Missile Threat Reduction and Monitoring in South Asia[1]

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Missile-based threats are becoming an ever-increasing element of the strategic landscape in South Asia. As India and Pakistan induct missiles into military units and push the performance envelope of missile capabilities, it is important to assess ways to limit the threats posed by these missiles. Regional stability with respect to missiles has both political and technical components. From a deterrence standpoint, striving to maintain some parity in capabilities could be a politically stabilizing factor in reducing the likelihood of conflict. Introduction of missiles might serve to correct imbalances in nuclear or conventional capabilities. On the other hand, as the inventories and types of missiles increase and as they are deployed, there could be an escalation of tension. These actions will result in more movement of systems, a rush to deploy new systems, the need for more testing, greater numbers of people with access to the systems, and the need for more distributed control. These and other factors raise concerns over system safety, security, and interpretation of intent. Together these developments serve to introduce instabilities that may outweigh the deterrence benefits.

Missiles are of primary concern because of their potential use as delivery vehicles for nuclear weapons. The short flight-times and lack of recall ability make them more destabilizing than aircraft-delivered weapons. Many of the military advantages of missile systems, such as mobility, speed, and long range make them weapons of choice. Transparency for missile programs may offer the prospect of building confidence and reducing threats. However, tradeoffs exist between providing transparency and risking vulnerability. These tradeoffs will be fundamental to missile discussions and agreements for years to come. Ultimately it must be decided that it is in the best national security interests of both countries to provide sufficient transparency, with its inherent risks, to avoid the even greater risks associated with misinterpretation, accident, or unauthorized use of missile systems.

This essay explores the concepts of missile control, especially missile non-deployment. It focuses especially on the role that monitoring technology and procedures could play in verifying controls or limits placed on the quantities, capabilities, or deployment of missile systems. With a history of conventional military conflict, and the demonstrated and declared nuclear weapon capabilities of India and Pakistan, it is vital that stability be maintained in the region.

[1] This work was supported by the United States Department of Energy through the Cooperative Monitoring Center at Sandia National Laboratories. Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

CONTEXT

India-Pakistan relations

India and Pakistan have never resolved their differences since both nations became independent in 1947. They have fought three major wars, beginning at the dawn of their independence. Other wars took place in 1965 and 1971. By many assessments, the 1999 conflict in Kashmir near Kargil can also be deemed to have been a war due to the intensity and large number of casualties. In addition, there is a long history of low-intensity conflict in Kashmir. Kashmir remains divided along a Line of Control that has existed with only minor changes since a cease-fire that ended the first major war. Diplomatic relations have been largely problematic with current formal interactions nearly non-existent. Even official commerce and trade between the two countries, which has tremendous potential, is very limited.

These factors are superimposed on a very dynamic political environment in which there have been frequent changes in leadership due to unstable domestic political alliances, assassinations, and in the case of Pakistan, military takeovers. The situation became even more tenuous in May 1998 when both nations exploded a series of nuclear weapons in underground tests to scientifically evaluate and politically demonstrate their capabilities as nuclear weapons states. These tests occurred outside the bounds of the Nuclear Nonproliferation Treaty to which neither India nor Pakistan is a signatory.

Against this backdrop, for nearly two decades the two nations have been developing and expanding their ballistic missile capabilities. These weapon delivery systems pose a risk of heightened tensions, inadvertent or accidental launch, and the prospect of use in a regional nuclear war.

Missile developments[2]

In 1983, India began a comprehensive missile development program known as the Integrated Guided Missile Development Programme. This program envisioned an intermediate-range (2,500 km) missile; a battlefield-support (150 km) missile; quick-reaction, surface-to-air missiles; and an anti-tank missile.[3] Of primary interest to this essay are the developments of the battlefield-support and intermediate-range missiles.

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[2] This section is a compilation of missile capabilities in the region, as reported in the public media.

[3] Nazir Kamal and Pravin Sawhney, "Missile Control in South Asia and the Role of Cooperative Monitoring Technology," SAND98-0505/4 (Albuquerque, NM: Sandia National Laboratories, October 1998).

The Prithvi (earth) is a single-stage, road-mobile, liquid-fueled battlefield missile. This short-range ballistic missile (SRBM) was first test-fired in 1988 and on 16 June 2000, India completed its seventeenth test firing of the Prithvi.[4] Several variants of the missile have been developed. The 150 km range army version is in service. A longer-range (250 km) air force version has also been developed. Under development is a 350-km variant of the Prithvi that will be used for naval purposes. This third variant, also known as Dhanush, may be solid fueled. Published reports in September 2000 indicated an Indian government decision to proceed with production of 300 Prithvi missiles.[5] The missiles were to be produced at the state-owned Bharat Dynamics Limited in Hyderabad. The army was to receive 150 missiles, the navy 100 missiles, and the air force 50 missiles. The Indian government later denied these reports.[6]

The Agni (fire) is a two-stage, intermediate-range ballistic missile (IRBM). The Agni missiles are designed to extend the reach of Indian nuclear capabilities, particularly to China. The Agni I technology demonstrator was first test-fired in May 1989. It had a nominal range of 1000 km. Its two-stage design consisted of a solid-fueled, first-stage motor based on the first stage of the satellite launch vehicle SLV-3 and the liquid-fueled second stage based on the Prithvi SRBM.[7] Two subsequent flight tests were conducted in May 1992 and February 1994. In August 2000, news reports indicated that India had ten Agni missiles and two prototypes of the Agni II.[8] The Agni II was first tested in April 1999. The two-stage Agni II "is a completely solid-fuel missile…. [T]he second stage (roughly 3m x 1m) solid motor has been designed anew specifically for the missile."[9] Reported range for the Agni II varies from 2000 to 2500 km. The most recent Agni II test in January 2001 reportedly struck its target at a distance of 2200 km.[10] In February 2001, Defence Minister George Fernandes said, "Agni II, which is capable of carrying nuclear weapons, is ready for induction into the defence arsenal."[11] The possibility of an even longer range Agni III, capable of reaching all of the population centers in China, has also been discussed.

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[4] Federation of American Scientists, 9 September 2000, Internet: www.fas.org/nuke/guide/india/missile/prithvi.htm.

