrons and Flights," *Bharat Rakshak*, <http://www.bharat-rakshak.com/IAF/Units/Others/289-MissileUnits.html>.

Sanjay Badri-Maharaj acknowledges that the air defense forces are in need of modernization; in his opinion, this would be worth taking advantage of to create a system

of missile and air defense.⁵⁵ The realization of such plans could be complicated by the fact that even on its own, modernizing the country's air defense may be too expensive. This could mean that it would not be possible to ensure sufficient funding for the creation of missile defense and early warning systems. According to a letter by General Vijay Kumar Singh, Army chief of staff, to Manmohan Singh, prime minister of India, almost 97 percent of India's air defense system is obsolete.⁵⁶

3.1. Developments in Air Defense

In the mid 1980s the government led by Prime Minister Indira Gandhi tasked the DRDO (founded in 1958) with conducting research and development work (R&D) in three areas, one of which concerned missiles of various classes, including anti-aircraft missile systems. Work in this area was carried out under the scope of the Integrated Guided Missiles Development Program, (IGMDP), which lasted from 1982 until 2007/2008.⁵⁷ The initial capital of the program amounted to 7.8 billion rupees (630 million dollars at the 1985 exchange rate).⁵⁸ During the development of India's missile technologies from 1980 to 1994, a transition occurred from a phase of technology adoption and inter-agency rivalries to the creation of a full-fledged program that united government agencies, businesses and factories, research centers, and private enterprise.⁵⁹

Development under the IGMDP of the Akash medium-range surface-to-air missile system (beginning in 1983) and the Trishul short-range SAMS led to limited success.⁶⁰ These projects were implemented with the use of both domestic and foreign technologies. In the Akash system, technology from the 3M9 surface-to-air guided missile (SAGM) of the Soviet 2K12 Kvadrat SAMS was used, and the Trishul used technology from the 9M33 SAGM of the 9K33 Osa SAMS.⁶¹

The first flight tests of the Akash SAMS were conducted in 1990, followed by a series of tests through 1997.⁶² In 1998, the SAMS started being tested against flying targets. In 2006, the system was transferred to the Indian Army for trials, where serious problems were revealed. Eliminating most of the identified deficiencies, together with DRDO lobbying efforts, reversed the situation by 2008, when trials of the Akash with the participation of the Air Force were deemed successful.⁶³

In the same year, the Air Force ordered two Akash divisions, including 32 launchers and 250 missiles, worth 12.2 billion rupees (267.4 million dollars at the 2008 exchange rate). Fulfillment of the order was entrusted to the Bharat Electronics Limited (BEL) corporation, which participated in the system's development (it developed the system's radar.)⁶⁴ At the end of 2008, it was announced that the Air

⁵⁵ Ibid.

⁵⁶ "97 Per Cent of India's Air Defence is Obsolete: Gen Singh, March 28, 2012," *Rediff News*, <http://www.rediff.com/news/slide-show/slide-show-1-ninety-five-per-cent-of-indias-air-defence-is-obsolete-gen-singh/20120328.htm>.

⁵⁷ For details about the IGMDP and the company Bharat Dynamics Limited, the main producer of missiles in India, see: P.V. Topychkanov, "The Bharat Dynamics Limited Corporation."

⁵⁸ Cheema, *Indian Nuclear Deterrence*, P. 262.

⁵⁹ G. Kampani, "Stakeholders in the Indian Strategic Missile Program," *The Nonproliferation Rev.* (Fall-Winter 2003): P. 56.

⁶⁰ Ibid., P. 60.

⁶¹ Barabanov et al, *Russia's Military and Technical Cooperation*, P. 351.

⁶² *Akash SAM*, Bharat Rakshak (January 17, 2009), <http://www.bharat-rakshak.com/MISSILES/sam/akash-sam.html>.

⁶³ V. Shcherbakov, "Delhi Has its Own *Nebo* Anti-Aircraft Missiles," *Nezavisimoe voennoe obozrenie*, March 27, 2009, http://nvo.ng.ru/armament/2009-03-27/1_india.html.

⁶⁴ R.V. Prasad, "Army Agrees to Acquire Indigenous Akash Missile," *Hindu*, April 14, 2010.

