CHAPTER 6

U.S. SATELLITE SPACE LAUNCH COOPERATION AND INDIA'S INTERCONTINENTAL BALLISTIC MISSILE PROGRAM

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The U.S. nonproliferation community currently is preoccupied with the George W. Bush administration's proposal for U.S.-Indian nuclear cooperation. But another element of the administration's plans for cooperation with India deserves scrutiny—the plans for space cooperation. These plans could lead to a replay of the regrets for the damaging U.S. space technology transfers to China. And they could lead to a direct threat against the U.S. homeland. The plans are an integral part of the administration's "glide path" for cooperation with India.

The "Glide Path."

A glide path is the gentle course that an airplane follows as it descends to a safe landing. If the plane encounters an unexpected development, it can divert, regain altitude, and change its course.

Because India has been developing nuclear weapons and missiles to deliver them, U.S.-Indian technology relations for many years have remained up in the air, not heading for a safe landing. After 4 years of Bush administration negotiations, the United States now describes its technology relations with India as being on a "glide path."

This chapter addresses the question of whether, in view of India's abundantly-reported intercontinental ballistic missile (ICBM) development, we should divert from our present "glide path" approach to space cooperation. On October 3, 2003, the *Washington Post* questioned then Secretary of State Colin Powell about the latest diplomatic developments with India.

> QUESTION: . . . last week, President Bush presented [Prime Minister Atal Bihari] Vajpayee with what was called, like, a "glide path" toward better relations. . . .
>
> SECRETARY POWELL: . . . there was a basket of issues that they were always asking us about called, well, we called it—we nicknamed it, "The Trinity." How could you help us? How can we expand our trade in high tech areas, in areas having to do with *space launch activities*, and with our nuclear industry? . . . we also have to protect certain red lines that we have with respect to proliferation, because it's sometimes hard to separate within space launch activities and industries and nuclear programs, that which could go to weapons, and that which could be solely for peaceful purposes. . . . And the "glide path" was a way of bringing closure to this debate.[1] (Emphasis added.)

Nearly 2 years later, President Bush and Vajpayee confirmed this cooperation in a joint statement, ". . . the two leaders resolve [to] . . . Build closer ties in space exploration, satellite navigation *and launch*, and in the commercial space arena. . . ."[2] (Emphasis added.)

As this cooperation was being negotiated and agreed upon, reports persisted that India was preparing to produce an ICBM. These reports had been accumulating for over 2 decades.[3] The latest public report appeared less than 6 weeks after the Presidents' joint statement.[4]

Over the last decade, the reports have been consistent in avering that the ICBM will be called *Surya*,

and that key elements of hardware and technology for the ICBM will come from India's gigantic Polar Space Launch Vehicle (PSLV). What are the capabilities of the ICBM, and why does India want it? How did India acquire the space launch vehicle technology for the weapon? And how did the United States come to ride a "glide path" to space launch cooperation with India? These topics will be covered in turn.

India's ICBM—What and Why.

In the 1980s, India adapted a space launch vehicle, the SLV-3, to become the *Agni* medium-range ballistic missile. In keeping with India's practice of describing nuclear and missile programs as civilian until their military character could not be denied, India originally claimed that the *Agni* was a "technology demonstrator." The *Agni* program now consists of three missiles with ranges, respectively, of upwards of 700, 2,000, and 3,000 kilometers.

India may have begun the *Surya* project (also sometimes known as *Agni IV*) officially in 1994.[5] Reports cite various dates, perhaps because the project has several decision points. Reports generally agree that the *Surya* program, like the *Agni* program, will result in missiles with various ranges.

- *Surya-1* will have a range of about 5,000 kilometers.[6]
- *Surya-2* will range from 8,000 to 12,000 kilometers.
- *Surya-3* will range up to 20,000 kilometers.

Table 1 compares the *Agni* and *Surya* families of missiles.

