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Reassessing Nuclear South Asia

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Introduction

by MATTHEW A. ROSENSTEIN

In his 2004 memoir *Engaging India: Diplomacy, Democracy, and the Bomb*, Strobe Talbott describes the reaction in Washington, DC after US officials first learned that India had detonated several nuclear devices in the desert in the Indian state of Rajasthan. Talbott, who was Deputy Secretary of State during Bill Clinton's presidency, explains that with its May 1998 nuclear tests, India graduated from its previously permanent status of "merely important" to "urgent" on the American diplomatic agenda. Despite calls for restraint, Pakistan followed India with nuclear tests of its own later that month. One can reasonably assert that both India and Pakistan have consistently commanded serious, if not perpetually urgent, attention from the United States and the international community ever since.

This issue of *Swords and Ploughshares* examines the impacts that can be discerned today, twelve years later, from the decision in 1998 by India and Pakistan to make their nuclear weapons capabilities overt. Topics such as the military balance between the two countries and their relative positions within the global strategic power structure inform the discussion here. This collection of articles also seeks to characterize South Asia's nuclearization particularly within the context of several new developments that have occurred since May 1998, and which have either already altered the regional and global security landscapes, or promise future qualitative shifts, including:

- a military conflict between nuclear-armed India and Pakistan (the 1999 Kargil War), as well as multiple full-scale army mobilizations on both sides during later periods of high tension;
- the September 11, 2001 attacks on New York and Washington, the resulting war on terror against Al Qaeda and the Taliban in Afghanistan and Pakistan, and stepped up US economic aid to Pakistan in exchange for its cooperation in the war;
- the exposure of Pakistani scientist A.Q. Khan's elaborate nuclear proliferation network;
- the strengthening of the strategic partnership between India and the United States, including their agreement to engage in civilian nuclear trade;
- domestic political changes in Pakistan, India, and the United States, with the parties in the ascendancy having shifted in the latter two cases, while in Pakistan civilian democratic governance was restored in 2008 after nine years of military rule under General Pervez Musharraf;
- and calls for renewed commitment to global nuclear disarmament efforts, signaled by US President Barack Obama's Prague speech of April 2009.

This publication starts from the premise that the passage of twelve years offers sufficient time to draw some conclusions about the motives for the 1998 nuclear tests, their meaning, and the implications for not only the India-Pakistan relationship but also the global nonproliferation regime. In the first article, P.R. Chari provides a thoughtful retrospective on the political climate that led to the 1998 tests by India and Pakistan, as well as the incremental steps that the two countries took towards nuclear weapons development in the preceding decades. The author goes on to explore the question of whether India and Pakistan have sufficient confidence in their nuclear weapons designs in order not to require further testing. Chari also touches on whether nuclearization has increased or decreased stability between India and Pakistan, an important problem that has concerned military strategists in both countries and the international scholarly community alike. With every crisis—Operation Brasstacks in 1986–87 (during what were undoubtedly "latent proliferation" stages for both India and Pakistan); the 1999 Kargil conflict; and the aftermath of the terrorist attacks in December 2001 on the Indian parliament and in November 2008 on Mumbai, both attributed to Pakistani-based militants—questions are raised about whether the presence of nuclear weapons encourages military adventurism or, conversely, fosters restraint, and whether each rival can truly know the other's "red line," the crossing of which might instigate a nuclear strike. Chari suggests that the jury is still out on these questions.

In the next article, Bharath Gopalaswamy and Moeed Yusuf highlight the diverse strategic and technical considerations that contribute to the fashioning of a *de facto* nuclear weapons state. While India has enunciated a relatively clear nuclear doctrine, Pakistan has found strategic benefits from keeping its nuclear posture deliberately ambiguous. In addition to discussing the policy aspects that both sides have taken into account in constructing their doctrines,

Gopalaswamy and Yusuf describe the recent historical and current research and development activities on delivery systems by India and Pakistan. While the 1998 tests showed that both countries had sufficient fissile materials, scientific knowledge, and engineering mastery to achieve nuclear explosions, the demonstrated ability to deliver the bomb to an adversary's territory constitutes another essential part of nuclear deterrence. As the authors show, both India and Pakistan have invested heavily in their missile programs over the past decade. With the corresponding higher level of precision, reach, and destructive capacity, they caution, comes an even greater obligation to ensure that confidence building measures are implemented to avoid catastrophic mistakes.

A central US and international concern in the post-9/11 environment has been the security of Pakistan's nuclear weapons complex. Rizwan Zeb cautions against singular preoccupation with Pakistan, however, while giving other nuclear-armed states a free pass. One major thread of his argument essentially derives from the dictum "people who live in glass houses should not throw stones." To be sure, Pakistan has a particularly dangerous mix of radicalism, weak governance, and a growing nuclear arsenal, all points which Zeb acknowledges, leading him to cite conventional wisdom on perceived threats to Pakistan's nuclear security. Nevertheless, he reminds us, the United States and Russia have their share of "loose nukes" episodes as well. As another line of argument, Zeb offers up that while Pakistan has gained notoriety for the nuclear black market activities of A.Q. Khan, the father of its bomb, people tend not to acknowledge that no similar activities have come to light since Khan's house arrest; the country's highly trained professional military has instituted a robust command and control structure, making theft or accidents far less likely; and Pakistan has acceded to several multilateral agreements expressly designed to enhance nuclear safety and security. Zeb implies that although there is more work to be done, the situation may not be as dire as commonly presented.

Another significant development that invites a reassessment of nuclear South Asia is the agreement, announced in 2005 and approved in 2008, between the United States and India to engage in civilian nuclear cooperation. Dinshaw Mistry examines two major criticisms that have been directed at the agreement, namely its potential to undermine the global nonproliferation regime and to incite a regional nuclear arms race. Mistry's analysis carefully points out that the end results are not foregone conclusions, but rather depend quite a bit on how the specific parameters of the nuclear deal are interpreted over time by India and other countries, and what additional nonproliferation steps might follow through proactive efforts to address the concerns that have been raised. Mistry also points out that there are possible positive consequences, with increased pressure on India to refrain from further nuclear testing, and increased cooperation across numerous sectors between India and the United States. Mistry closes the article with detailed accounting of the economic and environmental implications of the agreement.

Pakistan and India did not sign the 1968 Nuclear Nonproliferation Treaty (NPT), effectively meaning that for over forty years the two South Asian rivals have rejected the norms of global nonproliferation efforts. As officials from both countries have intimated, however, they see little shame in bucking an international regime that only serves to promote what then-Indian Minister for External Affairs Jaswant Singh referred to as "nuclear apartheid" in a 1998 *Foreign Affairs* article. Indeed, one cannot dismiss the fact that the indefinite extension of the NPT in 1995, while interpreted as a success in some quarters, from the perspective of others merely signaled that the existing nuclear weapons states would defer indefinitely their commitment to disarm fully. Nevertheless, once again momentum has been growing to pursue arms control and disarmament steps more earnestly, including calls from President Obama and numerous other high-profile public figures to make the complete abolition of nuclear weapons the ultimate goal. In the final article of this issue, T.S. Gopi Rethinaraj and Clifford Singer discuss a particularly crucial instrument for reversing the trend towards further nuclear proliferation, a fissile materials production cutoff treaty, or FMCT. The authors provide a thorough analysis of the key stumbling blocks to achieving a breakthrough on an FMCT, before evaluating the fissile inventories and options of India and Pakistan as two critical players in the debate. Rethinaraj and Singer are cautious in their forecast for success in arriving at a treaty or at least a fissile material production moratorium. Nevertheless, the potential approaches they outline invite policymakers from India, Pakistan, and the international community to resist allowing inertia to dictate the terms of their diplomatic efforts. Fittingly, and consistent with the messages to be found in each of the articles in this issue, the authors note that the leadership in both India and Pakistan can make conscious choices towards reducing nuclear tensions, but the burden is not theirs alone and must also be encouraged by parallel gestures from the United States, Russia, China, and other states possessing or pursuing nuclear weapons.

Short Takes

***N**ow I am become death, the destroyer of worlds.*

—The *Bhagavad Gita* (Hindu epic), quoted by J. Robert Oppenheimer, while viewing the first US nuclear test in New Mexico, 1945

***W**e do not want to cover our action with a veil of needless ambiguity. India is now a nuclear weapons state. Ours will never be weapons of aggression.*

—Prime Minister Atal Bihari Vajpayee, interview in *India Today* published May 25, 1998, two weeks after India's nuclear tests

***W**e were never trying to get into the nuclear race in the first place.*

—Pakistani Prime Minister Nawaz Sharif, statement on May 28, 1998 following Pakistan's nuclear tests

***T**he most dangerous place in the world, I think you could argue, is the Indian subcontinent and the line of control in Kashmir.*

—US President Bill Clinton, March 2000

***I**t was a summer of great rumblings in the belly of the earth, of atomic flatulence and geopolitical indigestion, consequences of the consumption of sectarian chickpeas by our famished and increasingly incontinent subcontinent.*

—Pakistani author Mohsin Hamid in his novel *Moth Smoke* (published in 2000), on the summer of 1998 in South Asia

***I** am concerned about a trend that we see reflected in the US-India nuclear deal where we try to address proliferation risks by assessing the character of regimes and governments.*

—Brent Scowcroft, National Security Advisor to Presidents Gerald Ford and George H.W. Bush, *The Australian*, April 13, 2006

***I** want to assure the world that the nuclear capability of Pakistan is under safe hands.*

—Pakistani President Asif Ali Zardari, as reported by Reuters, April 27, 2009

Reflections and Lessons Learned from the Indian and Pakistani 1998 Nuclear Tests

by P.R. CHARI

▶ **At the heart of India's decades-long nuclear quest lies resentment of the NPT's exclusion of India from the higher councils of the international system.**

▶ **An immediate consequence of India's 1974 Peaceful Nuclear Explosion was that Pakistan accelerated its nuclear quest status, which had secretly begun in 1972.**

One can evade the question and dissemble that we are too near the nuclear tests conducted in May 1998 by India, closely followed by Pakistan, for their implications to be analyzed with any authority. But twelve years is long enough to discern the influence of these nuclear tests on their national security and the non-proliferation regime. Before attempting this analysis it would be instructive to note the "creeping proliferation" route pursued by India to exercise its military nuclear option.

A Potted History of India's Nuclearization

India's military nuclear quest began in October 1964 when China exploded its first nuclear device. Occurring as it did within two years of China inflicting a humiliating defeat on India in the Sino-Indian border conflict of November 1962, the Chinese test inspired an alarmed debate in the Indian Parliament. Heckled by the Opposition, India's then Prime Minister, Lal Bahadur Shastri, was forced to concede that India's commitment to use atomic energy for only peaceful purposes was not immutable. A Subterranean Nuclear Explosion Project (SNEP) was authorized by him to proceed "up to a point where, once the go-ahead signal was given, it would take three months to have an explosion." The SNEP was abandoned in 1966 after the death of both Shastri and Homi Bhabha, head of the Atomic Energy Commission, who favored India's nuclearization. Their successors, Indira Gandhi and Homi Sethna, had no interest in continuing this program. On the technical side, India then possessed an autonomous plutonium source after its 40 MW CIRUS reactor went critical in 1960 and a plutonium reprocessing plant was completed in 1964. Neither facility was safeguarded, but India made extraordinary efforts to emphasize their peaceful intent, while avoiding any commitments that it had forsaken their use for military purposes in future.

India had initially supported, but later eschewed, entering the Nuclear Non-Proliferation Treaty (NPT) negotiated in July 1968, on the major grounds that it was plainly undemocratic in holding that: "For purposes of this Treaty, a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967." India continues to believe that its restraint in not testing a nuclear device before this cutoff date successfully excluded it from the Nuclear Club, a cartel made final in 1995, when the NPT was extended in perpetuity. At the heart of India's decades-long nuclear quest lies this resentment of the NPT's exclusion of India from the higher councils of the international system.

1974 and 1998

Fast forward to May 18, 1974 when India defiantly conducted its Peaceful Nuclear Explosion (PNE), ostensibly to study their feasibility for undertaking developmental tasks like excavating reservoirs and canals, leveling hills and so on. Since India had not entered the NPT and had utilized its un-safeguarded and autonomously established nuclear facilities to derive fissile materials for its PNE, its legal position was unassailable. The NPT, incidentally, recognizes the "potential benefits from…peaceful applications of nuclear explosions." Why India conducted this PNE but did not proceed further to explore their developmental possibilities, or change course to establish a nuclear arsenal, remains inexplicable to this day. Speculatively, an amalgam of security, prestige considerations, and domestic political motives were operating. But, the event indubitably had serious implications for the security of South Asia and the viability of the international non-proliferation regime.

An immediate consequence of the PNE was that Pakistan accelerated its nuclear quest status, which had secretly begun in 1972, shortly after Pakistan's humiliating defeat by India in December 1971 that had led to the excision of East Pakistan and the creation of Bangladesh. The parallel between Pakistan's dilemma in 1974 and India's quandary in 1964 is most striking. At the international level the severe disapprobation of India's radical action led to adverse repercussions on its atomic energy program. Canada cancelled its assistance for the two Rajasthan power plants, and supplies of low-enriched uranium for the U.S. supplied Tarapur reactors became problematical. The establishment of the Nuclear Suppliers Group

(London Club) in 1974 and passage of the U.S. Nuclear Non-Proliferation Act in 1978 designed to deny and constrain nuclear technology transfers are other fallouts directly attributable to India's PNE. India and Pakistan, however, continued with their military nuclear programs, and it became apparent soon that they either possessed a "bomb in the basement" or a bomb requiring only that the "last wires be connected." The nuclear history of South Asia over the eighties and nineties is marked by recurrent India-Pakistan crises—rumors of India attacking Pakistan's nuclear facilities in the mid-eighties, the Brasstacks exercise in 1986–87, and the Kashmir-related Spring crisis (1990). The state of existential deterrence existing between them, however, helped maintain the peace.

Fast forward again to May 11 and 13, 1998 when India conducted five nuclear tests, closely followed by Pakistan's six tests on May 28 and 30. They heralded the forced entry of India and Pakistan into the Nuclear Club as de facto nuclear weapon states, marking a cataclysm in the international system. Angry reactions emanated from the United States and China. Sanctions were imposed on both countries under Section 102 of the U.S. Arms Export Control Act (Glenn Amendment), leading to the termination of foreign aid and sale of defense items, and the denial of credit and loans by the U.S. Government and banks, which had serious financial repercussions on their economies. Despite these knee-jerk reactions, particularly by the Clinton Administration, the rigors of these sanctions have eroded over time. The Bush Administration concluded that the political dimensions of the Indo-U.S. relationship were more important than pursuing the non-proliferation ideal, highlighting the tensions marking the American non-proliferation policy that wishes to balance its regional compulsions with its non-proliferation concerns. These perceptions in Washington partly explain the rationale underlying the Indo-U.S. nuclear deal.