Force had ordered six additional Akash divisions for a sum of 35 billion rupees (716 million dollars), according to BEL data.⁶⁵

The Indian Army also expressed interest in the system. At a meeting of the Defense Acquisition Council on June 8, 2010, an order by the Army for twelve divisions (two regiments) of the Akash SAMS was approved. In March 2011, a corresponding agreement was signed between the Indian Army and Bharat Dynamics Limited (BDL), the main developer of missiles in India, including Akash. Under the agreement, the corporation must fully equip two regiments with 2000 missiles, launchers, radars, and other parts of the Akash system. The contract was for a sum of 140 billion rupees (3.2 billion dollars). The first batch of SAMS is expected in 2012.⁶⁶ The contract with the Indian manufacturer became the most expensive in the history of the Indian Armed Forces.⁶⁷

BDL has the capacity to produce 500 Akash missiles per year. The company plans to increase this amount, as evidenced by its purchase in fall 2011 of 500 acres of land in Amravati (Maharashtra). The BDL company, which will presumably focus on the production of SAMS in Amravati, will begin releasing military equipment here in 2015-2016.⁶⁸

In contrast to the Akash, development of the Trishul short-range SAMS ended in failure. More than 40 flight tests have been conducted since 1984, but their results have not satisfied the Indian Air Force, which has been the system's main purchaser. The Army questioned the ability of the Trishul to replace the 9K33 Osa system.⁶⁹

On February 27, 2007, Minister of Defense Arackaparambil Antony announced the completion of the Trishul project, which was given the status of "technology demonstrator" 2.8 billion rupees (65.9 million dollars at the 2008 exchange rate) had been spent on the project. By comparison, 5.2 billion rupees (122 million dollars at the 2008 exchange rate) had been spent on the Akash project.⁷⁰

Due to the problems with the Trishul project and its lag behind the Akash project, India decided to turn to foreign partners in order to purchase alternative systems. In 2005, an invitation for bids was put out for a short-range SAMS, which was won by the short-range SPYDER system produced by the Israeli company Rafael. In 2006, the Indian Air Force ordered six batteries with three systems in each. In 2007, an offset agreement was reached concerning the creation of an Indian-Israeli joint venture (JV) to produce eighteen SPYDER MR SAMS and develop other projects.⁷¹

But in 2008 the deal was revised by India in the wake of a corruption scandal, after which a temporary ban on contacts with Israeli defense companies was introduced.⁷² The new contract concluded in the same year with Rafael involves the supply of eighteen SPYDER systems for the Indian Air Force from the beginning of 2011 through August 2012. A licensing agreement is not expected.⁷³

⁶⁵ "India Eyes Producing More Akash Missiles, Bharat Electronics Expects Windfall," *Daily News & Analysis*, December 2, 2010.

⁶⁶ "Bharat Dynamics Limited Signs Largest Ever Deal With Army for Akash Missiles," *Defence Now*, March 28, 2011.

⁶⁷ "BDL Signs Deal with Army to Supply Akash Missiles," *Times of India*, March 26, 2011.

⁶⁸ Sh. Arya, "BDL to Set Up Missile Unit at Amravati," *Times of India*, November 3, 2011.

⁶⁹ *Trishul SAM*, Bharat Rakshak (January 17, 2009), <http://www.bharat-rakshak.com/MISSILES/sam/trishul-sam.html>.

⁷⁰ "India Shuts Down Trishul Missile Project," *Rediff India Abroad*, February 27, 2008.

⁷¹ Barabanov et al, *Russia's Military and Technical Cooperation*, PP. 130, 350.

⁷² "Israeli Missiles Will Cost India 2 Million Dollars," *Informatsionnyi portal PRO-PVO.RU*, March 26, 2009, <http://www.pro-pvo.ru/2009/03/26/israel.aspx>.

⁷³ "India Buys Israeli 'SPYDER' Mobile Air Defense System," *Defense Industry Daily*, August 19, 2009, <http://www.defenseindustrydaily.com/india-to-buy-israeli-spyder-mobile-air-defense-system-02702/>.