[5] "India to Make 300 Prithvi Missiles," *The Hindu* (Online edition), 8 September 2000, Internet: www.the-hindu.com.

[6] "Govt. denies report on Prithvi Production," *The Hindu* (Online edition), 9 September 2000, Internet: www.the-hindu.com.

[7] "Developing a Delivery System," *Frontline* Vol. 16, no. 9 (24 April–7 May 1999).

[8] "Agni missile ready for serial production," News update service on Indiaserver.com, 29 August 2000.

[9] "Developing a Delivery System."

[10] "Agni II ready for induction: Fernandes," News update service on Indiaserver.com, 7 February 2001.

[11] Ibid.

Pakistan also has had an active missile acquisition and development program since the early 1980s. This includes indigenous missile development (based in part on foreign designs) as well as the reported purchase of 300-km-range M-11 missiles from China in the early 1990's, reports denied by Pakistan and China.[12] Both SRBMs and IRBMs exist and/or are in development. Within Pakistan are competing organizational interests in missile development as with nuclear weapon development. The Pakistan Atomic Energy Commission (PAEC), the Khan Research Laboratories, and the Space and Upper Atmosphere Research Commission all play a missile development role.

The Hatf-1 is an indigenous "single-stage, solid-propellant missile with a range of 60 to 80 km carrying a 500 kg payload."[13] It was first flight-tested in 1989 and a longer 100-km range variant was most recently tested early in 2000.[14] It is believed to be in service in limited numbers. Although it is reported to be able to accommodate "a variety of warheads."[15] its short range is unlikely to be used for nuclear warheads. A longer 280-km range two-stage Hatf-2 was made up of stacked Hatf-1 stages. This program appears to have been "halted due to technical problems."[16] However, there are some sources that show the system to be in service.[17] The Space and Upper Atmosphere Research Commission developed both systems.

As mentioned above, it is believed that China supplied M-11 (300-km/500-kg payload) missiles to Pakistan in the early 1990s. Indigenous variants were also developed. The Shaheen (Eagle) missile is based on the Chinese M-11 missile design with extended range. Work began in 1995, managed by the National Defence Complex, a PAEC subsidiary. A 1997 missile test (designated a Hatf-3) claimed to have an 800-km range. Some confusion exists on the relationship of the Shaheen to a 1997 missile test designated Hatf-3. "The claimed 750-km range of the Shaheen is roughly double the standard range of

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12 "Pakistan Rejects Reports on Missiles," *Associated Press*, 3 July 2000.

13 Federation of American Scientists, 9 March 2000, Internet: http://www.fas.org/nuke/guide/pakistan/missile/hatf-1.htm.

14 "Pakistan test-fires Hatf-1 missile," *Dawn: The Internet Edition*, 8 February 2000, Internet: www.dawn.com.

15 Ibid.

16 Federation of American Scientists, 23 March 2000, Internet: http://www.fas.org/nuke/guide/pakistan/missile/hatf-2.htm,

17 "Pakistani Ballistic Missiles," *PakistaniDefence.com*, 21 May 2001, Internet: http://wahcantt.www8.50megs.com/Missile/PakMissile.html.

the Hatf-3/M-11, and is consistent with the range of the much larger Chinese M-9."[18] This 750-km range single-stage IRBM was tested on 15 April 1999.[19]

A more capable variant, Shaheen II, has also been developed and is awaiting flight-testing. Shaheen II is a two-stage, solid-fuel missile capable of carrying a heavier warhead of 1000 kg to 2500 kg to a range of 600 km. In December 2000, Chief scientist of the PAEC, Dr. Samar Mubarik Mand "informed the authorities that Shaheen-II was ready for test firing."[20] A pair of Shaheen-II ballistic missiles were displayed during the Pakistan Day parade in Islamabad on 23 March 2000. "The Shaheen-II is evidently a Pakistani version of the Chinese M-18."[21] Recently, "Pakistan has claimed that the medium range Shaheen-I and the intermediate range Shaheen-II ballistic missiles were not only in 'regular production' but have already been inducted into the army."[22]

A parallel IRBM effort under the direction of the Khan Research Laboratories is the Ghauri missile program. Ghauri-I is a liquid-fuel single stage 1000-km missile. The Ghauri-II is a liquid-fuel, two-stage missile with a claimed range of 2300 km. The Ghauri-II was first flight tested on 6 April 1998. Pakistan used the Hatf-5 label for both the Ghauri I and II.[23] Ghauri is believed to be derived from the North Korean Nodong missile design. The Ghauri-II was again flight tested in April 1999. An even longer range Ghauri-III based on the North Korean Taepo Dong was thought to have been tested in August 2000.[24] The Ghauri-III would have a range of nearly 3000 km. "The Ghauri name is highly symbolic and taken from a Muslim historical figure, Sultan Muhammad (Shahubiddin) Ghauri who defeated the Hindu ruler Prithvi Raj in the last decade of the 12th century. 'Prithvi' is the name India has assigned to its short-range ballistic missiles. Thus, Pakistan is attempting to manipulate public perceptions and show that it has developed a credible response to Indian missile capabilities."[25]

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[18] Federation of American Scientists, 9 September 2000, Internet: http://www.fas.org/nuke/guide/pakistan/missile/hatf-4.htm.

[19] Federation of American Scientists, 9 September 2000, Internet: http://www.fas.org/nuke/guide/pakistan/missile/hatf-3.htm.

[20] *Dawn Internet Edition*, 19 December 2000, Internet: www.dawn.com.

[21] Federation of American Scientists, 9 September 2000, Internet: http://www.fas.org/nuke/guide/pakistan/missile/shaheen-2.htm,

[22] Muralidhar Reddy, "Pakistan claims Shaheen inducted into army," *The Hindu*, 27 January 2001.

[23] "Pakistan's ballistic response," *Frontline* Vol. 16, no. 9 (24 April–7 May 1999).

[24] Muralidhar Reddy, "UFOs were Ghauri-III fragments," *The Hindu*, 24 August 2000.

[25] "Ghauri Missile," 9 September 2000, Internet: http://www.pakmilitary.com/army/missiles/ghauri.html.