▶ The Bush Administration concluded that the political dimensions of the Indo-U.S. relationship were more important than pursuing the non-proliferation ideal.

▶ After India tested in May 1998, it was a foregone conclusion that Pakistan would test its nuclear devices, which it did within a fortnight of the Indian tests, suggesting its readiness to meet this contingency.

Major Issues of Relevance

There are at least five parameters along which the implications of the nuclear tests conducted by India and Pakistan might be evaluated.

- First, were the reasons that persuaded India to conduct its nuclear tests on May 11 and 13 plausible? Were Pakistan's reasons for exploding its nuclear devices thereafter on May 28 and 30 explicable? Considerable embarrassment was caused by a confidential letter dispatched by India to the heads of governments around the world stating its rationale for conducting the tests leaking to the press. It identified the security threats emanating from China and Pakistan and their collusion against India as its rationale, provoking an angry response from China. Security threats apart, the ideological convictions of the National Democratic Alliance (NDA) government—led by the Bharatiya Janata Party (BJP)—were responsible, as also the pressure of the nuclear scientists, who favored India going nuclear for institutional reasons. It is unclear whether the certainty that Pakistan would follow suit, which it did, was taken into account by Prime Minister Atal Bihari Vajpayee in deciding to hold the tests. After India tested, it was a foregone conclusion that Pakistan would test its nuclear devices, which it did within a fortnight of the Indian tests, suggesting its readiness to meet this contingency. It was naïve of the Clinton Administration, therefore, to have imagined that it could have deflected Pakistan from testing its devices.
- Second, have the test results proved reassuring enough for both countries to go ahead with establishing their nuclear stockpiles? Little is known of Pakistan's confidence levels, except that its nuclear weapons are based on Chinese designs, and should be robust. But, much uncertainty underlies India's confidence in its nuclear weapons' designs. Apropos, India's five nuclear tests included three "sub-kiloton" devices, a 15-kiloton fission device (similar to its PNE), and a 45-kiloton thermonuclear device (hydrogen bomb). Some controversy attaches to whether the thermonuclear device tested was actually a boosted fission device. India then announced a moratorium on further nuclear testing, which has been reiterated in the Indo-U.S. nuclear deal agreement. But its reluctance to convert this moratorium into a permanent renunciation of nuclear testing suggests that it has no confidence in new weapon designs that might be developed, which is understandable since prudence demands that they should be field-tested. Computer simulations or sub-critical laboratory testing are obviously insufficient to inspire confidence in the armed forces.

  The germane question is: what confidence does India have about using the data generated by its five tests to develop more sophisticated designs by, for instance, reducing the weight to yield ratio of its nuclear weapons. It was stated after the nuclear tests that they "have significantly enhanced our capability in computer simulation of new designs and taken us to the stage of 'subcritical' experiments in the future." This vague terminology suggests that India may have confidence in the nuclear weapon designs that it has tested, but has doubts about the new designs that might be developed in future.

- Third, did these reciprocal nuclear tests by India and Pakistan, followed by their announcement that they had become nuclear weapon powers, confer this status on them? The short answer is no, and official propaganda to this effect is wholly misleading. As apparent, neither country had exploded a nuclear device before the presumptive date of January 1, 1967. What this means is that they might consider themselves and be considered by the international community to be *de facto* nuclear weapon states, but they can never be *de jure* nuclear weapon states unless the NPT is appropriately amended.

- Fourth, did these reciprocal nuclear tests moderate their adversarial relations and establish a modicum of stability in their relationship? Both countries indubitably achieved nuclear parity, which was reflected during the Kargil conflict in 1999. India could not enlarge its operational theater, or cross the Line of Control (LOC) to attack the staging bases of the Pakistani intruders; neither could Pakistan relieve pressure on its beleaguered troops by enlarging the operations. The state of nuclear deterrence obtaining was more clearly demonstrated during the 2001–2 border confrontation crisis when a million troops from both countries faced each other across the international border and the LOC. A tinderbox situation was created, but war was averted, and the two countries withdrew their armed forces after a ten-month long *sitzkrieg.* However, the deterrence provided by the nuclear tests did add to instabilities in the short term due to increased cross-border terrorism sponsored by Pakistan.

  But, soon thereafter in October 2003, overtures were made by both countries to establish a ceasefire along the LOC, which had become the theater for regular cross-border artillery duels. The ceasefire negotiated along the LOC was later extended to the Siachen glacier, where an undeclared war had been proceeding since the mid-eighties. These ceasefires have held to date, and been consolidated by several confidence-building measures (CBMs) reached by the two countries, including some addressing the nuclear threat. People-to-people relations have strengthened, notably by opening new land routes and communications, particularly across the LOC between the two parts of the former State of Kashmir. It is, therefore, arguable that, over the long run, the nuclear tests have succeeded in stabilizing India-Pakistan relations, although it is too early to pronounce final judgment in this matter. The uncertainty factors hinge around the effect of a catastrophic event occurring in either country, but more especially the internal stability of Pakistan, its success in arresting growing Islamic fundamentalism, and the likely future role of its Inter-Services Intelligence.

- Fifth, did these nuclear tests weaken the international nuclear regime? The short answer here is, yes. Most visibly they brought that tottering regime into greater crisis by highlighting the grim prospect of more countries crashing into the Nuclear Club, besides the *de jure* five, and the *de facto* three viz. India, Pakistan and Israel. Libya undoubtedly represents a success story for the international nuclear regime. But, over the past decade North Korea has joined the *de facto* three nuclear weapon states after its abortive (?) nuclear tests in 2006 and 2009, while Iran is determinedly pursuing its nuclear quest. The overt nuclearization of North Korea and Iran raises the specter of a domino effect excoriating Northeast Asia and the Gulf region by raising the prospect of tensions and instabilities escalating in two of the most sensitive regions of the world. The May 1998 nuclear tests in South Asia have indubitably encouraged this process of incipient proliferation. Strenuous attempts by India's nuclear Ayatollahs to portray them as strengthening the regime by placing the nuclear weapon states on notice to proceed expeditiously towards nuclear disarmament or deal with a world of many nuclear powers are self-serving overstatements to disguise the role of India and Pakistan in burying the international nuclear regime.

▶ India's reluctance to convert its announced moratorium into a permanent renunciation of nuclear testing suggests that it has no confidence in new weapon designs that might be developed.

▶ India and Pakistan might consider themselves and be considered by the international community to be *de facto* nuclear weapon states, but they can never be *de jure* nuclear weapon states unless the NPT is appropriately amended.

Conclusions

What is the total message conveyed by the nuclear tests conducted by India and Pakistan over a decade ago? It is unfair to deny their stabilizing role on the adversarial relationship between India and Pakistan, although the costs of conflict will now be much higher if nuclear weapons enter the scene. But it would also be unfair to ignore that nuclear deterrence has no relevance to the vast range of security threats relevant now to India-Pakistan relations, which include religious fundamentalism, Leftist and other forms of extremism, terrorism and insurgency—indigenous, regional and international—and the non-military threats arising from global factors like migration, environmental decay, and climate change—briefly, the downside of globalization. The reciprocal nuclear tests conducted by India and Pakistan are irrelevant to these present and future security threats. The current stabilization of their relations engendered by these tests is therefore brittle, but could be profitably used by them to address their real security threats, provided wise leadership guides New Delhi and Islamabad. However, the Mumbai attacks in November 2008 testify to an uneasy peace

existing in South Asia under the rubric of an uncertain nuclear deterrent relationship between India and Pakistan.

P.R. Chari is Research Professor at the Institute of Peace and Conflict Studies (IPCS), New Delhi. A former member of the Indian Administrative Service, he served in several senior positions in the Central and State Governments, voluntarily retiring in 1992 after thirty-two years in the Government. During the course of his official career he served two spells (1971–75 and 1985–88) in the Ministry of Defence. On the academic side, he was Director, Institute for Defence Studies and Analyses, New Delhi (1975–80); International Fellow, Centre for International Affairs, Harvard University (1983–84); Visiting Fellow, ACDIS, University of Illinois at Urbana-Champaign (1998); Research Professor, Centre for Policy Research (1992–96); and Co-Director and Director of IPCS, New Delhi (1996–2003). Chari has worked extensively on nuclear disarmament, non-proliferation and Indian security issues. He has written, edited, co-edited and co-authored 23 books, and published over 1500 op-ed articles in newspapers/web sites and over 150 monographs and papers in learned journals and book collections abroad and in India.

▶ It is arguable that, over the long run, the nuclear tests have succeeded in stabilizing India-Pakistan relations, although it is too early to pronounce final judgment in this matter.

▶ The May 1998 nuclear tests in South Asia have indubitably encouraged the process of incipient proliferation by others.

Nuclear South Asia: Implications of the Indian and Pakistani Arsenals

by BHARATH GOPALASWAMY *and* MOEED YUSUF

India's and Pakistan's respective nuclear explosions in Pokhran and the Ras Koh mountain range presented the world with two more nuclear weapons states. On May 11 and 13, 1998 India conducted a total of five tests: three low yield explosions for tactical nuclear weapons, a 12 kiloton (kt) fission bomb, and a 43 kt thermonuclear device. These tests were met with a Pakistani response on May 28 and 30, when Islamabad conducted six tests, with yields ranging from 3 kt to 30 kt (Sikka 2000). By carrying out these tests, the countries gate crashed the nuclear club and put in their applications to be recognized as "nuclear weapons states."

In January 2003, the Indian government unveiled a set of political principles and administrative arrangements to manage its arsenal of nuclear weapons.

Although Pakistan has not enunciated a nuclear doctrine, it is clear that Pakistan's nuclear arsenal is seen as the key to offsetting Indian conventional military superiority.

As Scott Sagan explains, for the foreseeable future it is clear that nuclear weapons will remain an integral part of South Asia, affirming the region's reputation as a dangerous place. While the nuclear deterrence system between India and Pakistan is much smaller and arguably less complex than the one that existed between the United States and the Soviet Union during the cold war, the South Asian equation throws up its own set of challenges, which leave little room for complacency. Unless and until the underlying points of discord, mainly centered around the territorial dispute over Kashmir, are addressed, the threat of conflict will remain current. The concern is further compounded by the presence of nuclear weapons on both sides, coupled with inadequate warning systems in place and short flight timings due to geographical contiguity of the two rivals, which make the timelines for decision making extremely compressed. In addition, there are legitimate concerns about social stability in both countries, especially in Pakistan, that could compromise nuclear weapons safety and security. Ensuring strategic stability in South Asia thus remains a significant challenge, but one from which the international community—and primarily the United States—cannot shy away due to strategic interests (Sagan 2004).

This article briefly describes the nuclear weapons policies of India and Pakistan and their current nuclear weapons delivery capabilities, with particular attention given here to their missile programs, before highlighting the potential concerns attributable to the South Asian nuclear calculus.

India's Nuclear Weapons Policy

India started its nuclear program in the 1950s under the "Atoms for Peace" program, and subsequently established a large civil and military infrastructure dedicated to nuclear development. India initiated its nuclear weapons program after China conducted a nuclear explosion in 1964, two years removed from a brief border war between the two countries that resulted in an Indian defeat. Though countering Pakistan remains a top priority for India, India also seems intent on challenging China for primacy in the Asia Pacific and is drafting its nuclear and foreign policy accordingly. The nation's strategic and political elite had been engaged in an effort to arrive at a broad consensus on the nature and the scope of the nuclear program ever since India conducted its first "peaceful nuclear explosion" in 1974 (Perkovich 2000). This debate assumed a new significance when India conducted the 1998 tests and followed up with a declaration of its nuclear doctrine. In January 2003, the Indian government unveiled a set of political principles and administrative arrangements to manage its arsenal of nuclear weapons. The main elements of its nuclear doctrine are:

- Building and maintaining a credible deterrent;
- A posture of No First Use (NFU);
- Retaliatory attacks only to be authorized by the civilian political leadership through the Nuclear Command Authority (NCA);
- Non-use of nuclear weapons against non-nuclear weapon states;
- Retaining the option of retaliating with nuclear weapons in the event of a major attack against India or Indian forces anywhere, by biological or chemical weapons;
- A continuance of controls on export of nuclear and missile related materials and technologies, participation in the Fissile Material Cut-Off Treaty (FMCT) negotiations, observance of the moratorium on nuclear tests, and universal nuclear disarmament (Pant and Gopalaswamy 2008; Pant 2005).

The declaration of its nuclear doctrine and creation of the NCA by India formalized what had been essentially a set of unstructured arrangements among senior members of the politico-military-scientific establishment (Perkovich 2000). The new framework provided the doctrinal underpinning to India's evolving nuclear posture and the sanctity of government approval for the use of nuclear weapons. Maximum restraint in the use of nuclear forces, absolute political control over decision making and an attempt to evolve an effective interface between civilian and military leaders in the administration of its nuclear arsenal have emerged as the basic tenets

of India's nuclear weapons policy. The declaration of its nuclear doctrine and installation of the NCA by India marked a significant step in India's plan to develop effective, robust command and control and indications-and-warning systems and infrastructure for its strategic nuclear forces commensurate with India's strategic requirements.

Pakistan's Nuclear Weapons Policy

Pakistan's nuclear weapons program was a response to the country's humiliating loss of the war to India over the erstwhile East Pakistan (now Bangladesh) in 1971. The defeat triggered a political decision in January 1972 under the then Prime Minister Zulfiqar Ali Bhutto to begin a crash nuclear weapons program (Ahmed 1999). Pakistan, otherwise possessing modest technological capabilities, sought technology from many sources. Assistance to Pakistan included uranium technology from Europe, as well as blueprints for a small nuclear weapon and missile technology from China and North Korea (Squassoni 2004). Although Pakistan has not enunciated a nuclear doctrine, the Director General of the Strategic Plans Division, Gen. Khalid Kidwai, has identified four conditions under which Pakistan would consider employing nuclear weapons: (i) India attacks Pakistan and takes a large part of its territory, (ii) India destroys a large part of Pakistani armed forces, (iii) India imposes an economic blockade on Pakistan, and (iv) India creates political destabilization or large-scale internal subversion in Pakistan (Cotta-Ramusino and Martellini 2002). It is obvious from this that the Pakistani program is India specific; it is seen as the key to offsetting Indian conventional military superiority. Formally, Pakistan espouses to a "credible minimum deterrent" policy, the "credible" being a dynamic concept benchmarked against Indian capability. By all indications, Pakistan is after a modest sized program; currently it is believed to have a stockpile of 70-90 warheads (Federation of American Scientists 2010). Being the conventionally weaker party, Pakistan has rejected the doctrine of no-first-use. It fears that giving up the option of employing nuclear weapons except in retaliation may allow India to overrun it conventionally.[1] Therefore, even though Pakistan's averseness to use of nuclear weapons is inescapable given that an Indian retaliation would virtually wipe Pakistan off the map, it uses the option of a nuclear launch as a deterrent against Indian conventional aggression.