The second area of cooperation was initiated in January 2006 by an agreement between the DRDO and Israel Aerospace Industries (IAI) on the development of the Barak medium-range SAMS (this year, Israeli-Indian trade in military equipment reached a record 1.5 billion dollars.⁷⁴)

This project was developed further. At the end of 2009, in response to a parliamentary inquiry, Arackaparambil Antony named the cost of two projects between the DRDO and IAI: 1) the long-range surface-to-air missile (LRSAM) for the Navy – 26.1 billion rupees (560.7 million dollars at the 2009 exchange rate); 2) a medium-range surface-to-air missile (MRSAM) for the Air Force – 100.8 billion rupees (2.2 billion dollars).⁷⁵ According to some reports, the main work under the two given projects is being carried out by IAI on the Israeli side and the DRDO and Nova Integrated Systems – a JV between Tata Group and IAI – on the Indian side.⁷⁶

3.2. Creating a Missile Defense System

In the middle of the first decade of the 21st century, India's development of a missile defense system based on the Prithvi short-range missile came to light.⁷⁷ Presumably, work on the BMD system began in 1999.⁷⁸ The developed BMD system should consist of two parts: 1) Prithvi Air Defense (PAD) for intercepting targets outside the atmosphere; 2) Advanced Air Defense (AAD) for intercepting targets after they enter the atmosphere. Unlike the PAD system, which is based on the Prithvi missile technology, AAD was created in India "from scratch."⁷⁹

PAD is a two-stage missile that accelerates along the boost phase up to 1.7 km/s. The first stage is liquid-fuelled, while the second is solid-fuelled. The system is focused on ballistic missiles with a range of 300-2,000 km that can be intercepted at an altitude of 50-80 km and a range of 150-200 km. AAD is a single-stage solid-fuelled missile that accelerates along the boost phase up to 1.0 km/s. The interception can happen at an altitude of up to 30 km and a range of up to 30 km.⁸⁰

The first flight tests of PAD that hit a target at an altitude of 48 km were successfully conducted on November 27, 2006. During the second successful test on March 6, 2009, a modification of the PAD-2 was used, which had more powerful engines, improved control and guidance systems, and a 30-kg Gimbaled Directional Warhead. The system was tested in automatic mode. The target was destroyed at an altitude of 75 km. In contrast to the previous test, during which the Elta Green Pine Israeli radar was used, the 2009 test was conducted using an experimental radar called Swordfish. According to Vijay Kumar Saraswat, scientific adviser at the DRDO, the capability of PAD-2 was increased by 30 percent compared to PAD.⁸¹ In connection with these

⁷⁴ "Indo-Israel Military Relations" (Palestinian Grassroots Anti-Apartheid Wall Campaign), <http://www.stopthewall.org/downloads/pdf/Indo-Israel-D.pdf>.

⁷⁵ Press Information Bureau, Government of India, *Joint Development of Missiles* (December 14, 2009), <http://pib.nic.in/newsite/erelease.aspx?relid=55756>.

⁷⁶ "India Buys Israeli 'SPYDER'."

⁷⁷ Gh. Yasmin, *Missile Defence in South Asia: Implications for the Region* (Islamabad: Institute for Strategic Studies, 2006), http://www.issi.org.pk/journal/2006_files/no_3/article/a4.htm.

⁷⁸ Wilkening, "The Strategic Impact," P. 217.

⁷⁹ "Missile Defense: DRDO to Test Ballistic Missile Interceptor in June 2007," *India Defence*, New Delhi, May 9, 2007, <http://aeroidia.org/reports-3156>.

⁸⁰ "DRDO to Test High Altitude Missile Defense System in February 2011," *India Defence*, New Delhi, Jan. 20, 2011, <http://aeroidia.org/reports-4958>; Wilkening, "The Strategic Impact," P. 217.