Even longer-range Pakistani missile development efforts with names such as Tipu, Ghaznavi and Haider have been reported. Clearly missile developments in both Pakistan and India are moving forward quickly and extensively.

Strategic and tactical concerns

The South Asia context presents its own set of unique issues and challenges when it comes to evaluating the threat and concerns associated with ballistic missiles and their proliferation. Following are some of the key parameters in the missile calculus of South Asia.

Short time of flight

Ballistic missiles currently represent the fastest means for delivery of weapons from one country to another. In a matter of a few minutes, a missile can cover a distance of hundreds of kilometers. For example reports of the 1999 flight test of the Ghauri-II indicated that "the missile reached the targeted distance of 1,165 km in 12 minutes."[26] The use of even shorter-range missiles makes it possible for attacks on national capitals to be carried out in less than five minutes.

Response times

India and Pakistan, who share a nearly 3000-km land boundary, are especially affected by the short response times associated with missile threats. Cities such as Lahore and Amritsar are only tens of kilometers from the border. Islamabad is less than 100 km from the border and even Delhi is less than 400 km from the border. Given that missile flight times themselves are only a few minutes, warning times are even less due to the time required for sensors to detect the missile already in flight. Response times are further reduced because of delays in communicating to decision makers, assessing information, making decisions, and finally giving orders on how to respond. It is likely that this process might not be completed before a threatening missile has reached its target. It also may result in a launch-on-warning posture in which countries respond prematurely before having time to fully assess the warning information received. At present India has declared a no-first-use policy for nuclear weapons. Pakistan has not adopted such a policy due to perceived conventional military asymmetries. While there is an

[26] "Pakistan Test Fires Ghauri-II," *The News* (Pakistan), 15 April 1999.

asymmetry in strategic depth between India and Pakistan, the fact that each country has critical assets near the border means that they both face potentially short response times in the case of missile attacks.

Accidents and misinterpretation

Concerns over misinterpretation of missile launch data are real. During the Cold War, there were a number of incidents involving accidents and misinterpretations related to nuclear weapons and delivery systems. One example of misinterpretation of missile-related data cited by Scott Sagan was the 1979 inadvertent placement of a training tape showing a missile attack into the live warning system.[27] Six minutes were needed to assess the threat before determining it was false. While that was sufficient time in the context of longer range US/USSR intercontinental missile threats, such time would not be available with the short flight times associated with the Indian and Pakistani missiles. Another incident in 1980, which resulted from a failed computer chip, again led to a false indication of missile attack.

In 1995, Russian officials misinterpreted a missile launch conducted as a joint Norwegian–Amercian research rocket study of the northern lights. Despite prior notification, Russian authorities did not get the word and used their internal hotline link to discuss a possible retaliatory strike.[28] Thus, given the small but real likelihood of false warnings, it is essential that India and Pakistan institutionalize the practice and procedures associated with adequate communication, launch notification, and anomaly resolution.

China factor

No discussion of the missile relationship of India and Pakistan could be complete without acknowledging China's role. China and India are rivals and have long-standing political and territorial disputes. In 1962, India fought a border war with China, losing large tracts of border land. In a letter to President Clinton following India's nuclear tests in May 1998, Indian Prime Minister Vajpayee wrote:

> I have been deeply concerned at the deteriorating security environment, specially the nuclear environment faced by India for some years past. We have an overt nuclear weapon state on our borders, a state which committed armed aggression against India in 1962. Although our relations with that country have improved in the last decade or so, an atmosphere of distrust persists mainly due to the unresolved border problem. To add to

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[27] Scott D. Sagan, *The Limits of Safety: Organizations, Accidents and Nuclear Weapons* (Princeton: Princeton University Press, 1993).

[28] Elaine Monaghan, "Russia, US, Cut Risk of Inadvertent Nuclear Strike," *Reuters*, 16 December 2000.

> the distrust that country has materially helped another neighbour of ours to become a covert nuclear weapons state. At the hand of this bitter neighbour we have suffered three aggressions in the last 50 years.[29]

The future of missile defenses remains a contentious issue in China and South Asia, as elsewhere. There are currently no effective anti-missile defense systems in South Asia. This increases the importance of the potential for devastation in the event of accidental or unauthorized launch of a missile since such attacks cannot be defended against. Decisions by the United States and others to deploy missile defenses may also impact regional missile proliferation in China and South Asia.

Unconfirmed reports of Chinese missiles poised to strike India from Tibet have also been circulating for years. India's Agni II missile has a range of up to 2500 km,[30] enabling it to reach critical portions of China. There are also positive, although tenuous, signs in the Sino-Indian relationship. Two border agreements were signed in the past decade.[31] High-level diplomatic visits between the two nations have increased. However, near the end of a visit by Chinese leader Li Peng to India in January 2001, India tested its latest long-range Agni missile system.

Pakistan has a strong missile connection with China. Chinese M-11 missiles were reportedly shipped to Pakistan in the early 1990s. Most other Pakistani missiles are believed to be variants of established Chinese or North Korean missile designs. Suspected Chinese assistance with the missile and nuclear programs of Pakistan has been a great source of political tension between India and China. This issue continues to be in the news. In its semiannual report to Congress on arms proliferation, the Central Intelligence Agency stated "Chinese missile-related assistance to Pakistan continued to be substantial during this reporting period."[32]

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[29] "India's Letter to Clinton on Nuclear Testing," *New York Times*, 13 May 1998.

[30] "India Successfully Tests its Nuclear-Capable Agni II Ballistic Missile," Carnegie Endowment for International Peace, 18 January 2001, Internet: www.ceip.org/files/nonprolif/templates/article.asp?NewsID=86.

[31] Agreement on the Maintenance of Peace and Tranquility in the Border Areas Along the Line of Actual Control, Beijing, 7 September 1993; Agreement Between the Government of the Republic of India and the Government of the People's Republic of China on Confidence-Building Measures in the Military Field Along the Line of Actual Control in the India–China Border Areas, New Delhi, December 1996.

[32] Bill Gertz, "China Aids Pakistani, 'Rogue' Missile Programs, CIA Says," *Washington Times*, 27 February 2001.