Missile	Size lxd (m)	Range (km)	Mobile?	Probable Target
Agni-1	15x1	700-1,000+	yes	Pakistan
Agni-2	20x1	2,000-3,000+	yes	China
Agni-3	20x1 or 13x1.8	3,000-or 5,000+	yes	China
Surya-1	~35x2.8	~5,000	no	China
Surya-2	~40x2.8	8,000-12,000	no	United States
Surya-3	40+x2.8	20,000	no	Global

Table 1. The *Agni* and *Surya* Missile Families.[7]

Reports agree that the *Surya* will have the option of a nuclear payload—and sometimes the claim is made that the payload will consist of multiple nuclear warheads.

Reports generally agree that the *Surya* will be a three-stage missile with the first two *Surya* stages derived from PSLV's solid-fuel rockets. India obtained the solid-fuel technology for the SLV-3 and the PSLV from the United States in the 1960s.[8] The third *Surya* stage is to use liquid fuel and will be derived either from the *Viking* rocket technology supplied by France in the 1980s (called *Vikas* when India manufactured PSLV stages with the technology) or from a more powerful Russian-supplied cryogenic upper stage for the Geosynchronous Space Launch Vehicle (GSLV), which is an adaptation of the PSLV.

If—as is most frequently reported—the *Surya* uses PSLV rocket motors, it will be an enormous rocket with solid-fuel stages 2.8 meters (about nine feet) in diameter and a total weight of up to 275 metric tons. This will make it by far the largest ICBM in the world—with a launch weight about three times that of the largest U.S. or Russian ICBMs.

There appears to be no literature on Indian plans to harden or conceal the *Surya* launch site, which would

be difficult to do because of the missile's size and weight. If a cryogenic third stage is used, the launch process will be lengthy. This means that the *Surya* is likely to be vulnerable to attack before launch, making it a "first-strike" weapon that could not survive in a conflict. Indeed, the *Surya*'s threatening nature and its prelaunch vulnerability would make it a classic candidate for preemptive attack in a crisis. In strategic theory this leads to "crisis instability," the increased incentive for a crisis to lead to strategic attacks because of each side's premium on striking first.

The one report of a mobile ICBM based on a combination of PSLV and *Agni* technology makes more sense militarily.[9] But, as described below, it entails other serious concerns. Why would India want such a weapon? The reported ranges of the *Surya* variants suggest the answer.

- A 5,000-kilometer *Surya*-1 might overlap the range of a reported 5,000-kilometer upgrade of the *Agni* missile.[10] *Surya*-1 would have only one advantage over such an upgraded *Agni*. That advantage would be a far larger payload—to carry a large (perhaps thermonuclear) warhead or multiple nuclear warheads. India has no reason to need a missile of "ICBM" range for use against Pakistan. 5,000 kilometers is arguably an appropriate missile range for military operations against distant targets in China. As illustrations of the relevant distances, the range from New Delhi to Beijing is 3,900 kilometers; from New Delhi to Shanghai, 4,400 kilometers; and from Mumbai to Shanghai, 5,100 kilometers.
- An 8,000-to-12,000-kilometer *Surya*-2 would be excessive for use against China. However, the distance from New Delhi to London is 6,800

kilometers; to Madrid, 7,400 kilometers; to Seattle, 11,500 kilometers; and to Washington, DC, 12,000 kilometers. In 1997 an article based on information from officials in India's Defence Research and Development Organisation (DRDO) or higher levels of India's defence establishment stated flatly, "*Surya*'s targets will be Europe and the United States."[11]

- A 20,000-kilometer range, *Surya*-3 could strike any point on the surface of the Earth.

Indian commentators generally cite two reasons for acquiring an ICBM: To establish India as a global power, and to enable India to deal with "high-tech aggression" of the type demonstrated in the wars with Iraq.[12] Because there is no obvious reason for India to want a military capability against Europe, there is only one target that stands out as the bullseye for an Indian ICBM—the United States. The reported 12,000-kilometer *Surya*-2 range is tailor-made to target the United States.

How India Got Here.

The established path to a space launch capability for the United States, the Soviet Union, the United Kingdom, France, and China was to adapt a ballistic missile as a space launch vehicle. India turned the process around, adapting a space launch vehicle as a ballistic missile. If Brazil, Japan, or South Korea were to develop long-range ballistic missiles, they would probably follow India's example.