Global concerns about Pakistan's nuclear program have remained higher than India's from the very beginning. Initially, Pakistan's anomalous civil-military equation and the Army's traditional de facto veto over national security issues worried many. While that concern remained, subsequently the A. Q. Khan proliferation scandal hit center stage and confirmed the worst fears of many outside observers. The "Father of the Pakistani bomb" was found to be running a nuclear black market without the knowledge of the Pakistani state (International Institute of Strategic Studies 2007). Finally, the growing instability within Pakistan at the behest of Islamist militants continues to raise concerns as well. Ironic as it is, these international concerns have forced the Pakistani strategic enclave to treat nuclear safety and security as an utmost priority and share as much information as possible to comfort external powers. Nuclear decision making is managed through the ten-member National Command Authority (NCA), which was set up in February 2000. The body is tasked with policy formulation and control over development and decision-making of the country's strategic nuclear forces (Luongo and Salik 2007). The NCA consists of senior cabinet members and the military top brass. The Prime Minister chairs the NCA and has the final say. Under outside pressure, Pakistan has also been working to tighten export controls and has gone to lengths to convince the world that the nuclear program remains insulated from the creeping influence of Islamist militants. To prevent unauthorized use, Pakistan has instituted a "three-man rule," which requires concurrent approval of three individuals for a nuclear launch, all relevant personnel are screened by four different agencies, and Islamabad is also working towards adapting the US Personnel Reliability and Emergency Support Teams (NEST) concept (Zeb 2007; Lavoy 2007). Pakistan has, with technical advice from the United States, also instituted elaborate protocols to ensure physical safety of its sensitive sites.

India's Missile Capabilities

A nuclear weapon program requires not only the production of fissile material and its weaponization, but also an effective and credible missile system with range, accuracy and survivability. The evolution of India's missile program is clearly intertwined with India's ambitions to emerge as a nuclear weapons state and is therefore guided by strategic ambitions and interests. India launched the Integrated Guided Missile Development Program (IGMDP) in 1983 with an initial ten-year budget of $260 million to be managed by India's Defense Research and

▶ The evolution of India's missile program is clearly intertwined with India's ambitions to emerge as a nuclear weapons state and is therefore guided by strategic ambitions and interests.

▶ The indigenously developed Agni-III missile helped India gain entry into the exclusive club of half a dozen states capable of hitting targets 3500 kilometers away.

[1] In November 2008, Pakistani president Asif Ali Zardari made headlines with comments that Pakistan would not be the first to use nuclear weapons in a conflict. Some defense analysts quickly labeled Zardari's remarks as "uninformed" or "off-the-cuff," noting that Pakistan's nuclear deterrence capabilities are in part predicated on ambiguity with respect to first use.

Development Laboratory (DRDL), which was part of the central military research and development facility of India, the Defense Research and Development Organization (DRDO). Agni and Prithvi formed the core families of missiles in the Indian program (Pant and Gopalaswamy 2008).

Agni is an Intermediate-Range Ballistic Missile (IRBM) being developed as a part of the IGMDP. The Agni-I was test fired successfully in May 1989 using a shortened Prithvi as the second stage (Jane's Defense Weekly 1989). India subsequently conducted three tests before halting the program under US pressure. India had then claimed that the Agni was being used only as a "technology demonstrator." However, India resumed its program after Pakistan's test of the 600 kilometer range HATF-III in 1997.

▶ Beginning with little aerospace or defense infrastructure, the Pakistani ballistic missile program has made surprisingly rapid progress.

▶ Given the relative weakness of Pakistan's air force compared to India's, Pakistan is likely to employ missiles for both nuclear and conventional warheads.

In April 1999, India tested its Agni-II missile over a distance of 1250 kilometers. The Agni-II is a two-stage, nuclear-capable missile with solid rocket motors. It incorporated a far more accurate terminal navigation and guidance system that constantly updated information about the flight path of the missile using Global Positioning System (GPS) satellites and ground-based beacons. It was also reported that the missile could be launched in fifteen minutes, compared with the day-long preparation required for Agni-I. India subsequently tested Agni-II in 2001 to a distance of 2000 kilometers and then again in January 2002 (Federation of American Scientists 2000).

The development of Agni-III was started reportedly around the late 1990s. The Agni-III was tested for the first time in July 2006. The test failed because of a defective heat shield that caused it to crash into the Bay of Bengal after traveling 1000 km. However, in May 2008, India successfully test fired the 3500 km range Agni-III missile from Wheeler Island off the coast of the Indian state of Orissa. This was a follow-up test to the one a year earlier when India had achieved success in test firing Agni-III for the first time. The indigenously developed two-stage, all solid fueled, 48 meter-long missile helped India gain entry into the exclusive club of half a dozen states that can launch IRBMs capable of hitting targets 3000 to 3500 kilometers away (Mistry 2006).

Prithvi was the first product of the IGMDP and it has three versions: Prithvi-I (a battlefield support version, 150 km range with a 1000 kg payload), Prithvi-II (250 km range with a 500-750 kg payload) and Prithvi-III, also known as "Dhanush" (350 km range with a 750 kg payload). Prithvi-I and Prithvi-II are liquid fueled and single-staged, while Dhanush is a two-staged solid fueled missile. While Prithvi-I and Prithvi-II are deployed, Prithvi-III is believed by defense analysts to be at an advanced stage of development. The development of Prithvi-III began in 1994 and the project was rumored to have been terminated. However, India conducted two missile tests in 2004, quashing those rumors.

Pakistan's Missile Capabilities

Pakistan began a military ballistic missile program in response to the initiation of India's IGMDP in 1983. Beginning with little aerospace or defense infrastructure, the Pakistani ballistic missile program has made surprisingly rapid progress. There are two parallel and competing special weapons programs for nuclear weapons and missiles: the A. Q. Khan Research Laboratories (KRL) and the National Defense Complex (NDC) of the Pakistan Atomic Energy Commission (PAEC). KRL, which was founded in 1976, focuses on two missions: 1) enriching uranium for nuclear weapons, and 2) developing liquid-fueled ballistic missiles. The NDC was created in 1993 under the PAEC with the objective of developing an infrastructure for indigenous development, production, and integration of solid-fueled missiles, launchers, explosive materials, and propellants (Nuclear Threat Initiative 2008).

A description of Pakistani missiles is complicated by the practice of using multiple names and/or re-designating new and existing missiles formerly applied to other systems. Some missiles also appear to be overlapping in their missions. In any case, more than half a dozen types of missiles have been tested in the "Hatf" series. Hatf-II, with a range of 70-80 km and a payload of 500 kg is already inducted into the army. An extended version of the Hatf-I missile, the "Abdali," was test-fired in May 2002. Pakistan conducted the first test of its liquid fueled MRBM Ghauri in April 1998. An improved version of the Ghauri missile, with a range of 1500 km, was produced subsequently and is now operational with the Pakistan Army. In March 2004, the Shaheen-II missile with a reported range of 2000 km was test fired. Finally, later in the same year Pakistan introduced cruise missiles into the South Asian calculus by test-firing "Babur" with a reported range of 700 km (Dawn 2007). Pakistan has also conducted successful tests of its solid-fuel Air Launched Cruise Missile (ALCM) "Ra'ad" (Express India 2008).

It is worth mentioning that Pakistan's missile program is believed to have benefited more from external assistance than did India's. Although Pakistan denies any link, Chinese assistance to Pakistan's missile program is well established in intellectual circles. Experts agree that China and Pakistan began a partnership in various defense programs in the late 1960s. Their relationship grew out of their mutual need in countering the Soviet and Indian threats and continued through the cold war period. Even post-Cold War, Chinese support to Pakistan's nuclear program, and specifically the missile program, is believed to have continued. Moreover, Pakistan is

also believed to have received liquid fueled missile technology from North Korea (Wright 1998).

Given the relative weakness of Pakistan's air force compared to India's, Pakistan is likely to employ missiles for both nuclear and conventional warheads. And given that, like China and India, Pakistan's missiles are mobile, they have added survivability and are thus attractive as the primary delivery systems. Indeed, it is reasonable to expect Pakistan to bank on its ballistic missiles in this role.

Consequences of Nuclearization

The "global zero" initiative notwithstanding, India and Pakistan stand out as exceptions who are continuing to expand their nuclear arsenals. Those who study the region carefully argue that the trend is unlikely to reverse any time soon. India formally espouses a triad, and along with other high-end technology such as Ballistic Missile Defense, is working towards achieving that end. Pakistan's quest to maintain a credible deterrent against India is nudging it to increase its own fissile material, stockpile size, and missile capability. All this adds to the existing concerns linked to the South Asian nuclear equation. While positive aspects such as a survivable nuclear capability for both sides, credibility of the deterrent, the virtual impossibility of successful preemption, and de-mated and low-alert postures are not inconsequential, we focus on the principal areas of concern below which are somehow different than what the Cold War rivals faced and more importantly, where the international community can play a direct role in mitigating the risks.

Although in India there is very little direct military influence on any aspect of nuclear weapons policy, Pakistan has been at the opposite end of the spectrum.

Perverse as it is, true or not, the view that a belligerent Pakistani military calls the shots on nuclear weapons adds to the deterrent effect vis-à-vis India.

The Potential for Conflict • Pakistan and India are the only two nuclear-armed states where outstanding disputes remain active. Glenn Snyder's "stability-instability paradox" plays out very clearly in the South Asian context with the two sides viewing limited wars as permissible (Snyder 1965; Krepon and Gagne 2001). Pakistan was guilty of testing India's red lines in 1999 when it infiltrated into Indian Kashmir and fought a low intensity conflict at Kargil. After another near-war crisis in 2001-2, India developed a Pakistan-specific war fighting doctrine—the "Cold Start"—designed specifically to attack Pakistan surgically without crossing its nuclear threshold (Ladwig 2007-08). With such limited war doctrines in place and with no previous experience at managing escalation beyond the lowest rung, the equilibrium is a tenuous one to say the least. Furthermore, India's growing conventional advantage over Pakistan will force the latter to bank even more heavily on its nuclear deterrent in the times ahead. Likewise, high-end Indian acquisitions like Ballistic Missile Defense will push Pakistan to augment its offensive capabilities needlessly and may unleash a fresh arms race dynamic.

Moreover, irrelevant to the Cold War, the Indo-Pak nuclear relationship is marked by the presence of, and heightened by international concerns about, non-state militant actors, particularly in Pakistan. Having been used by Pakistan as a foreign policy tool to force a change in the status quo in Kashmir during the 1990s, anti-India militant groups have become increasingly independent of the Pakistani intelligence agencies and now present a ticking time bomb when it comes to their potential to attack India from Pakistani soil and trigger an all-out conflict. They almost did so when they attacked the Indian parliament in December 2001 and the city of Mumbai in November 2008. Pakistan has pledged inability to fully control them and Indian patience is already severely tested. Should a repeat occur, India may well respond through force, which is certain to elicit a response in kind from Pakistan and consequently unleash the dreaded escalatory dynamic.

Level of Institutional Control • Decisions regarding nuclear weapons control have featured prominently in the proliferation debate over the years. During the Cold War, the Russians and Americans each developed an "assertive" command and control system with high-level civilian control, which is believed to be a prerequisite for stable deterrence. In the South Asian context, although the Indians have an assertive civilian control of the military with very little direct military influence on any aspect of nuclear weapons policy, Pakistan has been at the opposite end of the spectrum. The military has had the upper hand with only marginal influence from civilian political leaders, even during periods of civilian leadership in Islamabad. Although the NCA has the Prime Minister as the final authority, the civil-military relationship is so anomalous that the military may ultimately trump the politicians in any eventuality. Just how hegemonic the military's control really is over the final, dreaded decision to employ nuclear weapons will never be clear, however, as the Pakistani strategic planners have an incentive to insist publicly that civilians control the program, while also leaving views suggesting that the military is fully in charge unchallenged. Perverse as it is, true or not, the view that a belligerent Pakistani military calls the shots on nuclear weapons adds to the deterrent effect vis-à-vis India.

Geographical Proximity and Shared Heritage • As Scott D. Sagan explains, the United States and the Soviet Union were on completely different ends of the globe, had primarily an ideological rivalry, and viewed each other as mysterious due to factors such as their disparate histories, languages, and cultures. An important consideration is that they did not share any disputed territory (Sagan 2001). In contrast, India and Pakistan are geographically contiguous and share a common colonial and pre-colonial history, as

well as a common culture and heritage. Contiguity implies that unlike the Cold War, missile flights and reaction times are extremely short, leaving virtually no margin of error. Moreover, with dual-use missiles whose employment strategies are not always clear, either side can mistake an incoming battery for a nuclear launch and respond in kind prematurely. Contiguity also implies that once nuclear weapons are mated and actively deployed, there is a high incentive to disperse and pre-delegate launch authority, especially for Pakistan. In that sense, Islamabad is likely to err on the "always" side of Peter Feaver's "always-never dilemma;" this is known to be an instability inducing factor (Feaver 1992-93).

▶ China, India, and Pakistan are too close to each other for early warning systems to be meaningful in their war-fighting plans.

▶ Assistance from the United States and other countries in providing the concepts and technology could enable potential bilateral and multilateral agreements.

Oddly enough, the shared heritage plays out negatively as well, as it instills a false sense of understanding of the "other's" thought and decision making process. The fact is that the two sides have moved along very different institutional paths and their deliberate policy to keep their people apart has meant that they know little about what goes on across the border. Misperceptions about each other and their decision making are rife. In fact, during crises they have tended to suspend all direct communication and channel signals through third parties, which adds to the potential for belligerence.