MISSILE THREAT-REDUCTION AND MONITORING

While the situation in South Asia is unique in its history, geography, culture, and strategic concerns, there are some lessons to be learned from experiences in other parts of the world, including the US–Soviet relationship during the Cold War. The analysis presented here is intended to illustrate what is possible rather than prescribe what should be done.

This essay introduces a framework for evaluating ways to reduce and monitor the threats posed by ballistic missiles in South Asia. In the following sections a number of concepts are outlined for achieving these objectives. The effectiveness of each concept would depend on a complicated mix of political, technical, and operational factors. The goal is to achieve greater stability while reducing threats. There is a role for both transparency and opacity in missile threat reduction. Transparency is needed for information to be shared as a result of treaties or less formal agreements. Such information may include everything from force levels to testing plans.

While most of the emphasis here is on transparency and ways of sharing information to increase stability, sometimes, choosing not to share information could serve to enhance stability. Information that figures heavily in a country's deterrent strategy is not likely to be revealed. This includes items as diverse as system deployment locations, system vulnerabilities, and performance capabilities.

For any choice of action or piece of information related to South Asian missile programs, a matrix of data sharing and stability impacts needs to be assessed. When choosing actions or deciding on sharing information, choices should be based on stabilizing effects. In each case a decision needs to be made on whether being transparent or opaque would enhance stability. Generally, transparency would lead to greater stability when the following criteria are achieved as a result of providing information:

- Increased symmetry of forces and/or capabilities
- Increased warning time/Reduced likelihood of preemption success
- Reduced likelihood of misinterpretation of intent
- Minimized vulnerabilities for either side

Figure 1 shows examples of actions or information that fit the different quadrants of a stability matrix. The destabilizing examples emphasize asymmetries in capabilities and failure to reveal important information that could lead to misinterpretation. The stabilizing examples reveal actions intended to avoid misinterpretation and to minimize vulnerabilities to critical assets.

Figure 1: Example Stability/Transparency Matrix

DEMONSTRATE EXPANDED MISSILE RANGE AND PAYLOAD CAPABILITIES **(promote arms race)**	**PROVIDE MISSILE LAUNCH NOTIFICATION** **(avoid misinterpretation)**	**TRANSPARENT**
AVOID DIALOGUE ON MISSILE ALERT STATUS DURING CONVENTIONAL ARMED CONFLICT **(risk misinterpretation)**	**AVOID REVEALING COMPLETE LIST OF WARHEAD STORAGE LOCATIONS (minimize vulnerabilities)**	**OPAQUE**
DESTABILIZING	**STABILIZING**	

Actions and declarations could be unilateral or reciprocal in nature. Sometimes it is in the best interest of one's own security to act unilaterally, e.g., to avoid misinterpretation of intent. Likewise, in the case of asymmetrical forces, decisions to unilaterally re-deploy forces or reduce force strength could help to build confidence and promote dialogue without jeopardizing national security. Bilateral actions are those which by mutual agreement enhance the stability of both sides as a result of the action or data sharing.

The attempt here is not to be prescriptive but to outline a series of options for utilizing transparency to reduce threats. Specific proposals, timing and political motivation would determine the ultimate path forward on missile transparency.

Infrastructure needs

Communication systems form a necessary backbone for threat-reduction and monitoring. The process of managing missile possession in tense regions demands a reliable, secure, dedicated, and timely communications infrastructure. With the short timelines involved and the potential for misinterpretation of data or messages, it is vital that potential adversaries have a trusted means for communicating with one another. This communication may take the form of declarations and notifications, or may consist of sensor information from a verification system.

Such communication may consist of voice messages, sensor or other data, images, or text messages. The system may take the form of a "hotline" between military or political leaders. Between India and Pakistan, a hotline does exist between Directors-General Military Operations. However, a national command authority-dedicated hot line has not been a permanent feature of India–Pakistan relations. Such communications appear necessary to deal with time-critical issues of interpretation of missile-related information. Indian and Pakistani leaders acknowledged the importance of communication in a 1999 Memorandum of Understanding (MOU). In the memorandum, the Foreign Secretaries agreed that, "The two sides shall undertake a review of the existing communications links (e.g., between the respective Directors-General Military Operation) with a view to upgrading and improving these links, and to provide for fail-safe and secure communications."[33]

Another communication network may also be considered for transmission of routine missile-related information. The Nuclear Risk-Reduction Center (NRRC) that exists between the United States and states of the former Soviet Union is an example of such a system. The NRRC serves as a clearinghouse for treaty-related information exchanges.

Communication will be reassuring if there is trust in the validity of the information provided. Technical means could be employed to verify the authenticity of the data and messages. Use of encryption or data authentication would permit the recipient of data to know the specific source of information. Accuracy of the information, however, would be dependent on the need for periodic independent assessments of information from other sources such as intelligence data or on-site inspections.

Declarations and notifications

Public declarations could be stabilizing or destabilizing, as a previous Stimson Center report has noted:

> Well chosen words delivered in public declarations by national leaders can serve to reassure neighbors, demonstrate good will, reinforce common interests, open lines of communication, break deadlocks, and promote regional stability and security. Public

[33] Text of the Memorandum of Understanding signed by the Indian Foreign Secretary, Mr. K. Raghunath, and the Pakistan Foreign Secretary, Mr. Shamshad Ahmad in Lahore, 21 February 1999, Internet: www.indianembassy.org/South_Asia/Pakistan/mou(lahore01211999).html.

declarations can also be used to reinforce enemy images, mobilize for war, as well as other negative pursuits.[34]

On the positive side of the equation, declarations and notifications could be useful confidence-building measures (CBMs) associated with missile development and deployment. Missile quantities, movements, test launches, and exercises may be declared in order to avoid the risks associated with misinterpretation of intent. The value of such notifications was recognized in the 1999 Lahore Memorandum of Understanding, which stated, "The two sides undertake to provide each other with advance notification in respect of ballistic missile flight tests, and shall conclude a bilateral agreement in this regard."[35]

Shortly after the Lahore MOU, missile tests were conducted that followed the "spirit of Lahore." For example, in April 1999 the following Indian news item appeared: "But determined to preserve the Lahore momentum, India informed Pakistan and the great powers of the impending Agni test on April 9 two days before the event."[36] Similarly, in Pakistan, reports of a Foreign Office statement on the subsequent Ghauri missile test stated, "Pakistan had given prior notification of this test to India in accordance with the Memorandum of Understanding signed in Lahore in February."[37] Despite the conflicts and animosity that have surrounded India–Pakistan relations since the time of Lahore, this provision of launch notifications continues to be implemented in the absence of a more formalized agreement. For example, in January 2001 India tested its Agni II missile. "The Indian government said other countries, including neighboring China and Pakistan, were given advance notice of the Agni test, which was conducted hours before China's second most powerful leader Li Peng left for home after a nine-day visit."[38] In addition to providing test flight notifications, agreements to notify movement or repositioning of missile forces might also be considered. Such notification could add to confidence-building and minimize misinterpretation of motives.