President John Kennedy was once asked the difference between the *Atlas* space launch vehicle that put John Glenn into orbit and an *Atlas* missile aimed at

the Soviet Union. He answered with a one-word pun, "Attitude." Paul Wolfowitz is said to have compared space launch vehicles to "peaceful nuclear explosives" (PNEs); both have civilian uses but embody hardware and technology that are interchangeable with military applications. India has demonstrated this interchangeability with both space launch vehicles and PNEs.

The path to India's ICBM capability took more than 4 decades. The common threads in the history of Indian rocketry are that space launch vehicle technology is the basis for the Indian ICBM, and that India obtained the technology with foreign help.

- Early 1960s: NASA trains Indian scientists at Wallops Island, Virginia, in sounding rockets and provides N*ike-Apache* sounding rockets to India.[13] France, the United Kingdom, and the Soviet Union also supply sounding rockets.[14]
- 1963-64: A.P.J. Abdul Kalam, an Indian engineer, works at Wallops Island where the Scout space launch vehicle (an adaptation of *Minuteman* ICBM solid-fuel rocket technology) is flown.[15]
- 1965: Upon Kalam's return to India the Indian Atomic Energy Commission requests U.S. assistance with the *Scout*, and NASA provides unclassified reports.[16]
- 1969-70: U.S. firms supply equipment for the Solid Propellant Space Booster Plant at Sriharokota.[17]
- 1973: India tests a "peaceful nuclear explosion."
- 1970s: A. P. J. Abdul Kalam becomes head of the Indian Space Research Organisation (ISRO), in charge of developing space launch vehicles.

- 1980: India launches its first satellite with the SLV-3 rocket, a close copy of the NASA *Scout*.[18]
- February 1982: Kalam becomes head of DRDO, in charge of adapting space launch vehicle technology to ballistic missiles.
- 1989: India launches its first *Agni* "technology demonstrator" surface-to-surface missile. The *Agni*'s first stage is essentially the first stage of the SLV-3. Later, the *Agni* becomes a family of three short-to-intermediate-range ballistic missiles.[19]
- 1990: Russia agrees to supply India with cryogenic upper stage rockets and technology. The United States imposes sanctions on Russia until, in 1993, Russia agrees to limit the transfer to hardware and not technology. However, India claims it has acquired the technology to produce the rockets on its own.
- 1994: India launches the PSLV. Stages 1 and 3 are 2.8 meter-diameter solid-fuel rockets. Stages 2 and 4 are liquid-fuel *Vikas* engines derived from French technology transfers in the 1980s.
- 1994: This is the earliest date for which the *Surya* ICBM program, using PSLV technology, is reported to have been officially authorized. However, India's space and missile engineers—if not the "official" Indian government—had opened the option much earlier.
- 1998: India tests nuclear weapons after decades of protesting that its nuclear program was exclusively peaceful.
- 1999: India launches the *Agni II*, an extended range missile that tests reentry vehicle "technology [that] can be integrated with the

PSLV programme to creat an ICBM," according to a defense ministry official.[20]

- 1999: Defense News cites Indian Defence Research and Development Organisation (DRDO) officials as stating that the *Surya* is under development.[21]
- November 6, 1999: Indian Minister of State for Defence (and former head of DRDO) Bachi Singh Rawat says India is developing an ICBM known as *Surya* that would "have a range of up to 5,000 km."[22]
- November 23, 1999: Rawat is reported to have been stripped of his portfolio after his ICBM disclosure.[23]
- 2001: Khrunichev State Space Science and Production Center announces that it will supply five more cryogenic upper stages to India within the next 3 years.[24]
- 2001: The cryogenic engine is reported to be "the *Surya*'s test-bed."[25]
- 2001: A U.S. National Intelligence Estimate states, "India could convert its polar space launch vehicle into an ICBM within a year or two of a decision to do so."[26]
- 2004: A Russian Academy of Sciences Deputy Director states that India is planning to increase the range of the *Agni* missile to 5,000 kilometers and to design the *Surya* ICBM with a range of 8,000 to 12,000 kilometers.[27]
- 2005: According to Indian Ministry of Defence sources, there are plans to use the noncryogenic *Vikas* stage for the *Surya* and to have the missile deliver a 2-1/2 to 3-1/2 metric ton payload with

two or three warheads with explosive yields of 15 to 20 kilotons.[28]

How the United States Got Here.