Level of Technological Control • India and Pakistan are relative newcomers to the problems associated with owning nuclear weapons. The nearly sixty years of US nuclear weapons management has demonstrated that this is a dangerous game. There have been a number of accidents that have strained the safety features on US nuclear weapons, and pushed the US command and control system to the limit. Realistically, all three nuclear weapons states in the region—China, India, and Pakistan—can be concerned that the other countries' nuclear weapons are not sufficiently safe to be continuously deployed for extended periods of time. The three states are geographically too close to each other for early warning systems to be meaningful in their war-fighting plans. For instance, the time-of-flight of a Scud-type missile to fly the approximately 700 kilometers between Delhi and Islamabad is around six minutes. This is just about the time the Pentagon's threat assessment conferences took during the false alarms of 1979 ("training tape incident") and 1980 ("computer chip incident") (Forden, Podvig, and Postol 2000). In fact, real-time early warning might prove destabilizing. This is because if any of these countries decided to adopt a policy of launching its weapons on the warning of an attack, it would not give the other side enough time to properly evaluate, consider, and eliminate the inevitable false alarms. This is much different than the Cold War context where early warning satellites could be credited for preventing nuclear annihilation on more than one occasion.

Mortgaged Crisis Management • The Cold War was a superpower rivalry where no third power was strong enough to intervene or weigh in on a crisis between them. With India and Pakistan, the situation is much different. They not only are influenced by outside actors, but in fact have actively sought outside assistance in crisis situations to solicit an outcome in their favor. Since the advent of nuclear weapons, every crisis has seen the two sides reach out to the United States, which has been instrumental in nudging them to back down. This happened at Kargil in 1999, during the 2001-2 crisis, and during the post-Mumbai crisis in 2008. The situation is a highly destabilizing one as it effectively implies that crisis management in South Asia has been contracted out to the United States. While the United States has commendably resisted the temptation to support either party decisively, instead acting as a neutral "pivot" and ultimately successfully balancing between the two sides to ensure détente, there is no guarantee that it will be able to do so in the future (Yusuf 2010). This is both because, unlike the past, US interests or the international environment may not allow the United States to remain totally neutral; or because India or Pakistan may act before Washington has time to use its diplomatic offices. India's Cold Start makes this latter scenario a realistic possibility, whereby India may decide to punish Pakistan before the United States can impress upon it to exercise restraint. Regardless, the very fact that management of a crisis is to be conducted at the behest of an outside party in the absence of any direct, robust bilateral crisis management mechanism between India and Pakistan is highly destabilizing.

Discriminatory Global Regime • The international community must accept its share of the blame for intensifying the nuclear rivalry between India and Pakistan. The nuclear world is discriminatory and established nuclear states have been insincere towards disarmament despite having committed to it in the Non-proliferation Treaty (NPT).[2] This has allowed India and Pakistan to deflect international pressure with ease; both continue to point to others to justify their reluctance to rethink their nuclear capabilities. The two South Asian nuclear powers remain outside the global non-proliferation ambit and none of the major treaties apply to them. They enjoy the military and diplomatic benefits of being nuclear states, and

[2] Article VI of the NPT lays down an in principle agreement by the five recognized nuclear weapon states to move towards global disarmament. However, they have actively deflected the pressure to do so, citing security and technical concerns. In fact, the debate has now shifted to restricting Article IV rights, under which all NPT members have the right to access nuclear energy freely.

yet they are not constrained by non-proliferation obligations like all other NPT members.

The international community has either ignored calls to bring them into some sort of legally binding nonproliferation arrangement or has ended up making exceptions on an individual case-by-case basis. The latter tend to be counterproductive as they discriminate against one or the other party. The most recent example is the Indo-US civil nuclear deal, whose India-specific exceptions have antagonized Pakistan and prompted it to seek similar arrangements for itself (Hibbs 2010). A broader domino effect is a realistic possibility as well.

The Way Ahead for the International Community

Structural realities, human error, misperception or selective perception, faulty analogies, and miscalculation could combine in a number of ways to undermine the ragged strategic stability that exists in South Asia. The international community must work alongside India and Pakistan towards crisis prevention and stability. While a proactive role may be unwelcome, the United States and other friendly countries must continue to nudge both sides to resolve their outstanding differences. The combination of unresolved core issues and growing nuclear arsenals makes for a rather somber projection. Meanwhile, the international community must also use diplomatic leverage to convince India and Pakistan to give up on limited war designs. This also requires that Pakistan do its utmost to tame anti-India militant outfits on its territory in the first place.

Globally, key players on the nuclear scene must craft a strategy to pull India and Pakistan into the global non-proliferation regime. The nature of the regime necessitates an exception to nuclear states outside the system, but this is worthwhile if these two sides are to be assured of acceptance of their nuclear programs and brought to the table for serious negotiations on arms control and disarmament.

Another issue that is worth serious consideration is the level of technological control, in particular the early warning system. New nuclear states often run a substantial risk that their nuclear weapons may accidentally explode, perhaps triggering an inadvertent nuclear war. In that case, joint centers—supplying information from the sensors not involved in the conflict—might prevent a tragic accident from escalating to a regional nuclear war (Forden 2006). Established nuclear weapon states could assist in this regard. The United States could potentially help in providing intelligence and warning information, on a case-by-case basis, in peacetime and during crises to reduce the danger of false alarms. In addition, safer management of nuclear weapons operations can be encouraged through discussion with other nuclear states of organizational "best practices" in the area of nuclear weapons security and safety. The United States has already shared best practices with Pakistan and provided technical assistance to avoid accidental or inadvertent use, as well as knowledge regarding physically securing facilities and ensuring personnel reliability. Such cooperation could also be provided to India without treading upon sensitivities regarding intrusion into the program. At no cost, however, should the United States present itself as a keen mediator in crises such that India and Pakistan see US diplomatic persuasion to limit escalation as a substitute for direct bilateral crisis management tools.

Indians and Pakistanis must acknowledge their responsibilities as states possessing nuclear weapons, and the United States must acknowledge their right to seek assistance in terms of technology, political will, and the diplomatic push. Assistance from the United States and other countries in providing the concepts and arms verification technology could enable potential bilateral and multilateral agreements.

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Pakistan's Nukes: How Safe is Safe Enough?

BY RIZWAN ZEB

Reports of an August 2001 meeting between former engineers of the Pakistan Atomic Energy Commission and Osama bin Laden added to alarm about Pakistan's nuclear security.

Islamabad avers that it has foolproof security for its nuclear installations.

The safety and security of nuclear weapons, material, and related data is a subject of great worry for all concerned with international security. Since the "global war on terrorism" began in 2001, Pakistan has been criticized often as a country with inadequate security for its nuclear installations, technology, and know-how. The reports of an August 2001 meeting between former engineers of the Pakistan Atomic Energy Commission (PAEC), Sultan Bashiruddin Mahmood and Chaudhry Abdul Majeed, and Osama bin Laden added to this alarm. However, it is not clear what assistance Mahmood and Majeed could have provided, considering their lack of expertise on the weaponization side. The notorious A.Q. Khan network that was involved in global nuclear proliferation and allegedly supplied parts and plans to countries such as Libya, North Korea, and Iran is also reputed to have been a possible supplier to Al Qaeda, although no substantial proof of this connection has been made available. After an extensive investigation, Islamabad claimed that A.Q. Khan's activities constituted a rogue operation by Dr. Khan motivated by greed. In February 2004, Khan accepted responsibility for his actions on national television, after which he was pardoned by then President Pervez Musharraf but placed under house arrest. In 2008 Khan recanted his confession. Following a period of five years of house arrest, an Islamabad High Court ruling freed Khan in February 2009. The Pakistani government has resisted requests from the United States and the International Atomic Energy Agency to question Dr. Khan about his alleged involvement in black market nuclear trade, and undoubtedly will never grant such access.

Despite these high-profile episodes, Islamabad avers that it has foolproof security for its nuclear installations. Yet many in the country and abroad believe that Pakistani nuclear facilities—especially civilian ones—are not secure enough. They fear these installations can be attacked by terrorists and are susceptible to an insider or insider-outsider threat. A prominent national daily in its editorial pointed out some time ago: "Islamabad claims that it has a fail-safe system of safety for its nuclear facilities, but any known estimates of how a state may achieve complete security of nuclear materials militate against such a claim." This opinion might carry some weight, but is it specific to Pakistan only?

Security Breaches in Established Nuclear Weapons States

To provide some broader context regarding concerns over nuclear safety and security in Pakistan, it is instructive to look at the recent track record in this regard of established nuclear powers—formally recognized nuclear weapons states as per the terms of the Nuclear Non-proliferation Treaty (NPT). The following sampling of security incidents relevant to control and accounting of nuclear technology, materials, and information in the United States, Russia, and other countries might suffice to demonstrate that placing a disproportionate emphasis on Pakistan as a nuclear security scapegoat is arguably unfair. The incidents described below suggest there is ample justification to expand the discussion considerably to include other global actors.

On August 29, 2007, an American B-52 bomber took off from Minot Air Force Base in North Dakota and later landed at Barksdale Air Force Base in Louisiana with six live nuclear weapons onboard. An investigation conducted subsequent to this incident found that observance of security precautions and handling procedures had become so bad that these nuclear weapons were stored alongside conventional missiles and that the U.S. Air Force staff at the base were not even able to differentiate between the two. However, according to observers, the most worrisome point is that six nuclear weapons went missing for almost 36 hours and no one noticed.

In spring 2008, a group of terrorists were able to enter the Lawrence Livermore National Laboratory (LLNL), a U.S. nuclear research complex that includes a building housing some 2,000 pounds of plutonium and weapons-grade uranium. The Lab security failed miserably. Luckily for them it happened during an exercise. The objective of the exercise was that after reaching their target, the "terrorist" team was to try to hold on for enough time to build a dirty bomb, put together a simple nuclear device, or escape with fissile material. The security failure happened despite advance notice and the fact that this exercise lacked potential key aspects of a real attack, such as the initial shock or hostage taking (Zagorin 2008).

Since 2001, there have been at least seven occurrences of information security lapses at the U.S. Los Alamos National Laboratory, the birthplace of the atom bomb. According to publicly available details, classified computer disks have been misplaced, and classified information has been transmitted through insecure e-mails from the laboratory. In one incident, two hard drives containing highly classified, SIGMA-14 Nuclear Emergency Search Team (NEST) data went missing. These hard drives were later found "with all the fingerprints wiped away" behind a Xerox photocopier machine.

In an earlier incident at Los Alamos, Dr. Wen Ho Lee, a scientist at the lab, was fired and arrested for "jeopardizing virtually every nuclear warhead arsenal through unauthorized computer transfers of the country's most sensitive nuclear secrets" in 1999. He copied thousands of pages of sensitive documents in 1993, 1994 and 1997. According to one report in 1997, he copied a complete source code for the current version of the most advanced primary weapon design. This event was one of the main reasons behind the creation of the National Nuclear Security Administration (NNSA) to improve the security of the American nuclear complex.

In another event which surfaced in October 2006, Jessica Quitana, a clerk at Los Alamos, managed to take home 228 pages of hard copies printed on both sides and 408 separated documents in three flash drives, without authorization and without anybody checking her. According to one media report, although the information was not top secret it was sensitive and mostly classified. The point is not what she took; the point is the ease with which she was able to do so. Ironically, this breach was discovered only due to a police raid of the trailer home she shared with an admitted drug dealer (Zagorin 2007). One wonders how many other such security breaches have taken place, and of which nobody is aware or which have been covered up (as it has been reported that the NNSA tried to keep this incident secret from the Congress and the American people).

▶ In August 2007, six American nuclear weapons went missing for almost 36 hours and no U.S. Air Force staff members noticed.

▶ A 2006 U.S. National Intelligence Council report cites four known incidents since 1992 in which sizable amounts of weapons-grade or weapons-usable highly enriched uranium were stolen from Russian nuclear facilities.

The situation in Russia is hardly more reassuring. Russia maintains an estimated 12,000 nuclear warheads, including roughly 2,600 strategic warheads and 2,000 nonstrategic warheads in its operational arsenal, plus some 7,300 warheads in reserve or awaiting dismantlement (Norris and Christensen 2010). Yet, the country's nuclear materials protection, control, and accounting remain deeply problematic. The possibility of terrorist attacks or security breaches perpetrated by insiders both rank high on the list of concerns relevant to Russia's nuclear arsenal, given the deteriorated conditions of the technical and personnel infrastructure within the country's military-industrial complex. A 2006 U.S. National Intelligence Council report cites four known incidents since 1992 in which sizable amounts of weapons-grade or weapons-usable highly enriched uranium were stolen from Russian nuclear facilities, but in these cases the thefts were later detected. The report further asserts, however, that "undetected smuggling of weapons-usable nuclear materials has likely occurred," and that concerns exist regarding the total amount of material that could have been diverted or stolen since the dissolution of the Soviet Union (National Intelligence Council 2006). Meanwhile, the United States has invested billions of dollars over the past two decades in working cooperatively with Russia to reduce threats to the safety and security of the latter's nuclear arsenal—a testament to the attention given by both countries to nuclear security issues but also an acknowledgment of the seriousness of the situation.

Russia's civilian nuclear facilities are worthy of safety and security scrutiny, as well. Russia's nuclear regulatory body, Rostekhnadzor, has warned of potential problems as a result of the country's economic crisis corresponding to the global financial meltdown and the fall in natural gas and oil prices. Included in the report's list of areas for concern is the potential for nuclear scientists and technical specialists—newly unemployed due to staff cuts resulting from the economic decline—to sell their expertise and services. The report cites not only potential for overall erosion of safety due to the economic crisis, but references the prospects for depleted funding and infrastructure assigned to materials control and accounting and physical protection (Environment News Service 2008).

The central point here is that long-established nuclear weapons states have experienced significant episodes of proliferation risk and nuclear security breaches, and likely will continue to do so. One can also note the transnational nature of the threat: witness the made-for-Hollywood incident from 2006, in which the British authorities claim that a Russian spy, Andrei Lugovoi, came to London on a British Airways flight, landed at Heathrow, went through customs and immigration, killed former KGB agent Alexander Litvinenko with a highly toxic and radioactive material (polonium-210) by poisoning him, then returned to Moscow—without anyone at any stage able to detect the radioactive material until after the crime was completed. The fact that such material evidently can be smuggled across borders or through airport checkpoints in developed, nuclear weapons countries suggests that problems in managing nuclear or radiological material extend far beyond just Pakistan.

Pakistan under the Microscope: What Are the Risks?

A number of analysts believe that Al-Qaeda and other terrorist organizations are working to acquire nuclear weapons, which could be used against the United States and other Western countries. These analysts tend to view South Asia as the likeliest possible place from where these terrorists can get or steal a nuclear weapon or material. This view is based on the fact that despite the on-going peace process between the two nuclear states of India and Pakistan, South Asia is unstable and suffers from a number of internal and regional security problems.