⁸¹ "Missile Defense System Phase 1 to be Ready by 2011-2012: DRDO," *India Defence*, New Delhi, March 10, 2009, <http://aeroidia.org/reports-4267>.

tests, it became known that the system's developers had considered the possibility of intercepting the Russian RT-2PM2 Topol-M (SS-27) ICBMs with maneuvering warheads.⁸²

On December 6, 2007, India conducted its first successful test of the AAD system, which intercepted its target at an altitude of fifteen km. Inertial guidance was in effect during the initial part of its trajectory, and active radar homing kicked in during the final part of its trajectory. Radar tracking and target indication were provided by two Elta Green Pine⁸³ radar systems – or, according to other sources, Master A radar systems from the U.S.-French company ThalesRaytheonSystems.⁸⁴ After these tests, Vijay Kumar Saraswat reported that one missile defense battery can protect a region of up to 200 sq. km. Clearly, such a battery must include both PAD and AAD, which is confirmed by the intentions of the Indian developers to test the simultaneous interception of several targets both outside the atmosphere and after entering it.⁸⁵

A new series of BMD tests was conducted on March 15, 2010 (which failed due to the deviation of the target from the preplanned trajectory and the related failure of the interceptor missile's guidance system⁸⁶), July 26, 2010, and March 6, 2011 (which were successful). According to sources in the DRDO, the successful tests of 2011 make it possible to plan the deployment of BMD in India in 2015.⁸⁷ By this year, eight divisions equipped with the Akash SAMS are expected to be commissioned, of which six divisions will be deployed in the northeast of the country (in the direction of China), and two, most likely, in the west (in the direction of Pakistan).⁸⁸

3.3. The Development of Early Warning Technologies

By 2015 the country expects to get not only reliable interceptor missiles but also early warning systems, including radar and satellites. The rate of development of these systems forces India to treat these plans with caution. For example, the Swordfish long-range radar system was first tested in 2009, but in the very same year a decision was made to involve private companies in its development in order to enhance its effectiveness, and in particular, to increase its active range from a 600 km radius to 1500 km.⁸⁹ The given work was expected to have concluded by 2011,⁹⁰ but this was not confirmed officially.

The state of development of India's satellite systems does not inspire confidence concerning India's readiness to deploy space-based early warning systems in the near future. Of the 65 satellites that India has launched into orbit from 1975 to 2011, only 32 percent are capable of performing tasks related to observations of Earth (imaging, mapping, geodetic, and meteorological services).⁹¹ It is likely that only one of them

⁸² Ibid.

⁸³ S. Aminov, "India: Air and Missile Defense," *Vestnik PVO*, February 26, 2008, http://pvo.guns.ru/other/india/india_pvo_pro.htm; "Missile Defense: India Tests Supersonic Interceptor Missile," *India Defence*, New Delhi, Dec. 6, 2007, <http://aeroindia.org/reports-3641>.

⁸⁴ "Missile Defense: DRDO to Test Ballistic Missile Interceptor."

⁸⁵ "Major Cities to Get Missile Defense Shield."

⁸⁶ "India Conducted Unsuccessful Tests on the AAD Interceptor Missile," *Informatsionnyi portal PRO-PVO.RU*, March 15, 2010, <http://www.pro-pvo.ru/2010/03/15/aad.aspx>.

⁸⁷ "DRDO to Test High Altitude Missile Defense System."

⁸⁸ "India Will Have Akash Missiles Before 2015," *Informatsionnyi portal PRO-PVO.RU*, February 17, 2010, <http://www.pro-pvo.ru/2010/02/17/akash.aspx>.

⁸⁹ P. Abrar, "Indian Defence to Outsource Radar-Work and Battle Management System," *Economic Times*, December 2, 2009.

⁹⁰ P. Abrar, "Major Defence Deals up to Grabs," *Economic Times*, December 3, 2009.

⁹¹ Indian Space Research Organisation, *All Satellites*, <http://www.isro.org/satellites/allsatellites.aspx>.

is controlled by the Indian Air Force – the RISAT-2, developed jointly with the Israeli company IAI (launched into orbit on April 20, 2009). This is the first Indian satellite that is equipped with a radar that has a synthetic aperture, which allows it to take images in all weather conditions.⁹²

Prior to that, intelligence tasks were performed only by the Technology Experiment Satellite, which is equipped with a camera that takes panchromatic images with one-meter resolution, and an X-band radar with a phased antenna array (launched into orbit on October 22, 2001). The orbital period of both satellites is greater than 90 minutes, and the maximum view of the Earth's surface does not exceed 4 percent. Moving along a sun-synchronous orbit, these satellites are positioned constantly on the illuminated side of the Earth.⁹³ Clearly, the equipment installed on these satellites makes it possible to capture the movement of a potential adversary's troops and their military equipment, including mobile launchers, but not to warn of a missile attack.⁹⁴

⁹² "India Launches Key Spy Satellite," *BBC News*, Apr. 20, 2009, http://news.bbc.co.uk/2/hi/south_asia/8007653.stm?from=rssfeed); India Launches Spy Satellite RISAT-2 // *CNN-IBN*, Apr. 20, 2009 (<http://ibnlive.in.com/news/indias-spy-in-the-sky-isro-launches-risat2/90656-11.html?from=rssfeed>).