The United States has a policy against missile proliferation, but the policy has not been in place as long as the Indian missile program. Nor has the policy been applied consistently. The common thread in these developments is that the U.S. clarity about the relationship between space launch vehicles and missile proliferation appears close to being obscured in the case of India. India's agreement to adhere to the Missile Technology Control Regime's (MTCR) export control guidelines is a welcome development but does not entitle India to missile (or space launch vehicle) technology. Without India's adherence, if India were to export missile technology restricted by the MTCR, it would be a candidate for the imposition of sanctions under U.S. law. In fact, India's exports already have triggered U.S. sanctions. For the timeline of U.S. missile nonproliferation policy and India, see below:

- 1970s: The United States begins to consider a broad policy against missile proliferation.[29]
- 1980s: The United States and its six economic summit partners secretly negotiate the MTCR. After 1 1/2 years of difficult negotiations on the question of space launch vehicles, all partners agree that they must be treated as restrictively as ballistic missiles because their hardware, technology, and production facilities are interchangeable. The MTCR is informally implemented in 1985 and is publicly announced in 1987.[30]

- 1990: Two weeks after the United States enacts a sanctions law against missile proliferation, the Soviet Union announces its cryogenic rocket deal with India. The two parties are the first to have sanctions imposed on them under the new law.[31]
- 1993: The United States and Russia agree that Russia may transfer a limited number of cryogenic rocket engines to India, but not their production technology.[32]
- 1998: India tests nuclear weapons. The United States imposes broad sanctions on nuclear and missile/space-related transfers.
- 1999: Kalam says he wants to "neutralise" the "stranglehold" some nations have over the MTCR, which had tried—but failed—to "throttle" India's missile program. "I would like to devalue missiles by selling the technology to many nations and break their stranglehold."[33]
- September 22, 2001: The United States lifts many of the technology sanctions imposed in 1998. Subsequently, India's Prime Minister visits the United States amid agreements to broaden the technology dialogue.[34]
- 2002: Kalam becomes President of India.
- 2002: The United States tells India it will not object to India launching foreign satellites, as long as they do not contain U.S.-origin components.[35]
- April 2003: The last mention of India is made in the Director of Central Intelligence's unclassified semi-annual report to Congress on the acquisition of weapons of mass destruction (WMD). Future reports delete descriptions of India's activities.[36]

- October 2003: Secretary of State Powell speaks to the *Washington Post* about the "Trinity" and the "glide path."[37]
- January 2004: President Bush agrees to expand cooperation with India in "civilian space programs" but not explicitly to cooperate with space launches. This measure is part of a bilateral initiative dubbed "Next Steps in Strategic Partnership."[38]
- July 2005: President Bush agrees to cooperate with India on "satellite navigation and launch." The Prime Minister of India agrees to "adherence to Missile Technology Control Regime . . . guidelines."[39]

India's Exports.

India has a close historical relationship with Iran.[40] The United States and Israel have urged India to cool this relationship—specifically in areas of military and energy cooperation and with respect to IAEA deliberations on Iran's nuclear program.[41]

But the relationship is strong. In January 2003 Iranian President Khatami joined Indian President Kalam to watch *Agni* missiles roll by in the Indian Republic Day parade; and the two presidents signed a strategic accord providing India with access to Iranian bases in an emergency in return for Indian transfers of defense products, training, maintenance, and military modernization support.[42] This relationship is strongly supported by India's left-wing, and India cannot seem to extricate itself.[43] Even if the current ruling party could disentangle itself from Iran, the underlying political support for Iranian ties might lead a future Indian government to resume the relationship.

Indian entities have supplied sensitive military technology and WMD-related items to Iran, triggering U.S. sanctions. The United States has imposed sanctions on Bharat Electronics Ltd, Dr. C. Surendar, Dr. Y. S. R. Prasad, NEC Engineers, the Nuclear Power Corporation of India, Projects and Development India Ltd, Rallis India, and Transpek Industry Ltd.[44] Moreover, Indian entities have engaged in WMD-related transfers to Libya and Iraq.[45]

India's potential customers do not stop there. India's DRDO has aspirations to export missiles—below the MTCR threshold at present—to "many African, Gulf and Southeast Asian countries," subject to government approval.[46]

Analysis.