For its part, India has a history of thefts and accidents related to nuclear and radioactive materials or equipment. Incidents include over eight kilograms

of uranium stolen from the Indira Gandhi Centre for Atomic Research in 1998, and thefts of radioactive materials from hospitals and industry sources, such as steel plants and uranium mines (Basrur and Steinhäusler 2004). India has also been identified, along with several other South, Southeastern, and Central Asian states, as a significant site for the smuggling and trafficking of materials needed to make nuclear or radiological weapons. As with other countries, the "success" stories—incidents where theft or trafficking has been detected by authorities—may in fact serve to underscore the notion that there are still more examples of undetected nuclear theft and smuggling (Prosser 2004). Despite such concerns, India has "so far rejected offers of nuclear security cooperation" from international partners such as the United States (Bunn and Newman 2008).

▶ Long-established nuclear weapons states have experienced significant episodes of proliferation risk and nuclear security breaches, and likely will continue to do so.

▶ Analysts have identified a spectrum of threats to Pakistani nuclear weapons and installations—including outsider, insider, and insider/outsider threats.

However, Pakistan remains the main focus of nuclear security anxieties among the international media, scholars, and analysts. Since the war against terror began, a number of observers and experts have raised concerns about the safety of Pakistan's nuclear weapons, fissile material stocks, and nuclear facilities. A recent study by Matthew Bunn of Harvard University's Managing the Atom Project asserts that Pakistan's stockpile "faces a greater threat from Islamic extremists seeking nuclear weapons than any other nuclear stockpile on earth" (Bunn 2010). Graham Allison, director of Harvard's Belfer Center for Science and International Affairs, characterizes the threat as follows: "The assassination of former Pakistani Prime Minister Benazir Bhutto [in December 2007] reminds us starkly of an unanswered question most of us would prefer to forget: how secure are Pakistan's nuclear weapons? Could Al Qaeda or another terrorist group acquire a warhead or enough radioactive material to create a dirty bomb?" Referencing multiple near-miss assassination attempts on Pakistan's then-President Pervez Musharraf, Allison asked how plausible it is that the country's nuclear arsenal is more secure than the president of the country himself. Allison further suggested that "the design of Pakistan's nuclear control system creates risks of insider theft" (Allison 2007).

According to David Albright, noted nuclear proliferation analyst and President of the Institute for Science and International Security, Pakistan's nuclear weapons are not thought to be "one-point safe" or equipped with permissive action links (PALs), at least as defined by the United States. He has identified a spectrum of threats to Pakistani nuclear weapons and installations. Security breach scenarios include *outsider*, *insider*, and *insider/outsider threats*—where, respectively, armed individuals or groups from outside a facility, individuals who work at a facility, or both types working together gain access to and remove fissile material, weapons, or weapons components. At the most extreme end of Albright's threat categorizations are scenarios resulting from major instability or civil war: *loss of central control of storage facilities* or a *coup*—with either the existing Pakistani government losing clear lines of communication and control over nuclear facilities in the former case, or a new regime attempting to gain control of the nuclear complex in the latter (Albright 2001).

Zafar Ali of the Pakistani Army's Strategic Plans Division has outlined American concerns regarding Pakistan's nuclear facilities and materials similar to those described above. He further adds that some analysts have expressed worries about the vulnerability of the country's nuclear weapons during war time, movement, and deployment; and that security breach scenarios could lead not simply to theft of materials or loss of control of facilities, but in the worst case even an accidental or unauthorized launch of nuclear weapons (Ali 2007).

Given the difficulties that any state faces in ensuring complete security over its nuclear weapons, materials, and sensitive data—as demonstrated in the above discussion of US and Russian security breaches—the fears about Pakistan carry some weight. However, one might identify at least some parallel concerns in all other nuclear weapons states, as extremism and criminal activity exist in every country. Moreover, there is another side to the story about Pakistan, which might serve to moderate the alarmism that prevails in the Western media. Namely, what measures has Pakistan taken to establish a reliable command and control regime over its nuclear weapons and installations?

Nuclear Command and Control in Pakistan

Islamabad has taken a number of steps over the years to ensure the safety and security of its civilian nuclear facilities and assets and its military nuclear installations, nuclear weapons, and fissile material stocks. First, Pakistan has participated in international nuclear safety and security programs. It acceded to the Convention on the Physical Protection of Nuclear Material (CPPNM), ratifying the 1979 CPPNM on September 4, 2000. It is a party to the 1986 Convention on Early Notification of a Nuclear Accident and Nuclear Safety, having acceded on September 11, 1989. Pakistan also is a signatory to the 1994 International Convention on Nuclear Safety, having formalized its ratification on September 30, 1997.

This cooperation with international regimes is reflected in the steps Pakistan has taken domestically to manage its civilian nuclear industry. The Pakistan Nuclear Regulatory Authority (PNRA) was established in 2001 by government ordinance, to ensure and enhance safety, security, and accountability of all Pakistani nuclear facilities. The PNRA has been entrusted with the control, regulation and supervision of all matters related to nuclear safety and

radiation protection measures in Pakistan, and works with the International Atomic Energy Agency.

Pakistan has likewise developed a robust command and control system over its nuclear weapons complex. On February 2, 2000, the country's National Security Council approved the creation of the National Command Authority (NCA). The NCA is responsible for nuclear strategic policy formulation and exercises control over the employment and development of all strategic nuclear forces and strategic organizations. The NCA is comprised of the Employment Control Committee (ECC) and the Development Control Committee (DCC), as well as the Strategic Plans Division (SPD), which acts as Secretariat. The Employment Control Committee, chaired by the head of the government—the prime minister of Pakistan—includes the Ministers of Foreign Affairs (Deputy Chairman), Defence, and Interior; the Chairman of the Joint Chiefs of Staff Committee (CJCSC) and the Services Chiefs; and the Director General of the Strategic Plans Division, who is also the secretary of this committee. Technical advisers and others can attend if and when asked and/or required by the Chairman. The main duty of this committee is to formulate the country's nuclear strategy, including the targeting policy. The head of the government is also the chair of the Development Control Committee, which is responsible for the development of strategic assets. This committee includes the Chairman of the JCSC, who acts as Deputy Chairman; the three Services Chiefs; the Director General of the Strategic Plans Division; and the heads of concerned strategic organizations as and when required. The Strategic Plans Division is currently headed by Lt. General (Retd.) Khalid Ahmed Kidwai. The primary duty of the SPD is the planning and coordination of the establishment of a reliable command, control, communication, computers and intelligence (C4I) network for the NCA.

In a lecture at the Naval Postgraduate School in October 2006, Kidwai acknowledged some of the fears of the international community and media about Pakistan's nuclear arsenal. However, he attributed those anxieties largely to the general lack of information about the country's command and control structure, and noted a "snowballing effect" from insufficient communications (presumably by state officials) that has led to some misconceptions. He pointed generally to the programs developed by the NCA and PNRA to improve safety, security, and accountability. Kidwai also attempted to ease concerns about unauthorized use of Pakistan's nuclear weapons, explaining that "Pakistani nuclear controls include some functional equivalent to the two-man rule and permissive action links (PALs) that the United States and some other nuclear weapons states rely on to protect against loss of control, inadvertent weapons use, accidents, and other mishaps" (Walker 2006). In addition to such procedural and technical measures, Pakistan has also established a very rigorous selection process for personnel working on nuclear duties. According to available details, the process is close to the American Personnel Reliability Program (PRP). All employees and their families are vetted, and this process is repeated every two years or when the staff member is transferred.

In short, while the threats to the security of Pakistan's nuclear weapons, technology, and materials have been cited repeatedly—particularly since 9/11 and exposure of the A.Q. Khan network—Pakistan's progress in enhancing its infrastructure to protect the country's nuclear assets generally receives little attention. Likewise, although Pakistan remains a non-signatory to the NPT—primarily due to its security and deterrence imperatives with respect to India rather than a desire to buck international norms, state officials would contend—it has actively engaged with the international community on a series of nuclear security and safety agreements and their corresponding requirements. Meanwhile, Pakistan has also taken steps to regulate and further professionalize both its civilian and military nuclear installations and personnel. These facts tend to get lost amidst the media echo chamber's fixation with Pakistani "loose nukes" scenarios.

▶ There are also worries about the vulnerability of Pakistan's nuclear weapons during war time, movement, and deployment.

▶ In 2000, Pakistan created the National Command Authority to formulate nuclear strategic policy and control the employment and development of all strategic nuclear forces.

The Importance of a Balanced and Earnest Perspective

One can make the case that Pakistan is the most misunderstood and misinterpreted country in the world. Pakistan is portrayed as a country on the verge of collapse, of being taken over by jihadists, or of standing by while rogue elements of its army seize—and use—its nuclear weapons. These are overly sensationalistic impressions that ignore significant contravening realities, namely: that a popular movement managed to steer the country away from military dictatorship and back towards a civilian-led, secular parliamentary democracy, with free and fair elections in 2008 in which Islamist parties garnered less than 3% of the vote; that the Pakistani government has taken the toughest possible police and military actions in recent years against extremists in Swat Valley, South Waziristan, and other parts of the country's Northwest Frontier Province and Federally Administered Tribal Areas, as well as wherever extremists may operate in Pakistan's urban centers; and that the Pakistani army ranks among the most disciplined and well trained armed forces in the world. So Anatol Lieven is correct when he argues, "While they [jihadists] can attack the state they cannot overthrow it" (Lieven 2008).

With respect to nuclear security, it is about time that the American policy makers and analysts focused on what is happening right under their noses before

criticizing others for not doing enough. Pakistan is working diligently to secure its nuclear complex, not simply because the United States and the West want such measures, but because of its own sense of responsibility. Islamabad was brave enough to accept and correct the illegal practices of a few persons. Since the creation of the NCA, not a single security lapse or breach has been reported with respect to Pakistan's nuclear installations, although Pakistan is a new entrant in the nuclear field and its security mechanism is still evolving. This is not to say that nothing further can be done to strengthen the security of the Pakistani nuclear complex, nor that there are no threats or problems. However, it is clear that Pakistani officials realize the necessity to secure the country's nuclear assets, and every possible effort is being made in this regard.

▶ Pakistan's progress in enhancing its infrastructure to protect the country's nuclear assets generally receives little attention.

▶ Although a non-signatory to the NPT, Pakistan has actively engaged with the international community on nuclear security and safety agreements.

It is imperative that instead of criticizing each other, all nuclear states and nuclear-capable states should work together to ensure that nuclear weapons, materials and related data are safe and cannot be stolen or utilized by terrorists. This is a shared responsibility of all countries. The recent reports of security incidents particularly in the United States indicate that even the security of the American nuclear complex is not foolproof. What has been happening in the U.S. nuclear weapons complex over the years makes one wonder how safe and secure its own nuclear materials really are, and invites criticism of hypocritical treatment towards Pakistan. To paraphrase Oscar Wilde, losing sensitive nuclear weapons materials and information once may be regarded as a misfortune, but losing them repeatedly looks like carelessness.

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The Strategic, Economic, and Environmental Implications of the US-India Nuclear Agreement

by DINSHAW MISTRY

▶ In 2008, the US Congress and the international Nuclear Suppliers Group lifted their longstanding embargo on civilian nuclear trade with India.

▶ For some thirty years, countries could receive civilian nuclear technology if they joined the NPT and renounced nuclear weapons, but were denied this technology if they were not in the treaty.

In July 2005, in a joint statement with Prime Minister Manmohan Singh, President George Bush committed to attaining civilian nuclear energy cooperation with India. Three years later, after protracted negotiations—between Washington and New Delhi, and between their governments and domestic opponents of the nuclear accord—India was finally able to import civilian nuclear technology. In September–October 2008, the US Congress and the international Nuclear Suppliers Group (NSG) lifted their longstanding embargo on civilian nuclear trade with India. India could thereafter acquire nuclear reactors, as well as uranium fuel for its reactors, from foreign suppliers. In return, India's government agreed to separate its civilian and military nuclear facilities and place the civilian component under international safeguards. It would place 14 of its 22 power reactors (i.e. its 18 heavy water reactors, two US-supplied boiling water reactors, and two Russian-built light water reactors) under permanent safeguards. It would keep its breeder reactor outside safeguards. And it would shut down one of its two military-related reactors. Further, India's government agreed to maintain a moratorium on nuclear testing, support talks on the Fissile Material Cutoff Treaty, and adhere to international guidelines on nuclear and missile export controls.

What are the strategic and economic consequences of the nuclear agreement with India? On strategic grounds, the nuclear agreement could have both negative and positive implications for the nonproliferation regime. It could also strengthen political ties between Washington and New Delhi, and boost the strategic partnership between both countries. On economic and environmental grounds, the agreement can be beneficial by providing India's economy with a clean source of energy. Still, the magnitude of the strategic and economic gains from the nuclear agreement remains unclear, and would depend on prevailing political and economic factors.

Undermining the Nuclear Nonproliferation Regime

Halting the spread of nuclear weapons through a strong nuclear nonproliferation regime is a major priority on the international security agenda. The nuclear agreement with India has two potentially negative implications for the nonproliferation regime.

First, the agreement granted India an exemption from a very important NSG rule and US law, which forbids the transfer of civilian nuclear technology to any state that has not acceded to the nuclear nonproliferation treaty (NPT) and accepted full-scope safeguards. A serious concern with this exemption, as the *New York Times* noted on April 7, 2006, is that "in trying to give India a special exemption, Mr. Bush is threatening a carrot-and-stick approach that has been effective for more than 35 years." For some thirty years, countries could receive civilian nuclear technology (the carrot) if they joined the NPT and renounced nuclear weapons, but were denied this technology (the stick) if they were not in the treaty, and India is being given an exemption from this approach. If the other two countries that have not joined the NPT—Pakistan and Israel—also seek and are given an exemption, then the full-scope safeguard rule would be relaxed not just for one country (India) but for three (Israel, Pakistan, and India). It would then be harder to reject exemptions for additional countries in Asia or Europe or the Middle East if they leave the NPT.

In particular, if a country relies significantly on nuclear energy, and on foreign imports of reactors and fuel, then it is less likely to break out of the NPT if doing so disrupts its energy supplies—which would happen under the current rules of the NSG. Yet if leaving the NPT does not affect its nuclear energy imports (because it is receiving an exemption from NSG rules), the country would be more inclined to leave the NPT. Thus, the exemption for India can influence decisions about leaving the NPT in other countries, and this would seriously undermine the NPT.