While declaratory measures have the potential to build confidence among parties, deliberate attempts at misinformation or disingenuous declarations could serve to undermine security and confidence. As P.R. Chari has noted, "In the case of India and Pakistan, national leaders have

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[34] Michael Krepon, Jenny S. Drezin, and Michael Newbill, eds., *Declaratory Diplomacy: Rhetorical Initiatives and Confidence-Building*, Report 27 (Washington, DC: The Henry L. Stimson Center, May 1999).

[35] Ibid.

[36] "Missile Tests and the Lahore Spirit," *The Hindu: Online Edition*, 14 April 1999.

[37] "Pakistan Test-Fires Ghauri-II."

[38] Sanjeev Miglani, "India Tests Nuclear-Capable Agni II Missile," *Reuters*, 17 January 2001.

occasionally made positive declarations, but to little effect. The empirical evidence suggests that confidence-building measures, including positive declaratory statements, have been difficult to initiate and sustain in the Indo–Pakistani milieu."[39]

Notification agreements have been and continue to be an important element of US–Russia nuclear cooperation. Discussions continue between the United States and Russia to further expand the notion of communications and data sharing:

> The pre- and post-launch notification system envisages a data center opening in Moscow and builds on agreements to share early warning information signed in 1998 and June 1999…. The two countries agreed back in 1991 under START I, the first in a series of Strategic Arms Reduction Treaties slashing nuclear arsenals, to tell each other about launches of intercontinental and submarine-launched ballistic missiles…. (the recent) memorandum of understanding expanded on this to include shorter-range ballistic missiles, sounding and research rockets and most space launch vehicles.[40]

Also noteworthy is that under the agreement other countries will be invited to participate in the notification system. Specifically, considering Indian and Pakistani participation in this system could provide an initial framework for cooperation.

Non-deployment and de-alerting

The goals of missile non-deployment and de-alerting are to reduce the tensions and risks associated with missile systems that could be readily employed. This includes reducing the likelihood of accidental or unauthorized use and increasing the time required to make the system operational.

The status of missile development and deployment is a key issue in regional strategic stability, nonproliferation, as well as weapon system safety and security. Generally, deployed weapons systems are those that have reached a necessary level of technical maturity and reliability, have been issued to operational military units, are in place in appropriate positions, and can therefore be available on short notice to be used by those units in support of military objectives. Non-deployed and less fully deployed systems lack some or all of the above criteria.

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[39] P.R. Chari, "Declaratory Statements and Confidence-Building in South Asia," in Krepon, Drezen and Newbill, eds., *Declaratory Diplomacy*.

[40] Elaine Monaghan, "Russia, US, Cut Risk of Inadvertent Nuclear Strike," *Reuters*, 16 December 2000.

For example, systems that lack sufficient development and testing to be used reliably are not assigned to operational units and are not available for military use. Some systems may have been sufficiently tested but are still in the process of being deployed with operational units and could not be used militarily in a short time. In this case, more training and familiarity is needed to integrate the weapon into the war fighting capabilities of the military and to be considered deployed. Limited deployment is another variant. Deployments could be limited in terms of numbers or location. For instance, deployment with an operational military unit whose location is out of range of an enemy is a form of limited deployment.

Finally, de-alerting measures have been defined as "reversible actions taken to increase the time or effort required to launch a…ballistic missile."[41] These measures are designed to prevent accidents or unauthorized use, and also serve to slow the deliberate or intended use of a weapon system by requiring time to fully re-deploy the system. In this case the hardware, training, and missions are clear but operational roadblocks to use are intentionally put in place.

The degree to which missiles are deployed is primarily a political decision. Other factors such as technical development, training, and perceptions of threat may also play an important role in the timing of missile deployment.

Disassembly and storage

One aspect of non-deployment or de-alerting is storage of the major missile components or systems. Deployment would require movement of items out of storage. Storage and subsequent movement provide opportunities for monitoring. Questions exist on the degree of intrusiveness that would be permitted for such monitoring. Items placed in declared storage locations can be monitored by a combination of inspections and technical monitoring means.

Complete weapon systems could be stored fully assembled. The fact that they are stored rather than deployed in an operational sense is one level of de-alerting. One could further de-alert the missiles by removing or disassembling critical components. The fact that reassembly or reinstallation is required makes the system more inherently safe and reduces the likelihood of unauthorized use. Components that have been removed or disassembled could be co-located or stored at separate locations. Status of storage and level of assembly of these systems could then be subject to monitoring and inspection. This assumes

[41] Michael W. Edenburn et. al., "De-Alerting Strategic Ballistic Missiles," Cooperative Monitoring Center Occasional Paper/9, SAND98-0505/9 (Albuquerque, NM: Sandia National Laboratories, March 1999).

that monitoring agreements on storage and disassembly involve the declaration of storage sites and some level of intrusiveness in permitting monitoring or inspection of those sites.

Technical monitoring of storage areas involves use of a number of sensor types to detect activity level in or around the facility. Under terms of a missile non-deployment or de-alerting agreement, such activity may be prohibited or require advance notification. Ground sensors such as seismic, magnetic, or acoustic sensors could be used to detect movement around the facility perimeter or on access roads leading to the facility. These data could be collected and stored on site and sent by radio, satellite, phone, Internet or other communication means to agreed parties anywhere in the world. Similarly, facility-monitoring sensors such as door switches, motion sensors, or electronic seals could be used to detect entry or activity in the facility. Use of sensor-triggered video systems, which capture a digital image when another sensor is activated, could be used to better characterize any detected interior or exterior event. Use of appropriate data authentication or encryption techniques could provide necessary security to the data collected and transmitted.