⁹³ For details about artificial satellites and orbits, see: P.V. Topychkanov, "Outer Space: Basic Principles," in *Outer Space: Weapons, Diplomacy, and Security*, ed. A. Arbatov and V. Dvorkin, Carnegie Moscow Center, 21-31 (Moscow: Rossiiskaya politicheskaya entsiklopediya, 2009).

⁹⁴ Mian, Rajaraman, and Ramana, "Early Warning in South Asia," P. 126.

4. THE PROBABLE RESPONSE TO INDIAN BMD (THE EXAMPLE OF PAKISTAN)

A number of Pakistani and Indian specialists are convinced that in the near future, Indian developments in missile defense cannot undermine the nuclear deterrence capabilities of potential adversaries.⁹⁵ However, India's success in the area of missile and air defense, together with the development of military technologies for missile, air, and naval forces, will undoubtedly play a role in doing so.

According to Zafar Nawaz Jaspal, associate professor of the School of Politics and International Relations at Quaid-i-Azam University, the effect of the development of India's missile defense on Pakistani-Indian relations is that it generates misperceptions, aggressive behavior by the state with the advantage, an arms race, and an increase in the combat readiness of the armed forces, including nuclear forces. According to the expert, these consequences of the negative impact of missile defense can lead to a rollback in the process of establishing confidence-building measures, to strategic instability, to escalated tensions, and even to war between India and Pakistan.⁹⁶

Pakistan's reaction to the creation and deployment of missile defense in India, according to Maria Sultan, director of the South Asian Strategic Stability Institute (in Pakistan), could be quantitative, qualitative, and asymmetric in nature:

- Pakistan's quantitative answer to India's growing capabilities could include the following measures: increasing the number of nuclear and conventional warheads for ballistic missiles; providing missile launchers with greater mobility; increasing the level of combat readiness of its nuclear forces; and purchasing air and sea-based systems, thus creating the potential for nuclear retaliation. However, according to Sultan, these measures could be counterproductive and dangerous, due to Pakistan's special geographical conditions, its lack of strategic depth, and the high population density in the region. In particular, maintaining nuclear forces in a state of high combat readiness makes an accidental nuclear exchange more likely.
- A qualitative response to India's development of missile defense could include the development of technology: first, to overcome missile defense, and second, to warn about an impending missile attack. The ability of these measures to adversely affect the strategic balance in Indian-Pakistani relations is less than that of the quantitative measures. However, a qualitative response is more costly for Pakistan, and therefore less accessible, due to financial and technological limitations (which does not apply to India's other potential adversary, China).
- Measures of an asymmetric nature include electronic warfare and sabotage operations for neutralizing specific systems in India. However, Sultan acknowledges that such measures could lead to a rapid escalation of a conflict.⁹⁷ This is confirmed by a number of interviews with authoritative experts in India. According to these experts, in this country the possibility of using nuclear weapons as a deterrent against any acts of Pakistani aggression has been discussed, even if it is a question of terrorist attacks that could be linked to the neighboring country.⁹⁸

⁹⁵ Author's interview with representatives of Indian and Pakistani government agencies, who wished to remain anonymous (New Delhi, October 5, 2011; Islamabad, October 3, 2011).

⁹⁶ Report of Zafar Nawaz Jaspal at a meeting of the Russian-Pakistani working group on nuclear policy on April 2, 2012 (Islamabad).

⁹⁷ Sultan, "Strategic Transitions," PP. 42-48.

⁹⁸ Author's interview with representatives of the Center for International Relations at the Observer Research Foundation and the Vivekananda International Foundation (New Delhi, October 22-26, 2010).