The consequences of the exemption for India may well depend on how it is framed. If the exemption emphasizes that countries may only be exempt from the full-scope safeguards rule after being subject to this rule for some twenty to thirty years (as is the case with India)—and only if they adhere with major nonproliferation rules—the damage to the nonproliferation regime may be lessened. In this case, the carrot-and-stick NPT approach would still be affirmed, because India incurred important costs (of being denied civilian nuclear imports for three decades) before receiving an exemption. Further, it only received an exemption because of its relatively clean export control record (it had not exported sensitive nuclear and missile technology to other countries), and it will presumably only continue to receive this exception as long as it complies with nonproliferation norms against nuclear testing.

A Regional Arms Race

A second potentially negative implication of the nuclear agreement with India is that it could enable

India to expand its nuclear arsenal, leading Pakistan, and presumably China, to also expand their arsenals. India's military-related Dhruva reactor—which will not be safeguarded under the nuclear agreement—has been producing, and will continue to produce, plutonium sufficient for five nuclear weapons annually. India could further expand its nuclear weapons stockpile in two ways. First, because India's breeder reactor would not be under international safeguards, India could use weapons-grade plutonium from this reactor to expand its nuclear arsenal. A few years after it is operational—say around 2014—there are concerns that this reactor would produce plutonium sufficient for a few tens of nuclear weapons annually. Still, only about one-fourth to one-third of this plutonium would be weapons-grade, the remainder would be reactor-grade material. Further, India may require all of the breeder-derived plutonium to fuel future breeder reactors. India's Department of Atomic Energy (DAE) plans to build three to four additional breeder reactors by around 2020. Much of the plutonium produced from India's first breeder reactor would then be used to fuel these future breeder reactors, because DAE does not have sufficient plutonium reserves to otherwise fuel these future reactors.

▶ The exemption for India can influence decisions about leaving the NPT in other countries, and this would seriously undermine the NPT.

▶ India may soon have enough nuclear material for a minimum deterrent.

▶ Under the civilian nuclear agreement, India's leaders would be more inclined to maintain their moratorium on nuclear testing.

Second, foreign uranium fuel for India's civilian nuclear reactors could theoretically free up India's scarce domestic uranium supplies for use in military nuclear reactors. Because eight of India's power reactors will be outside safeguards, India could use imported uranium to fully fuel its safeguarded reactors, and could use its scarce domestic uranium supplies for its unsafeguarded reactors, which could in turn produce plutonium for nuclear weapons. This concern may not materialize because India's heavy water reactors produce reactor-grade rather than weapons-grade plutonium when operated in a normal mode. However, if operated in a low burn up mode, these reactors would produce weapons-grade plutonium. Thus, India could operate a single 220 megawatt heavy water reactor in a low burn up mode, whereby it would consume a considerable 190 tons of uranium annually, and could produce 150–200 kg of weapons-grade plutonium, sufficient for perhaps twenty nuclear weapons annually.

The concerns about India's using unsafeguarded power reactors and breeder-derived plutonium for nuclear weapons can be addressed in two ways. First, they could be addressed by a Fissile Material Cutoff Treaty or a global moratorium on fissile material production. Once such a treaty is in place and India signs it, then India would not be able to use plutonium from any of its reactors for nuclear weapons. Second, India may soon have enough nuclear material for a minimum deterrent. In theory, some 100–150 deliverable nuclear weapons would provide India with a minimum deterrent against China and Pakistan—and India's existing military reactors may already have produced, or could soon produce, plutonium sufficient for 100–150 nuclear weapons. Indeed, because India may have enough material for a minimum deterrent, it could be more amenable to signing a fissile material cutoff treaty, or observing a global or regional moratorium on the production of weapons-grade fissile material.

Restraining Nuclear Testing in Asia

While having potentially negative implications for the nuclear nonproliferation regime, the nuclear agreement with India also has a potentially positive implication. It restrains India's governments—and, indirectly, governments in Pakistan and China—from testing new generations of nuclear weapons including thermonuclear weapons. Most of India's nuclear weapons are believed to be first-generation fission weapons, and India's 1998 test of a thermonuclear device was at best a partial success. Thus, India's leaders may well seek additional nuclear tests, but they have also committed to a moratorium on nuclear testing under the civilian nuclear agreement. If they break this moratorium, then they will jeopardize India's ability to import nuclear reactors and uranium fuel to meet India's energy requirements. Thus, under the civilian nuclear agreement, India's leaders would be more inclined to maintain their moratorium on nuclear testing. As long as India maintains its test moratorium, Pakistan, and presumably China, will have one less reason to test nuclear weapons.

Cementing a Strategic Partnership

Washington pursued the civilian nuclear agreement to cement its strategic partnership with India. It is assumed that a stronger India, and a stronger US-India strategic partnership, would help Washington balance a rising China. Still, the meaning of a strategic partnership remains unclear, and the role of the nuclear agreement in cementing this strategic partnership is also unclear.

In general, a strategic partnership involves greater cooperation in political and military affairs. On this issue, US-India political, military, and economic ties were steadily expanding even before the nuclear agreement was in place. Since the early 2000s, the two countries regularly conducted military exercises involving all three branches of their armed forces; their navies jointly patrolled the Straits of Malacca; there was some intelligence sharing between the two countries; and India began purchasing American military equipment. This included artillery-finding radars, a naval combat vessel, six transport aircraft, and eight long range maritime patrol aircraft. Further, the two countries cooperated more closely in global security affairs. In 2005–06, India voted twice with the United States on resolutions against Iran's

nuclear program at the International Atomic Energy Agency (India would not have voted against Iran if the nuclear agreement with the US was not under consideration).

It is quite possible that US-India political, military, and economic ties could have expanded even without the nuclear agreement. The political significance of the nuclear agreement is that it removes one major obstacle to closer US-India strategic ties, i.e. their differences over India's nuclear weapons program.

Economic, Energy, and Environmental Issues

▶ The political significance of the nuclear agreement is that it removes one major obstacle to closer US-India strategic ties—their differences over India's nuclear weapons program.

▶ Nuclear power could make modest contributions to India's energy grid.

India's economy has grown at a rate of six to eight percent annually in the past decade. If this growth rate is maintained, then India's demand for electricity is expected to increase considerably. The nuclear agreement could provide an important, and environmentally-friendly, energy source for a growing Indian economy. It could also offer export opportunities for international nuclear suppliers.

India's existing nuclear power reactors can generate some 4,400 megawatt of electricity (but because of uranium fuel constraints noted below, they only operated at fifty to sixty percent of their capacity during the 2000s). In addition, two Russian-built 1000 megawatt light water reactors and an Indian-built 500 megawatt breeder reactor would be complete by 2011. Thereafter, DAE expects to build eight 700 megawatt reactors. Thus, by 2020, India's nuclear sector could generate some 14,000 megawatt of electricity, but DAE still plans to import several 1,000 megawatt reactors to meet its targets of generating 20,000 megawatt of electricity by 2020. The civilian nuclear agreement enabled India to import these reactors. According to press reports, over the next two decades, India would develop several energy parks each having six to ten nuclear reactors. These planned parks would be located at Kudankulam in Tamil Nadu, with six Russian reactors generating 6800 MW; Jaitapur in Maharashtra, with six French Areva reactors generating 9600 MW; Mithi Virdi in Gujarat, with Westinghouse AP1000 reactors; Kovvada in Andhra Pradesh, with General Electric-Hitachi reactors; and Haripur in West Bengal, with four Russian reactors generating 4800 MW.

Further, the civilian nuclear agreement will allow India to import uranium fuel for its reactors. In the 2000s, because of the limited scale of its uranium mills, India's reactors operated at only 50 to 60 percent of their capacity. In 2010, two of India's reactors, the Rajasthan-5 and -6, were placed under safeguards and fuelled with imported uranium. In the future, while India will expand its uranium milling capacity, it will also build more reactors, and India would therefore benefit from continued uranium imports. This would provide additional commercial opportunities for uranium suppliers such as Canada and Australia and countries in Africa.

It should be clarified that the cost of nuclear energy is generally greater than that from coal-fired plants. However, economies of scale (whereby four to eight nuclear plants are built at a single location) and environmental savings may make nuclear energy more competitive compared to other forms of energy. Thus, if India's energy planners find nuclear energy affordable, and they opt to import nuclear reactors in the coming decade, then nuclear power could make modest contributions to India's energy grid.

As shown in Table 1, nuclear plants could contribute some 3.7–4 percent of India's electricity by 2012. By 2020, with the completion of eight Indian-built 700 megawatt reactors but no nuclear reactor imports, nuclear energy could contribute some 4 to 6 percent of India's electricity; with the import of ten 1000 megawatt light water reactors, it could contribute some 7 to 10 percent of India's electricity.

India's increasing reliance on nuclear energy could have positive environmental implications, but

Table 1 India's Projected Nuclear Power Expansion

	PHWRs (MW)	LWR (MW)	Breeder reactor (MW)	Total Nuclear Capacity (GW)	Nuclear Share of Electrical Capacity
2007	3800	320		4	3.2%
2012	4460	2320	500	7	3.7–4 %
c. 2020	10000	2320	1000–2000	14	4–6 %
c.2020 plus imports	”	10000	”	24	7–10%
c. 2030	14000	40000	?	~60	8–15 %

PHWR: Pressurized Heavy Water Reactor
LWR: Light Water Reactor (includes two US-supplied plants at Tarapur that generate 320 megawatts).
Source: Author's projections, based on compound annual growth rates varying from 4.3% to 8% for India's total installed electrical generating capacity.

the magnitude of these environmental gains would be modest. In general (as noted by David Victor in his Testimony before the US Senate Committee on Energy and Natural Resources in July 2006), every 10,000 megawatt of new nuclear energy capacity translates into a carbon-dioxide reduction of some 75 million tons. Thus, if India increases its nuclear generating capacity by 20,000 megawatt (as it plans to do by 2020–2025), then these new nuclear plants, if they were to substitute for coal-fired plants, would lessen India's carbon dioxide emissions by about 150 million tons per year. If it increases its nuclear capacity by 40,000 megawatt (as it plans to do by 2030), then the carbon dioxide savings would be 300 million tons per year. These reductions are small compared to India's total carbon-dioxide emissions—which are expected to be about 1300–1600 million tons by 2010–2015 and 2000 million tons by 2025, as shown in Table 2. However, they compare favorably to reductions planned by other states (emission cuts planned by the European Union under the Kyoto Protocol are some 200 million tons per year).

▶ India's increasing reliance on nuclear energy could have positive environmental implications, but the magnitude of these environmental gains would be modest.

▶ If India expands its nuclear arsenal and possibly also tests nuclear weapons, but still benefits from large-scale civilian nuclear imports, the nonproliferation regime would be significantly undermined.

Conclusions

The nuclear agreement with India could, ultimately, have either positive or negative strategic and economic consequences. The main negative consequence is that it undermines a very important rule in the nonproliferation regime. This negative consequence can be offset by positive consequences, or can be exacerbated by further negative consequences.

The nuclear agreement with India will have net positive consequences for India, the United States, and other countries if the following take place over the next five to ten years: India maintains its moratorium on nuclear testing and joins the test ban treaty; ends its production of weapons grade fissile material and eventually joins a future fissile material cutoff treaty; strengthens its strategic partnership with Washington; and imports a significant number of nuclear reactors which would provide a modest amount of energy for its economy, benefit the global environment, and offer export opportunities for nuclear supplier countries.

On the other hand, if India expands its nuclear arsenal and possibly also tests nuclear weapons, but still benefits from large-scale civilian nuclear imports, the nonproliferation regime would be significantly undermined. However, any civilian nuclear imports could still be beneficial for India's economy, the world environment, and international nuclear suppliers. If India does not undertake large-scale nuclear imports—because its three-phase indigenous nuclear program becomes viable, imported nuclear energy becomes too expensive, or its economic growth slows—then the economic and environmental benefits of the nuclear agreement would be lessened.

In summary, India's decisions on restraining its nuclear weapons programs, aligning more closely with Washington, and importing significant quantities of nuclear energy, would ultimately determine whether the civilian nuclear agreement with India would have positive or negative consequences.

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Table 2 Carbon Dioxide Emissions and Projections (Million Metric Tons)

	2003	2010	2015	2020	2025
China	3,541	5,857	7,000	8,159	9,349
United States	5,796	6,365	6,718	7,119	7,587
India	1,023	1,369	1,592	1,799	2,008
OECD Europe	4,264	4,474	4,632	4,741	4,909
Total World	25,028	30,362	33,663	36,748	40,045

Source: Energy Information Agency, *Annual Energy Outlook 2006* (US Department of Energy, Washington, DC, June 2006; Report #: DOE/EIA-0484(2006))

Fissile Material Cut-off Treaty: Revisiting Indian and Pakistani Options

by T.S. GOPI RETHINARAJ *and*
CLIFFORD E. SINGER

In 1993 the UN General Assembly unanimously passed a resolution calling for negotiations for a treaty banning the production of fissile material for nuclear weapons.

FMCT discussions at the Conference on Disarmament in Geneva have been stalled except for a brief period in 1998.

Development of nuclear weapons by states hinges on three principal ingredients: fissile materials, nuclear explosives testing data, and delivery systems and platforms. With the exception of North Korea's tests in October 2006 and May 2009, there has been a de facto moratorium on nuclear explosions observed by all other countries since 1998. The moratorium on nuclear explosions is reinforced by India normalizing its relations on nuclear technology with the rest of the world. Since delivery systems and platforms also have conventional roles, stopping fissile material production for nuclear explosives remains the key indicator of countries' willingness to halt nuclear arms build-ups. However, achieving a global production moratorium of military fissile materials remains a major challenge. Although the permanent five (P-5) members of the UN Security Council have apparently ceased production of fissile material for weapons, the same is not true of India and Pakistan. Thus, ending production of military fissile materials in South Asia will effectively achieve a broader production moratorium. If the Six-party dialogue with North Korea resumes and makes viable progress, and the United States and others can convince Israel that its current stocks of weapons-usable fissile materials are adequate, then a comprehensive global production moratorium might even be achieved.

Impediments for an FMCT

The importance of ending military fissile material production was recognized as early as 1946 under the Baruch Plan, which sought elimination of nuclear weapons and international ownership of civilian nuclear fuel cycle facilities. Not surprisingly, that proposal was unacceptable to the Soviet Union when the United States had such a large lead in the military sphere. Although several such proposals were suggested in the ensuing period, it was only after the end of the Cold War that proposals for a fissile materials production cutoff treaty (FMCT) received serious international attention. In 1993 the United Nations General Assembly unanimously passed Resolution 48/75L which called for negotiations for a "non-discriminatory, multinational and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons and other nuclear explosive devices" (UNGA 1993). The commitment of the parties to the Nuclear Non-proliferation Treaty (NPT) was in principle reiterated upon the indefinite extension of that treaty. At that point negotiation of an FMCT was identified as the next order of business after opening for signature of the Comprehensive Test Ban Treaty (CTBT).