Facility-monitoring of sensitive facilities, such as International Atomic Energy Agency (IAEA) safeguarded sites around the world, has been conducted with tags, seals, and video recording systems for many years. The tags have been used to uniquely mark controlled items. Seals have been used to indicate any tampering with containers, monitoring equipment, or portions of the facility that have been closed and sealed. Video systems have been based on periodic recording of video images in nuclear facilities of interest. In each of these cases, the technologies are a supplement to a regular program of on-site inspections. The tags and seals are checked by IAEA inspectors and the video tapes removed at times of inspections and returned to Vienna for review by inspection officials.

More recent experiments between the U.S. Department of Energy and the IAEA have demonstrated the use of sensor-triggered video in a number of countries. These systems provide more timely data and may also reduce the needed inspection frequency. Such use of technology and inspections might play a similar role in the confidence-building associated with missile-monitoring in South Asia. If missile agreements could be reached there may be a need to define monitoring regimes and to conduct baseline inspections associated with initial agreement declarations. In addition, follow-up inspections on a periodic or challenge basis might also be necessary to build sufficient confidence in the notification of activities and successful operation of monitoring systems.

Another form of disassembly and de-alerting is maintaining liquid-fueled missiles in an unfueled condition. This minimizes the likelihood of accidental or unauthorized use. Before a missile could be launched, a time-consuming process of fueling must take place. The activity levels associated with the vehicles and crews necessary to do the fueling also provide an added monitoring signature. While this option exists for some South Asian missiles such as the Indian Prithvi and Pakistani Ghauri, many of the other systems are solid fueled and do not require this added step prior to launch.

Non-deployment areas and missile movements

Restricting deployment of missile systems from specific geographic locations is another control mechanism to limit threats. For shorter-range missiles, decisions to remove the missiles away from borders and out of range of the other side could build confidence and reduce the potential threat level. Much as a demilitarized zone (DMZ) is intended to provide some cushion to avoid rapid conventional military escalation, so this missile DMZ could provide a buffer against rapid escalation to the use of battlefield missiles. These actions could be taken cooperatively or unilaterally.

As an example, in 1997 it was reported that India had moved Prithvi missiles to locations near Jullundur in Punjab adjacent to the border with Pakistan.[42] However, the subsequent warnings and political impacts in the region and internationally caused India to reconsider. "India has shown subsequent good sense by physically removing them (Prithvis) to Secunderabad."[43] This, in effect, creates a unilateral non-deployment zone near the border for these systems. Non-deployment CBMs could therefore begin with such unilateral declarations or actions and later progress towards more formalized agreements including provisions for cooperative monitoring.

Monitoring of such a zone could be conducted by commercial observation satellites, national technical means, periodic inspections, or by cooperative aerial monitoring. In addition, declared storage locations could be monitored by means of on-site sensors and camera systems.

The Open Skies Treaty is a model for cooperative aerial overflights in the context of the Conventional Forces in Europe (CFE) Treaty. It permits jointly staffed aircraft to fly over the territory of another state in order to confirm the absence of prohibited military buildups. This multilateral agreement was only recently ratified in Russia and now becomes eligible for entry into force. However, over the past decade many trial flights over the U.S., Russia, and Europe have taken place. On a smaller scale, the bilateral open skies regime established between Hungary and Romania might prove to be a more valid precedent for consideration by India and Pakistan. In either case, the goal would be to establish protocols for periodic or challenge overflights of the missile non-deployment regions to confirm the absence of missiles. Challenges will be to establish timely overflights and to deal with concern over intentional

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[42] R. Jeffrey Smith, "India Moves Missiles Near Pakistani Border," *Washington Post*, 3 June 1997.

[43] Raja Menon, *A Nuclear Strategy for India* (New Delhi: Sage Publications, 2000), 202.

concealment of missiles. A comprehensive monitoring regime would employ several monitoring techniques to enhance confidence in the agreement. The use of tags to uniquely mark inspected missiles could help ensure compliance with agreed notifications of missile movements.

Launch barriers

Another technique proposed to de-alert a missile system is the use of launch barriers. These physical or electronic systems would be designed to add time to the process of reconstituting missile forces. If attempts to remove the barriers were monitored, the time delay would give an adversary added warning time; time that would be devoted to peacefully resolving disputes before further escalation. As with most concepts for cooperative monitoring, there are varying degrees of intrusiveness associated with monitoring systems. The benefits to stability need to outweigh the vulnerability risks of permitting direct monitoring of missile positions and status.

Physical barriers would be designed to delay access or prevent movement. One example might be a massive weight such as a block of concrete that is placed in front of a storage bunker for warheads or missiles. This weight would have to be removed to gain access to the storage area. Use of remote monitoring systems that included sensors such as pressure switches, motion sensors, and/or cameras could be put in place to monitor such movement. The time delay introduced by the presence of the barrier would permit detection and opportunity for those monitoring the bunker to raise concerns or prepare their own response.

Another example of a physical barrier might be an attachment on the missile or missile launcher that makes it inoperable without first being removed. In addition to providing added security against unauthorized or accidental launch, the status of this “lock out” mechanism could also be monitored to provide advanced warning to an adversary of potential threats.

Introducing electronic components to prevent immediate use might also be possible. Timers could be employed that require a fixed time interval before opening or unlocking the missile system or a physical barrier. Similar technologies are integrated, for instance, into bank vault doors that cannot be opened outside of authorized banking hours. While these launch barrier concepts are technically feasible, there are no significant precedents for their use in missile monitoring.

De-targeting and self-destruct options

De-targeting involves putting harmless target coordinates into a missile guidance system. In this case, any accidental or unauthorized launch of a missile system would cause it to land in areas that would not harm individuals or provoke retaliation by an adversary. Examples could include targeting to broad ocean areas or uninhabited territory within one's own country. While this is primarily a symbolic gesture and would be difficult to verify, as a unilateral measure it could provide significant value in event of an accidental or unauthorized missile launch.