The story of India's ICBM illustrates short-sightedness on the parts of both India and the United States. If India completes the development of an ICBM, the following consequences can be expected:

- An incentive to preempt against India in times of crisis (especially if the ICBM is of PSLV dimensions and, consequently, is easily targeted),
- A diversion of India's military funds away from applications that would complement more readily "strategic partnership" with the United States,
- Increased tensions and dangers with China,
- Confusion and anger on the part of India's friends in Europe and the United States,
- A backlash against India that will hinder further cooperation in a number of areas, and

- A goad to other potential missile proliferators and their potential suppliers to become more unrestrained.

The governments of India and the United States have nothing to be proud of in this business. In seeking to become a global power by acquiring a first-strike WMD, the Indian government is succumbing to its most immature and irresponsible instincts. The U.S. Government, by offering India the "Trinity" of cooperation, is flirting with counterproductive activities that could lead to more proliferation.

There are, of course, arguments in favor of such cooperation:

- Strategic cooperation with India is of greater value than theological concerns about proliferation.
- India already has developed nuclear weapons and long-range missiles, so resistance to such proliferation is futile.
- India has not necessarily made the final decision to develop an ICBM.
- And, India is our friend, so we need not worry about its strategic programs.

It is true that there is considerable value to strategic cooperation with India. But nuclear and space launch cooperation are not the only kinds of assistance that India can use. It has a greater use for conventional military assistance, development aid, and access to economic markets. Moreover, nonproliferation has a strategic value at least as great as that of an Indian partnership. A little proliferation goes a long way. It encourages other nations (such as Pakistan, Brazil,

Japan, South Korea, and Taiwan) to consider similar programs. And the example of U.S. cooperation encourages other suppliers to relax their restraint.

It is true that India already has developed nuclear weapons and long-range missiles. But India has a long way to go to improve their performance, and it has a history of using nuclear and space launch assistance to do just that. Some areas in which India can still improve its missiles are:

- Accuracy. For a ballistic missile, accuracy deteriorates with range. India's ICBM could make use of better guidance technology, and it might obtain such technology with "high-tech" cooperation with the United States.
- Weight. Unnecessary weight in a missile reduces payload and range. Or it forces the development of gigantic missiles such as India's PSLV-derived ICBM. India is striving to obtain better materials and master their use to reduce unnecessary missile weight.[47]
- Reliability. India's space launch vehicles and medium-range missiles have suffered their share of flight failures. Engineering assistance in space launches could improve India's missile reliability—as was demonstrated with unapproved technology transfers incident to launches of U.S. satellites by China.[48]
- Multiple warheads. India's reported interest in missile payloads with multiple nuclear warheads means that certain elements of satellite technology may get diverted to military use. Deliberate or inadvertant transfers of technology associated with dispensing and orienting satellites could, as in the Chinese

case, make it easier to develop multiple reentry vehicles.

- Countermeasures against missile defenses. Assistance to India in certain types of satellite technology, such as the automated deployment of structures in space, could aid the development of penetration aids for India's long-range missiles. Given that the United States is the obvious target for an Indian ICBM, such countermeasures could stress U.S. missile defenses.

Supplier restraint can slow down India's missile progress and make such missiles more expensive and unreliable—perhaps delaying programs until a new regime takes a fresh look at them and considers deemphasizing them. Apart from the technical assistance that the United States is considering supplying, the relaxation of U.S. objections to foreign use of Indian launch services will augment the ISRO budget for rocket development.[49] Even if India were not aided materially by U.S. space launch cooperation, the example is certain to kindle hopes in such nations as Brazil that they can get away with the same tactics. And France and Russia, India's traditional and less-restrained rocket technology suppliers, are certain to want a piece of the action.

It is true that India has not necessarily made the final commitment to develop an ICBM. But many, many steps have been taken to this end. And, even if India has no current intention to develop the *Surya*, intentions (and ruling parties) can change. Unwise U.S. space cooperation would facilitate India's final steps toward an ICBM.