But FMCT discussions at the Conference on Disarmament (CD) in Geneva in the past have been stalled except for a brief period in 1998. Both formally and substantively, the impasse has been over the linkage between negotiating an FMCT, formation of an Ad Hoc Working Group on the Future of Nuclear Weapons, and what to do about Prevention of an Arms Race in Outer Space (PAROS) (Singer and Sands 2002). The brief 1998 thaw at the CD followed the agreement of the United States and Russia to finally agree to the demand of non-weapons-states parties to the NPT on the Ad Hoc Working Group. However, when the U.S. Congress insisted on national missile defense deployment when technically feasible, China and Russia at first demanded simultaneous negotiation for PAROS and an FMCT. Although China has apparently stopped production of military fissile materials after 1993 (Albright et al. 1997), it was unwilling to commit to a cap on production in the face of potentially unlimited build-up of missile defenses by the United States.

Subsequently China and Russia indicated support for a PAROS negotiating mandate not necessarily incompatible with U.S. national missile defense plans. Later they also agreed to discussing the PAROS negotiating mandate with the FMCT text that was being negotiated, rather than simultaneously negotiating on PAROS and FMCT. By this time, however, the position of the 2001-2008 U.S. administration was that there was nothing that it could conceive of negotiating on PAROS—a position incompatible with unblocking the impasse at the CD. Towards the end of that administration it suggested uncoupling working on the FMCT from the rest of the CD agenda. But this suggestion has not struck enough of a resonance to allow any progress. Nuclear weapons states viewed the FMCT more as a useful non-proliferation tool than as a genuine confidence building measure among states to set the stage for serious nuclear arms control and disarmament negotiations. Hence they have typically insisted on a ban on future production of fissile materials for military use rather than reducing existing military fissile inventories. The United States and Russia have a huge excess of military stocks over what they need to maintain their current arsenals. Since P-5 states and Israel have accumulated adequate fissile stocks for military use (IPFM 2008), and the North Korean situation is being negotiated separately, the most important effect of a broader moratorium or ban on future production will be a halt to the growing military fissile inventories of India and Pakistan.

With a new U.S. administration in 2009 placing a stronger emphasis on multilateral cooperation, there is greater likelihood that the impasse over the three parts of the CD agenda could be unblocked. Even before taking office, the incoming U.S. president declared his interest in working towards a world without nuclear weapons, a stance which he reiterated in an April 2009 speech in Prague. So the question of discussion of the future of nuclear weapons in an Ad Hoc Working Group in the CD should not resurface amongst the P-5 to create an impasse as long as the other P-5 countries do not change their positions on the matter.

Concerning PAROS, it is clearly in the near-term interests of the United States and the long-term interests of mankind to avoid deliberate production of dangerous long-lived space debris. Of particular concern are geosynchronous orbits, and polar orbits in the 700–1000 km altitude range that are heavily used by the United States for reconnaissance. If a satellite in one of these orbits is shattered by kinetic impact it can produce a sizeable number of pieces of linear dimension from about 1-10 centimeters, a size of debris both dangerous and difficult to detect. The resulting debris can cause a cascade of further impacts with other satellites that can make large and valuable regions of space almost unusable with current technology and be a serious nuisance for hundreds or even thousands of years. Acting in its own interest, the United States would never precipitate such a calamity in any case, but could instead use other means to temporarily or permanently disable a satellite if it deemed that step absolutely essential. It is thus in the interests of the United States, and arguably of mankind as a whole, to reach an international consensus against the deliberate production of long-lived space debris in valuable orbits. Hence there is at least one question that could be worth negotiating under the PAROS banner at the CD in the near term. The CD should thus be able to turn its attention to the substantive issues that need to be dealt with concerning production of fissile materials for nuclear explosives programs.

There are three substantive issues likely to arise during FMCT negotiations: existing stocks, naval propulsion, and verification. Table 1 provides estimates, in some cases very approximate, of total separated plutonium inventories, excluding plutonium still entrained in reactor spent fuel. Pakistan has in the past suggested an interest in more transparency, i.e. on the part of India, but India has not been responsive. France has in the past been reluctant to be as transparent on weapons grade plutonium stocks as the United Kingdom. The United States has been transparent about plutonium but shown some reluctance when it comes to highly enriched uranium (HEU). Despite extensive cooperation with the United States under the cooperative threat reduction program, Russia is yet to produce a full accounting of its military fissile inventory on a facility-by-facility basis. On plutonium there is also some ambiguity about which nuclear reactor discharges are potentially useful for nuclear weapons, especially in the case of early discharges from on-line refuelled heavy water reactors. Most plutonium separated from commercial reactor spent fuel would be of little use to countries having adequate weapons grade plutonium, ideally consisting of 93 percent or more plutonium-239. However, there could be endless debate about both accounting for overall plutonium stocks and the utility of lower grade material for weapons programs. Thus the question of existing stocks will have to be finessed by some unilateral and largely symbolic increases in transparency, without the CD entering deeper into this tangled thicket.

▶ The question of existing fissile material stocks will have to be finessed by some unilateral and largely symbolic increases in transparency.

▶ Given its convenient access to weapon grade plutonium, India is unlikely to object to restrictions on very high enrichment levels for naval reactor fuel.

Table 1 Global Civil and Military Fissile Material Inventories not in Spent Fuel (IPFM 2008)

Country	HEU (MT)	Plutonium (MT)
Russia	1270	187.4
United States	741	91.9
China	20	4
France	36.4	57.4
UK	22.4	84.8
India	0.6	7.08
Pakistan	2	0.09
Israel	0.1	0.6
North Korea		0.037
Japan		44.7
Belgium		0.6
Germany		15
Others	10	
Total	2103	494

The use of uranium enriched to over 20 percent in uranium-235 for naval propulsion will also need to be dealt with in the CD. Naval reactor fuel is tied to the question of existing stocks because of the use of higher than weapon grade uranium by some countries to achieve compact and long-lived cores. Particularly, the U.S. Navy has preferred designs of reactor cores that can last for a few decades or even the entire life time of a ship. And moving to lower enrichment and shorter refuelling cycles will have some impact on planning logistics and operational cycles of navies currently using bomb grade uranium for naval propulsion.

Although it is possible to use plutonium cores for naval propulsion, uranium cores have remained the

preferred option of all nuclear navies. The annual requirement of the entire U.S. naval reactor fleet comprising 158 reactors is around 1 ton of highly enriched uranium (National Research Council 1995). Current stocks of uranium enriched to 93 percent or more in the United States and Russia should meet their naval propulsion needs for well over a century. The United States has apparently decided that this level of enrichment should be adequate for future naval propulsion needs even though enrichment to about 97 percent has been used for this purpose. The UK will follow the U.S. lead as long as their special relationship ties their nuclear submarine programs together. Other countries appear to be willing to use lower enrichment for naval propulsion.

▶ Pakistan could fiercely resist restrictions on uranium enrichment levels because of its principal reliance on highly enriched uranium for its weapons stockpile.

▶ Designing an acceptable verification regime is likely to be the most serious technically complicated impediment to entry into force of an FMCT.

Uranium enrichment for India's naval propulsion program will be over the 20 percent limit, but still well below the threshold needed to be of practical use for fission explosives. As a country that already has convenient access to weapon grade plutonium, India does not need to object to restrictions on very high enrichment levels for naval reactor fuel. Pakistan's problem is quite different from other countries. Although it doesn't have any program for naval nuclear propulsion, Pakistan could fiercely resist restrictions on uranium enrichment levels because of its principal reliance on highly enriched uranium for its weapons stockpile. From a Pakistani perspective, restrictions on uranium enrichment levels—even if designed in the context of naval reactor fuel—will impact it more than any other country.

Another obstacle to halting the production of highly enriched uranium is the use of this material for thermonuclear weapons. But this is unlikely to be of substantial military relevance, for the P-5 countries with their already adequate stocks, nor for others in the absence of further nuclear explosives testing. Still, this consideration and the naval propulsion conundrum suggests that an outright permanent ban on uranium enrichment above the twenty percent level is unlikely to be forthcoming. The U.S. Navy would likely object on principle, and such an approach would be unacceptable to India and Pakistan for different reasons. What should be compatible with naval propulsion plans is an extended moratorium on uranium enrichment all the way up to typical weapons grade, pending discussions on how a more comprehensive verification regime might eventually be built.

Finally, designing an acceptable verification regime is likely to be the most serious technically complicated impediment to entry into force of an FMCT. North Korea balked at more intrusive inspections in connection with Six-party arrangements. Israel's presumed continuing tritium production could make it reluctant to cooperate with an intrusive verification system. Verification in India's partitioned system of civil-military nuclear facilities is likely to present peculiar challenges and difficulties. It could also be difficult to obtain the needed two-thirds majority in the U.S. Senate, with some senators concerned about both the cost of verification to the United States and the adequacy of an international verification regime.

The UN Secretary General has suggested that a moratorium on the production of fissile materials for nuclear weapons precede a treaty. In light of the above discussion, this appears not only to be a sensible suggestion, but also likely the only feasible near-term step. The general outlines of such a moratorium may well be worked out either in the CD or in bilateral and multilateral discussions that occur in the background as the formal CD process proceeds. Ultimately, it will be the level of confidence that can be built up through bilateral and multilateral bases that will determine whether or not a broader moratorium on production of fissile materials for nuclear explosives programs can be established and how long it might endure. Possible mechanisms include the Six-party talks for Korea, discussions between the United States and Israel, and understandings between China and one or more other countries. The most critical confidence building needed, however, will be between India and Pakistan. As these countries are excluded from and remain suspicious of the pronouncements that often emanate from the NPT review conferences, the CD remains the most likely multilateral forum to provide political cover for substantive discussions between India and Pakistan on fissile materials production and avoiding an unbounded nuclear arms competition in South Asia. Recent private communications and public statements by members of the Pakistani security establishment give the impression that the idea that Pakistan halting fissile materials production for nuclear explosives if India does is understood within Pakistan's national security establishment to be in Pakistan's interest. If so, then the challenge is for the Pakistani and Indian political leadership to come to the same conclusion and chart a path towards mutual participation in a production moratorium. However, any India-Pakistan pact on halting fissile material production for nuclear explosives is likely to endure only if China freezes its nuclear force levels. South Asia is unlikely to remain immune to nuclear arms build up and nuclear force modernization by China, even if they were in response to developments in the United States or its relations with other potential adversaries.

India's Fissile Inventory and Options

India's military fissile inventory comprises mostly plutonium derived from the two production reactors (heavy water moderated and cooled reactors) located at the Bhabha Atomic Research Center (BARC)

complex in Mumbai. Most independent assessments of India's military fissile inventory include only these two reactors: the Canadian supplied CIRUS (40 MWth) and the indigenously developed Dhruva (100 MWth). Theoretically, India could produce up to 50 kg of weapon grade plutonium annually from these two reactors alone. But these two reactors also have had frequent operational problems, resulting in extended shutdowns for maintenance and refurbishment. Since records of actual operational histories of these two reactors are classified, as noted above independent estimates of fissile inventories are somewhat uncertain.

▶ India's military fissile inventory comprises mostly plutonium derived from the two production reactors located at the Bhabha Atomic Research Center complex in Mumbai.

▶ Some Indian analysts have blamed successive governments for not taking weaponization seriously and warn against erosion of India's deterrent value against China and Pakistan in the long run.

According to some estimates (Albright et al. 1997; IPFM 2008), India could have accumulated around 600 kg of weapon grade—sufficient for making around 100 implosion type weapons—from CIRUS and Dhruva. Boosting these weapons with tritium, a radioactive isotope of hydrogen produced in reactors, can increase the explosive yield by several-fold. A 1998 report documented the tritium extraction facilities operated by India in these reactors as well as some older commercial power reactors for preventing plant personnel from excessive exposure to tritium (Rethinaraj 1998). India has also produced tritium using lithium targets in the two BARC reactors (Iyengar 1998). Even a few hundred grams of tritium can greatly enhance the explosive capabilities of India's modest fissile material inventory. India also has a larger inventory of civilian plutonium. About 18 tons could be residing in spent fuel discharged from all civilian power reactors so far (Bharadwaj, Krishnan, and Rajagopal 2008). Estimates of India's separated civilian inventory vary, but at least two tons that will be required for the initial core of the 500 MWe Prototype Fast Breeder Reactor (PFBR) under construction would have been separated. India's ability to reprocess civilian plutonium is currently limited by its combined reprocessing capacity of 200 metric tons of heavy metal per year at two commercial sites.

There has long been suspicion that India could have used some of its civilian reactors by discharging fuel at low burn-up to make weapon grade plutonium in order to make up for the production losses from CIRUS and Dhruva during their extended shutdowns. In that case, the choice of backups for CIRUS and Dhruva or even supplemental plutonium production are most likely drawn from the eight pressurized heavy water reactors (PHWRs) in the suggested military list outlined in the March 2006 civil-military separation offer of nuclear facilities by India. However, India's decision to place more PHWRs in the military list is likely mainly to provide tritium and also plutonium for the unsafeguarded breeder reactor program rather than for an open ended weapons build-up. Nevertheless, India retains operational flexibility to increase fissile material for explosives by operating unsafeguarded reactors at low burn-up if desired.

The status of the Canadian-supplied CIRUS has always been a tricky issue because the plutonium used for the 1974 test came from it. However, the legal cover of the loosely written bilateral contract between India and Canada, which did not prohibit "peaceful nuclear explosions," allowed India to claim flexibility. Although India has committed to permanently shut down CIRUS in 2010 (Bush and Singh 2005), plutonium produced from this reactor is potentially available for military purposes. It is plausible that India could surprise the world by putting all of CIRUS-generated plutonium and spent fuel under safeguards as a confidence building measure, if other plutonium stocks were considered adequate. Another possibility is to use the weapon grade plutonium, uranium-233, or both produced in the breeder reactor (under construction) to augment future stocks. India could produce up to 150 kg of weapons grade plutonium annually in the axial and radial blankets of 500 MWe PFBR (Glaser and Ramana 2007). This estimate, which is based on a capacity factor of 75 percent, is very high and not compatible to the operational history of plutonium-fueled breeders in the past. It is more likely that India's PFBR will have a substantially lower availability during the first decade of operation, but even 25 percent availability could substantially increase the rate of production of weapons grade fissile material.