A precedent for de-targeting was established in January 1994 when President Clinton and Russian President Yeltsin agreed in the Moscow Declaration that they would "direct the de-targeting of strategic nuclear missiles under their respective commands so that by May 30, 1994, those missiles will not be targeted." [44]

Self-destruct features are intended to permit manual or automatic destruction of a missile that is on an errant trajectory or which may have been launched unintentionally. "There are no precedents for using these measures on operational missiles, but self-destruct commands have been used for safety purposes on U.S. missile test ranges since the beginning of the U.S. missile program."[45] The missile test flights are so equipped in order to avoid risk to civilian populations in the case of a missile error or malfunction. By extension, this concept could be applied to ballistic missiles in the possession of military forces. Attempting to control a missile after it is in flight is one form of de-alerting and also overlaps with command and control functions.

Other limits and controls

In addition to the non-deployment and de-alerting concepts presented, it is important to acknowledge other ways in which to reduce the threats posed by ballistic missiles in South Asia.

Quantity limits

The proliferation of numbers as well as types of missiles would increase the chances of accidents, unauthorized use, and crisis instability. Many of the Cold War nuclear arms control treaties between the

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[44] Text of Moscow Declaration by President Clinton and Russian President Yeltsin, Moscow, 14 January 1994.

[45] Michael W. Edenburn et al., "De-Alerting Strategic Ballistic Missiles."

United States and the former Soviet Union were based on limits on delivery systems rather than warhead limits. It is possible to set quantity or production limits designed to limit the magnitude of the missile threat. In those cases, production monitoring and inspection to ensure compliance with agreed limits could be implemented. Under the Intermediate Range Nuclear Forces (INF) Treaty, the United States and Russia have maintained production monitoring equipment and personnel at missile production sites in each other's countries for thirteen years. This was done in order to ensure that no further production was carried out of the Russian SS-20 and US Pershing missiles banned under terms of the treaty. In these cases, portal/perimeter monitoring was conducted that permitted an assessment to be made of shipments exiting production facilities. Production areas inside of the facilities were not inspected. Therefore, in considering any monitoring regime, the areas to be monitored are subject to negotiation and mutual agreement. Under terms of the INF treaty, these extensive inspection provisions are scheduled to end in May 2001.[46]

Setting limits not only on production but also on total inventories of missiles would require more intrusiveness to develop high levels of confidence in compliance. In this case the number of weapons systems of a particular type that exist would be declared, then a baseline inspection process undertaken to confirm the declaration. It might be necessary to uniquely identify the items inspected using high-security tags to ensure the accuracy of the count. Any items discovered subsequently without tags would be in violation of the agreement.

Enforcing quantity limits might also necessitate monitoring missile destruction. Agreeing on approved methods for missile destruction and elimination would be required if reductions in missile inventories were agreed upon. A variety of elimination methods would be employed. Cutting, exploding, or even launching missiles as test flights have been agreed on in past treaties as means for reducing missile inventories. The goal in each case is to ensure sufficient loss of capability that the missiles designated for destruction cannot again be repaired for use.

Capability limits

Another means for reducing the escalating threats associated with missiles is to place limits on the capabilities or types of missiles developed. Capability limits would include such items as size, range, payload capacity, or multiple warheads. Agreeing early to such limits could limit the scope of any missile arms race before it starts down another path. Similarly, decisions to limit basing schemes for missiles, such as sea or submarine launched systems, could also limit the scope of the concerns.

[46] Stephanie Nebehay, "U.S., Russia Agree to End INF Missile Inspections," *Reuters*, 14 December 2000.

As in the case of the INF treaty, capability limits in South Asia could seek to eliminate or prevent development or deployment of an entire category of missile system. Compliance determination with such an agreement would require inspections to verify the absence of any restricted systems. Depending on the nature of the restrictions, it might also be possible to provide technical monitoring at production facilities to ensure no production of prohibited items.

Missile trade limits and the Missile Technology Control Regime

Because missile systems are not necessarily indigenous products, control of missile threats must address the commerce of missiles. Beginning in 1987, seven countries met to establish the Missile Technology Control Regime (MTCR). At present thirty-two countries are participants. The regime recognizes the role that trade plays in missile proliferation. The MTCR set guidelines for commerce in missile-related technologies and components. Both India and Pakistan have been impacted by MTCR guidelines.

An important element of missile control in South Asia would be the need to address the role of third countries in assisting missile programs in India and Pakistan. This is clearly a sensitive issue and one that most likely will come much later in any missile dialogue between the two countries.

Administrative and technical use control

The threat posed by missile and weapon systems could be reduced if more extensive administrative and technical use control measures are implemented. Use control measures are those procedures, hardware items, or software that limit or restrict access or use of a weapon system. Use control systems could be effective in preventing not only external threats to unauthorized use but even to control use by those who are authorized. An example is use of a permissive action link (PAL) that requires two authorized individuals to work together to gain access to the system or enter commands for its use.

The generally highly classified nature of weapon use-control systems makes their cooperative implementation unlikely. However, unilateral implementation of use-control principles could help safeguard missile systems within each country and reduce the likelihood of unauthorized use.

Some have suggested that the nuclear-weapon states recognized under the Non-Proliferation Treaty (NPT) share information on nuclear command and control with India and Pakistan as a means for enhancing safety and security. Lingering concerns over Indian and Pakistani nuclear testing and their position outside of nuclear treaty regimes make such cooperation difficult. Debates over providing support for command and control will continue.

Verifiability of CBMs

Not all CBMs lend themselves to independent verification. Policies such as "No First Use" and "De-targeting" are difficult to verify. In some cases the starting point for cooperation and introduction of CBMs may be unilateral rather than cooperative. For example, choosing to share test flight information, even unilaterally, could prevent misinterpretation and preemption on the part of the other side. Similarly, storing liquid-fueled missiles unfueled, or separating warheads from missiles decreases the likelihood of accidents or unauthorized use whether both sides agree to the idea or not.