It is clear that a Pakistani response to India's deployment of missile and air defense systems against the backdrop of its development of nuclear and conventional weapons will be complex in nature. Since it has no interest in disturbing the strategic balance in the region, it should refrain from taking unproductive and dangerous steps that could cause an escalation of the conflict between India and Pakistan (similar to the conflict in Kargil in 1999).⁹⁹

But, first of all, Pakistan has a small arsenal of potential retaliatory measures, due to its limited resources. The most accessible measures it can take are quantitative and asymmetric. The growth of Pakistan's nuclear capabilities will mean the development of the associated infrastructure, which will require additional efforts from the state in the area of nuclear safety in order to prevent various incidents at the nuclear sites, including terrorist acts.¹⁰⁰

Second, Islamabad's refusal to take dangerous steps implies that New Delhi will also refrain from actions that Islamabad could interpret as destabilizing. Such actions could include, first and foremost, India's development of missile defense¹⁰¹ and the introduction of the so-called "Cold Start Doctrine," which does not actually reflect the military planning of the Indian Armed Forces.¹⁰²

In the absence of a bilateral agreement governing acceptable and unacceptable actions, and with a deficit of confidence-building measures between India and Pakistan, such mutual restraint on the part of these two countries is difficult to achieve.

⁹⁹ For details, see: M.S. Barabanov, "The Indian-Pakistani Conflict in Kargil," in *Chuzhie voyny [Foreign Wars]*, ed. R.N. Pukhov, 97-111 (Moscow: Tsentr analiza strategii i tekhnologii, 2012).

¹⁰⁰ For more on the threats of "vertical" and "horizontal" proliferation in Pakistan, see: P.V. Topychkanov, "The South Asian Standoff," in *The Nuclear Reset: Arms Reduction and Nonproliferation*, ed. A.G. Arbatov and V.Z. Dvorkin, 129-135 (Moscow: Rossiiskaya politicheskaya entsiklopediya, 2011).

¹⁰¹ The destabilizing impact on regional security of India's development of missile defense is recognized not only by Pakistan, but also by several Indian specialists (from the commentary of one of the leading physicists in India on the author's report given at the XXIV International School for the Study of Disarmament and Conflicts [Andalo, January 13, 2011]).

¹⁰² It is believed that the "Cold Start Doctrine" refers to the creation of forward based battle groups for rapid but limited preemptive/preventive or retaliatory strikes against enemy forces, including terrorist groups on foreign territory (from a report of Zafar Nawaz Jaspal at a meeting of the Russian-Pakistani working group on nuclear policy on April 2, 2012 [Islamabad]; "Nuclear Security and Nonproliferation in South Asia: Engaging India and Pakistan," [Carnegie Endowment for International Peace, November 17, 2010], <http://carnegieendowment.org/2010/11/17/nuclear-security-and-nonproliferation-in-south-asia-engaging-india-and-pakistan/2d4>). However, as is rightly noted by Ali Ahmed, research fellow at the Institute of Defense and Security Studies, this "doctrine" is not an official document of the Indian Armed Forces. (A. Ahmed, "Towards a Proactive Military Strategy: 'Cold Start and Stop,'" *Strategic Analysis* 35, No. 3 [May 2011]: P. 405).

CONCLUSION

This study makes it possible to draw a number of conclusions concerning the main factors contributing to and hindering the development of missile defense in India, as well as that system's possible architecture and the reaction of potential adversaries. India's development of BMD technology stems from its need to improve the survivability of its nuclear forces, to protect vulnerable areas and facilities, and to use it as a factor in its domestic and foreign policy. Missile defense is designed to demonstrate the strength, sophistication, and ambition of the Indian state. In addition, India's adoption and development of BMD will help the country reach a new technological level, which will benefit both the military and civil sectors of industry.

India does face obstacles on the path to having functional BMD, including its limited domestic resources and possibilities for obtaining the necessary technologies through military and technical cooperation with other countries. The air defense forces, which could be used as a foundation on which to build a missile and air defense system, are in poor condition, and updating them would require significant costs and time.