India's uranium enrichment capacity is relatively modest. There are two uranium enrichment plants in India: a pilot scale facility in the main BARC complex and a commercial scale facility near Mysore in Karnataka. There is no information in the public domain about their operational status and history. According to one independent estimate, the Karnataka facility could have produced around 1000 kg of highly enriched uranium at the end of 2006 (Mian et al. 2006). The enrichment level reached at this facility is far lower than weapon grade uranium composition and intended mainly for the naval reactor program that is underway. Another estimate suggests that India's HEU inventory could be 460-700 kg (Albright et al. 1997).

India has set in motion various programs to develop nuclear warheads and delivery systems. Although the intent to develop a "credible minimum deterrent" nuclear force is official, details about the desired force levels and its subsequent integration with the military remain sketchy or classified. The Indian government released an official "Draft Nuclear Doctrine" in August 1999 outlining a nuclear weapons policy based on "no first use" and "credible minimum deterrent" provisions. Some Indian analysts privy to the decision-making apparatus have blamed successive governments for not taking

weaponization seriously and warn that "perils of half-measures" will erode India's deterrent value against China and also Pakistan in the long run (Karnad 2005). There is also concern amongst the strategic community that India's current military fissile stocks are inadequate to produce a credible deterrent against China. China's estimated military plutonium inventory is roughly five times greater than India's and its estimated HEU inventory is thirty times larger (See Table 1). Moreover, included in India's plutonium stocks is the large civilian stockpile (not ideally suited for weapons) that is slated for use in the 500 MWe fast breeder reactor under construction. More generally, from an Indian perspective, the willingness of P-5 states to start FMCT talks emerges from the luxury of having amassed valuable data from several nuclear tests besides sitting on top of much larger military fissile stocks than needed. The net result is resistance in India to a fissile material production cut-off that may be sufficient to delay a moratorium until after several years of additional production. India is also unlikely to ratify an FMCT until more progress has been made on a global build-down of nuclear weapons holdings.

Pakistan made it clear soon after the 1998 tests that its approach to FMCT will be determined by the pace and degree of India's weaponization programs.

The special waiver for India to resume international civilian nuclear cooperation will be viewed by Pakistan as an unfair and destabilizing development in the region.

Pakistan's Fissile Inventory and Options

Pakistan's military fissile inventory comprises mostly weapon grade uranium derived from the pilot-scale uranium enrichment plant operating since 1971 at Sihala and the larger production facility operating since 1981 at Kahuta (Steer 1998). These two plants were built largely with the aid of an international smuggling network operated by former URENCO employee A.Q. Khan, the Pakistani scientist credited with building the country's nuclear weapons program. Pakistan's weapons grade uranium stockpile is estimated at around two metric tons (IPFM 2008). Since 1973 Pakistan has operated the Karachi Nuclear Power Plant (KANUPP)—a heavy water reactor built with Canadian assistance—under international safeguards. Recent evidence indicates that Pakistan has also accumulated modest quantities of weapons grade plutonium, but the source of this plutonium is the 50 MWth reactor at Khushab built with Chinese assistance in 1998. There is very little information about the details and operational history of this reactor, but an independent assessment claims this facility could have produced up to 90 kg of weapons grade plutonium over the last ten years (IPFM 2008).

Although Pakistan has adequate fissile material stocks for producing perhaps about a hundred nuclear weapons, its approach to FMCT discussions in the past has been calibrated by India's and not just Pakistan's own capabilities. If one were to exclude India's civilian plutonium inventory, as most independent estimates do, there may be rough parity in nuclear explosive holdings between India and Pakistan. But if one includes India's large civilian plutonium inventory, the balance between the two countries changes dramatically. The theoretical weapons potential of India's civilian plutonium inventory and operational flexibility to produce weapons grade plutonium in its breeder reactor and some of its commercial power reactors may not have been lost on Pakistan's nuclear weapons establishment.

Furthermore, the special waiver for India to resume international civilian nuclear cooperation will be viewed by Pakistan as an unfair and destabilizing development in the region. These realities will have a major influence on Pakistan's approach to FMCT if serious discussions begin at the CD in Geneva. Pakistan made it clear soon after the 1998 tests that its approach to FMCT will be determined by the pace and degree of India's weaponization programs and the size and quality of its fissile material inventory. It is not yet clear if Pakistan will cite India's civilian plutonium inventory, which will remain outside safeguards under the civil-military separation plan, and refuse to become a party to an FMCT or production moratorium. While Pakistan may be content with the status quo, any future Indian plans to significantly increase its stockpile to counter China will result in a perception in Islamabad about the erosion of Pakistan's own deterrent capability. But Pakistan's dependence on U.S. aid will also limit the extent to which it can influence a multilateral process if there emerges a broad consensus on this question. But Pakistan's dependence on U.S. aid could limit the extent to which it can influence a multilateral process if there emerges a broad consensus on this question, and at some point Pakistan's cooperation with U.S. goals concerning the Taliban no longer trumps other considerations.

NPT Non-Weapons States

The question of cutting off production of unsafeguarded weapons grade materials in countries that actually have produced them needs to be clearly limited to those countries. Today adding Iran to the discussion of the former set can easily scuttle progress; but several other NPT signatories have also been a concern, and more NPT non-weapons state signatories may yet pursue spent fuel reprocessing or uranium enrichment programs with dubious economic benefits. However, unless and until another country actually joins the nine countries that claim not to be non-weapons-state NPT signatories, only fog, obfuscation and a higher chance of stalemate will result from throwing other countries into the discussion of the cutting off unsafeguarded production of weapons grade fissile materials.

Conclusion: South Asia and FMCT Future

To summarize, the current situation is more propitious than ever for progress on a broader moratorium on production of fissile materials for nuclear explosives programs. With a new U.S. administration, the deadlock between China and others and the United States in the Geneva Conference on Disarmament should be resolvable. The United States should now be amenable to discussions proceeding in an Ad Hoc Working Group on the Future of Nuclear Weapons. At the minimum, it should be possible for the United States to admit the possibility of discussion of at least one item as a part of a possible negotiation mandate on PAROS: an agreement against the deliberate production of dangerous long-lived space debris in valuable orbits.

As the experience with the comprehensive nuclear test ban suggests, there may be a period of decades between the onset of a broader moratorium on fissile material production and the entry into force, if ever, of a corresponding treaty.

The actual nearer term outcome of a process of negotiating over an FMCT is more likely to be a broader moratorium than entry into force of a treaty with a full-blown international verification regime. The question of existing stocks of weapons-usable fissile materials could be finessed via unilateral initiatives on somewhat increased transparency. The question of enriched uranium for naval propulsion should be manageable by starting with a moratorium, e.g. designed to last twenty-five years or more, on enrichment all of the way to weapon grade. Instead of an elaborate universal verification regime, what is likely to be more manageable is a set of bilateral and multilateral confidence building measures. As the experience with the comprehensive nuclear test ban suggests, there may be a period of decades between the onset of a broader moratorium and the entry into force, if ever, of a corresponding treaty.

It can also be helpful if the United States and Russia restart and convey the impression of continuing progress on building down of their Cold War nuclear arsenals. But the key to a broader moratorium on fissile material production for nuclear explosives programs lies in India and Pakistan deciding that participation is in any case in their own best interests, and of course China not unwittingly precipitating nuclear arms build-up by India. From the point of view of Pakistan's national security establishment, with India poised for a major expansion of production capability the time may be ripe for a mutual understanding, provided that India decides that what is meant by "minimum deterrence" is compatible with its existing stocks when a production moratorium starts. These are of course only sufficient conditions. An appropriate opportunity when such a confidence building measure is attractive to both India's and Pakistan's governments will need to present itself, and the international community will have previously had to lay the groundwork for such a decision to fit adequately within the broader international context.

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Nuclear South Asia since 1998: A Timeline

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The following is a chronology from 1998 onwards of selected events related to nuclear weapons development and nuclear policy in India and Pakistan, as well as notable acts of proliferation and efforts at non-proliferation affecting the region of South Asia.

April 6, 1998	Pakistan test-fires 937-mile range Ghauri missile, which it says can carry nuclear warheads and is meant to deter India.
May 11, 1998	India sets off three nuclear devices at the Pokhran test range. The testing project is codenamed Operation Shakti ("strength").
May 13, 1998	India conducts a second round of tests at Pokhran, detonating two nuclear devices with sub-kiloton yields. The US imposes economic sanctions against India.
May 15, 1998	Indian Prime Minister Atal Bihari Vajpayee says the country is capable of making a "big bomb" that would be used to defend the country.
May 17, 1998	US President Bill Clinton issues a fresh appeal to Pakistan to forgo nuclear tests.
May 18, 1998	An Indian cabinet minister warns Pakistan against trying to boost a separatist Muslim insurgency in Kashmir.
May 19, 1998	Pakistani Prime Minister Nawaz Sharif charges that India has threatened to attack the Pakistani-controlled part of Kashmir.
May 21, 1998	India announces a moratorium on the testing of nuclear weapons. It claims it is willing to negotiate an agreement on a formal test ban.
May 27, 1998	India revises its blanket declaration that it would not use nuclear weapons first in any conflict.
May 28, 1998	Pakistan conducts its first nuclear tests, five in all. President Clinton says the US is forced by law to impose sanctions on Pakistan and India.
May 29, 1998	Pakistani officials declare that they would not hesitate to employ nuclear weapons in response to an attack.
May 30, 1998	Pakistan detonates another nuclear device with a reported yield of 12 kilotons. The tests were conducted at Baluchistan, bringing the total number of claimed tests to six.
June 1, 1998	A newspaper report quotes a top Pakistani scientist as saying that the country has developed a new medium-range missile for nuclear warheads.
July 1, 1998	A former Pakistani nuclear weapons engineer warns that his country's top military and intelligence officials discussed plans for a preemptive nuclear strike on New Delhi.
July 30, 1998	The prime ministers of India and Pakistan agree to a new round of security talks but appear as divided as ever about the disputed territory of Kashmir.
October 1998	Pakistan and India end their first peace talks in a year with agreement to meet again the following February in New Delhi.

Late 1990s	Pakistani nuclear scientist A.Q. Khan's network starts supplying centrifuges and depleted uranium hexafluoride to North Korea.
February 21, 1999	India and Pakistan agree to work to reduce the risk of a nuclear war by exchanging strategic information about their arsenals and giving each other advance notice of ballistic-missile tests.
May 26, 1999	India launches a series of airstrikes at armed Muslim infiltrators in the Kargil district of Indian-administered Kashmir. Indian authorities say Pakistan had helped several hundred of them cross into the territory.
May 27, 1999	Pakistan's armed forces report having shot down two Indian fighter jets over the Pakistani-controlled portion of Kashmir, marking a sharp escalation of military tensions between the world's two newest nuclear powers.
June 11, 1999	One day after accusing the Pakistani army of torturing and executing six Indian soldiers, India says it has tapes of telephone conversations showing that Pakistani army officials are running military operations against Indian forces in Kashmir.
June 1999	Weeks of border skirmishes erupt between Pakistan and India over Muslim militant infiltrators who seized hilltop positions on the Indian side of the Line of Control. Fighting continues until July, with the US helping to ease tensions.
August 18, 1999	India's National Security Advisory Board releases a Draft Nuclear Doctrine, under which only the elected prime minister could authorize a nuclear strike and which would allow India to use such weapons only if attacked by another nuclear power.
February 2000	Pakistan establishes National Command Authority, responsible for control over the country's strategic nuclear assets and policy formulation.
September 12, 2000	Pakistan accedes to the Convention on the Physical Protection of Nuclear Material, which obliges member states to ensure physical protection of nuclear material during international transport.
2001	Pakistani President Pervez Musharraf removes A.Q. Khan as head of Pakistan's nuclear programs and names him as scientific adviser to the president.
September 23, 2001	Following the 9/11 attacks on New York and Washington, the US lifts all remaining nuclear related sanctions against India and Pakistan.
2002	India and Pakistan close to war after December 2001 attack on parliament in New Delhi blamed on Pakistani-based militants.
March 12, 2002	India accedes to the Convention on the Physical Protection of Nuclear Material.
January 2003	India announces the formalization of its nuclear doctrine, making public a set of political principles and administrative arrangements (including establishment of a Nuclear Command Authority) to manage its arsenal of nuclear weapons.
December 2003	Pakistan says it is questioning nuclear scientists, including A.Q. Khan, over allegations of proliferation. It says it is acting on information from Iran and Libya passed on by the UN's International Atomic Energy Agency.

January 2004	Probe leads to removal of A.Q. Khan as adviser to Pakistan's prime minister.
February 2, 2004	Senior military official says Khan makes statement confessing to supplying designs, hardware and materials used to make enriched uranium for atomic bombs to Iran, Libya and North Korea.
February 4, 2004	Khan appears on state television to make personal apology to the nation for endangering national security by leaking nuclear secrets abroad.
May 22, 2004	The Commonwealth announces that Pakistan will be re-admitted after a five-year ban. Pakistan was suspended after Musharraf's 1999 coup.
June 19, 2004	India and Pakistan resume talks on easing nuclear tensions and identifying confidence building measures between the two countries. The talks had been suspended soon after the 2001 attack on India's parliment.
2005	Pakistan launches its first long-range nuclear-capable missile and its first cruise missile.
July 18, 2005	A joint statement by Indian Prime Minister Manmohan Singh and US President George W. Bush announces that the two countries have reached a framework agreement to enable civilian nuclear trade between them.
Summer 2006	Construction of a third plutonium reactor begins at Khushab in Pakistan. It is similar in size to the country's second plutonium reactor.
November 2006	Pakistan successfully test-fires a new version of its medium-range, nuclear-capable missile.
February 2007	India and Pakistan sign an agreement designed to reduce the risk of nuclear war between the countries.
September 2008	The Nuclear Suppliers' Group decides to exempt India from certain commercial restrictions.
October 8, 2008	President Bush signs the U.S.-India 123 agreement, which implements bilateral nuclear trade.
July 26, 2009	India launches its first nuclear-powered submarine, the *Arihant* ("destroyer of enemies"). The launch date coincides with the tenth anniversary of the end of the Kargil War between India and Pakistan.
August 27, 2009	K. Santhanam, a senior scientist in India's Defense Research and Development Organization, says that India's test in 1998 of a thermonuclear device was a fizzle. He asserts that the country should be prepared to test again and should refrain from signing the Comprehensive Test Ban Treaty.

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