Finding ways to confirm unilateral actions through cooperative measures should help to build confidence and further reduce the likelihood of unintended consequences. As more CBMs are proposed or implemented there would be a need to provide greater levels of verification to ensure compliance with agreements. Verification might come in the form of manned inspections of production, storage, test, or deployment locations. It might also include ever more capable sensor systems designed to detect and characterize activities of interest. Assessing activity levels, monitoring movement, and providing unique identifiers for equipment are examples of applicable technology tools. Ensuring reliability and integrity of data collected would be essential to establishing confidence in monitoring systems. There is no single correct way to implement these concepts. Rather, monitoring options would be based on a complex set of criteria that are both technical and political in nature. It is possible to start slowly and increase the extent and sophistication of monitoring as experience dictates.

Synergism among CBMs

While no monitoring system is 100 percent effective, the goal is to design a system with sufficient redundancy, and a variety of human and sensor measurement capabilities to provide high levels of confidence in the monitoring results. While many of the missile non-deployment and limitation CBMs have been presented as single, unique options, they could be combined to create more complete missile control regimes in the subcontinent. For example, notifications of missile test launches could be augmented with invitations to permit observers to view the test launches. Unilateral declaration of non-deployment zones for missiles could be enhanced with permitted inspections to verify the absence of missiles in the area. Agreements to store missile components could be verified with on-site monitoring technologies that are designed to detect entry into the storage facilities. Similarly, a layered use of monitoring systems makes efforts to circumvent their purpose more difficult. As more layers of CBMs are implemented, a greater confidence level could be achieved.

Not only is it important to evolve adequate mechanisms for verifying missile agreements, it is also necessary to ensure adequate mechanisms for addressing disputes that arise. If anomalies or violations are detected, it is incumbent on the parties to seek adherence to agreement obligations, peaceful resolution of disputes, and escalation control. This is especially true in a nuclear and missile-equipped South Asia.

Importance and next steps

Possessing missile systems carries with it multiple risks, including accidents, misinterpretation of threat, and unauthorized use as well as the potential for theft or loss. Missiles also pose the risk of extreme devastation associated with a nuclear detonation or the health risks associated with less catastrophic, non-nuclear detonations which scatter nuclear materials. Therefore, political leaders must place a high priority on controlling missile threats in South Asia.

The concepts described represent a wide range of possibilities. However, political will and other factors do not make all of these notions equally likely in the near term. Figure 2 summarizes the ideas presented and the sequence in which they might be implemented.

Figure 2- Missile Threat Reduction Time Frames

Near Term	Mid Term	Long Term
• Begin missile dialogue • Establish/expand data sharing communications infrastructure • Provide and formalize missile launch notifications • Maintain unilateral non-deployed missile status including non-deployment areas • Seek other means for minimizing misinterpretation, e.g. trajectory of test launches	• Set missile capability limits • Formalize limits on missile trade • Implement and monitor launch barriers • Establish and monitor missile non-deployment zones • Provide declarations of missile force structures/quantities • Define and conduct missile monitoring experiments	• Establish and monitor missile quantity limits • Monitor system or component removal and missile de-alert status • Verify missile use control • Formally establish or participate in missile control regimes

The first step must be a willingness to address the issues. Establishing a dialogue on missile threats is essential. Initially, the dialogue could be limited in scope with more issues addressed as success and conditions warrant.

Next, it is important to limit adverse consequences from systems that are already in place and that could create instability in the short term. Formalizing notification processes that prevent surprise or misinterpretation are among the highest priorities. Also, agreeing to maintain missile systems in a non-deployed and/or de-alerted state minimizes the safety, security, and use-control risks associated with maintaining missiles on alert. Structuring missile tests with flight trajectories away from the other country could also be useful in minimizing chances of misinterpretation of threats. Working to establish the necessary infrastructure for sharing information accurately and in a timely manner is also essential.

Expanding the dialogue to address possible monitoring options in support of missile limits will be important. Due to the great distrust that characterizes India–Pakistan relations it is important that adequate verification be incorporated in missile agreements. Without it, agreements might not be reached or could flounder in their implementation. Non-threatening experiments could be proposed to build confidence in technical monitoring and inspection procedures. This "try before you buy" concept could help in structuring acceptable agreements to limit missile threats. The process of working together on such experiments could itself be a CBM.

Finding ways to limit the vertical proliferation of missile capabilities within the region could also be productive. It is generally easier to agree not to do something than to reverse that which has already been done. Examples of such limits might include agreeing to not have multiple independently targeted reentry vehicles (MIRVs) or not to have surface-ship or submarine-based nuclear missile capabilities. Beginning the process of implementing specific control agreements on activities, quantities, production, testing, deployment, storage, use control, trade, and other elements of a missile life cycle would further the aim of regional stability.

In the absence of a dialogue on these issues, it is still important for both sides to carefully consider unilateral actions that enhance stability. This has been done in the case of missile launch notifications. Expanding these unilateral CBMs may be an effective first step in leading to the establishment of a bilateral or multilateral dialogue.

CONCLUSIONS

South Asia continues to be viewed as among the most volatile regions in the world. The escalation of missile development in the subcontinent serves to further undermine regional stability.

There is a need to begin to work to set limits on missile proliferation in the region and to provide stability mechanisms for systems that already exist.

The process must begin with a political will to address the missile issue. Elements of the Lahore Agreement in 1999 showed evidence of that political will. Subsequent informal efforts to share missile launch information are a step in the right direction. Continued progress would involve establishing the necessary infrastructure for information sharing and dispute resolution. Providing formalized notification processes and agreeing to set limits on missile quantities, deployment, and basing would contribute to tension reduction.

Establishing a missile threat reduction dialogue might lead to a framework for risk-reduction measures. Agreement on monitoring and verification mechanisms would be an important element of moving forward on setting limits and minimizing threats. Using a variety of technologies and inspection protocols, missiles could be monitored and inspected throughout their life cycles from development to final retirement or disposition. This process would require some level of intrusiveness. A careful balance must be struck between the benefits and risks of transparency to achieve stability.

Prior to formalized agreements, unilateral measures or limited scale cooperative experiments could be undertaken to demonstrate and evaluate the effectiveness of monitoring options. The potentially devastating consequences of accidents, unauthorized use or misinterpretation of threats require that India and Pakistan find common ground for dialogue and action.