An important characteristic of the national debate in India is the existence of political consensus regarding the need for further development in the area of missile defense, while at the same time there is an absence of consensus among experts concerning the expediency of BMD, given the significant costs associated with it, along with the fact that it not only cannot guarantee the country's protection from missile and nuclear threats, but it also provokes new threats.

Because of the combination of positive and negative factors, the plans to deploy missile defense and modernize air defense by 2015 must be treated with great caution. Considering India's plans as a whole, it is possible to identify four levels of defense against missile attacks. The first two levels – PAD and AAD – should be integrated parts of BMD, while the second two – short- and medium-range anti-aircraft missiles – will probably be part of an independent system.

There is a view according to which the PAD level of missile defense is designed to protect India against threats from China and Pakistan, while air defense and the AAD level of missile defense should only provide protection against Pakistan.¹⁰³ However, India's plans to deploy divisions equipped with the Akash system along the Indian-Chinese border indicate that future four-tier defense, including PAD and AAD BMD as well as air defense should cover both potentially dangerous directions. Clearly, border-based air defense is designed to complement point and area missile and air defense. At the same time, the modern architecture of air defense, as well as statements by officials, suggests that area defense should play the primary role.

This study does not provide any confident answer to the question of whether the architecture of India's missile and air defense systems is responsive to regional conditions. It is clear that the variety of missile classes of potential adversaries, the close proximity to India of possible missile launch sites, and the difficult geographical and climatic conditions all greatly constrain India's capabilities in quickly detecting and eliminating missile threats. Therefore, in parallel with the development of missile and air defense technologies, India is forced to devote considerable effort toward developing strategic nuclear forces in order to achieve the possibility of making a retaliatory nuclear strike.

It seems that for India, it would be preferable if its potential adversaries responded

¹⁰³ Author's interview with the editor of one of India's leading newspapers, who wishes to remain anonymous (New Delhi, October 8, 2011).

to its projects symmetrically and predictably. A limited race in defensive and offensive weapons would allow the parties to maintain well-defined regional stability. It is doubtful that China's and Pakistan's responses will meet India's expectations.

In the case of Pakistan, it is clear that this state is more likely to choose a quantitative and asymmetric response, which is more accessible than a qualitative or symmetrical response. In addition, the expansion of India's nuclear capabilities and its desire to develop effective missile and air defense systems act as strong stimuli for China and Pakistan to deepen their cooperation – an extremely troubling situation for India.

In the foreseeable future, these countries will improve the effectiveness of their nuclear forces and, to the extent possible, develop their missile and air defense technologies. In the absence of regional confidence-building measures and conflict-resolution mechanisms, such unilateral actions could pose a serious threat, not only to regional stability, but also for the nonproliferation of nuclear and missile technologies, since there is a close relationship between the spread of missiles and missile technology and the further development of missile defense systems.

On the one hand, India's policy in this area demonstrates the dependence of its efforts to create missile and air defense systems on the status of the missile capabilities of other countries in the region (primarily China and Pakistan). On the other hand, India's deployment of missile and air defense will stimulate the development of these countries' missile capabilities, mostly in Pakistan. This dependence could manifest itself not only on a regional but also on a global level, in particular in the expansion of cooperation between Pakistan and China in the area of nuclear and missile technologies.

The rise of the regional and global threats associated with the development of the nuclear missile capabilities and missile and air defense systems in China, India, and Pakistan can only have negative consequences in the form of crises. Since Beijing, New Delhi, and Islamabad are interested in maintaining regional stability at a defined level and preventing uncontrolled arms races, mechanisms to maintain the balance of power, including control over offensive and defensive weapons and effective confidence-building measures, should meet their long-term interests.

For the moment, such mechanisms exist only between India and Pakistan.¹⁰⁴ Growing concern about the advancing capabilities of their potential adversaries and the intensifying threats of crises should encourage China, India, and Pakistan to build on existing mechanisms and develop new ones.

This task seems more realistic in the event that third-party states take it into consideration as they develop bilateral relations with China, India, and Pakistan, in particular in relation to military technology cooperation. Ignorance or neglect of their concerns by other countries could adversely affect regional security and prevent the three countries from maintaining regional stability at a well-defined level.

¹⁰⁴ For details, see: Topychkanov, "Nuclear Weapons and Strategic Security in South Asia," pp. 15-16.

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