It is true that India is our friend and "strategic partner", at least at the present time. History raises

questions whether such friendship would continue through an adverse change in India's ruling party or through a conflict with Pakistan. And India's interest in an ICBM, which only makes sense as a weapon against the United States, raises questions whether the friendship is mutual. Moreover, nonproliferation policy often is directed against programs in friendly nations. Argentina, Brazil, Israel, Pakistan, South Africa, South Korea, Taiwan, and Ukraine are all friendly nations for which the United States has attempted to hinder WMD and missile programs without undermining broader relations. An exception for India is certain to be followed by more strident demands for exceptions elsewhere. Is the space-launch component of "friendship" worth a world filled with nations with nuclear-armed missiles?

India's missile program has evolved over more than 4 decades. The history of proliferation demonstrates the difficulty of holding to a strong nonproliferation policy over years, let alone decades.[50] There will always be temptations to trade nonproliferation for some bilateral or strategic advantage of the moment. In the current situation, India may have out-negotiated the United States. After India's 1998 nuclear weapon tests, the United States imposed sanctions and then gradually lifted them. In nuclear and rocket matters, this was not enough for India. And once the United States began easing up on India, the United States kept easing up.

The United States professes to be holding to its "red lines"—in Secretary of State Powell's words—in whatever kind of cooperation it is considering. But the world needs to know where these lines are when it comes to "space launch" cooperation. It is one thing for the United States to provide launch services for Indian

satellites. It is another thing for the United States to use or help improve India's ICBM-capable rockets. Are the "red lines" firm or flexible? Is the "glide path" a slippery slope? These questions bring us to a number of recommendations.

Recommendations.

Under the July 18, 2005 joint statement, the United States and India committed themselves to "build closer ties in space exploration, satellite navigation and launch, and in the commercial space arena." This does not require, nor should it encourage, U.S. cooperation on India's ICBM program directly or indirectly. In fact, the United States already has taken a step in the right direction by offering to launch Indian astronauts in upcoming space shuttle missions and to involve them to the fullest extent in the International Space Station.

The United States should do more to encourage India to launch its satellites and science packages on U.S. and foreign launchers by making these launches more affordable. The United States also should be forthcoming in offering India access, as appropriate, to the benefits of U.S. satellite programs—including communications, earth resource observation, and exploration of the cosmos.

India, in fact, has some of the world's best astrophysicists and cosmologists. It is in our interest, as well as the world's, that we welcome these Indian experts into the search for basic answers about the universe. We should make the data from the Hubble telescope and similar systems available to Indian scientists and encourage them to become full partners in its analysis.

On the other hand, there are some critical cautions to be observed.

1. Do not be naive about the nature of India's program. After more than 2 decades of reports about India's interest in an ICBM—including reports from Russia, statements on India's ICBM capability by the U.S. intelligence community, and the firing of an Indian official after he publicly described the *Surya* program—there should be no illusions. The reports consistently state that India's ICBM will be derived from its space launch vehicle technology.

- The United States should not believe that it is possible to separate India's "civilian" space launch program—the incubator of its long-range missiles—from India's military program.
- There should be no illusions about the target of the ICBM. It is the United States—to protect India from the theoretical possibility of "high-tech aggression."
- The U.S. intelligence community's semi-annual unclassified reporting to Congress on India's nuclear and missile programs was discontinued after April 2003. This reporting should be resumed.

2. Do not assist India's space *launch* programs. The United States should not cooperate either with India's space launches or with satellites that India will launch. India hopes that satellite launches will earn revenues that will accelerate its space program—including rocket development. U.S. payloads for Indian launches—such as the envisioned cooperative lunar project—risk technology transfer (see recommendation #3) and invite other nations to be less restrained in their use of Indian launches.

- The United States should resume discouraging

other nations from using Indian launches, while encouraging India to resume the practice of launching satellites on other nations' space launch vehicles.

- Given the frequent reports of Russian cryogenic rockets being used in the *Surya*, the United States should work with Russia to ensure that Russian space cooperation with India does not undercut U.S. restraint.
- Because there is no meaningful distinction between India's civilian and military rocket programs, the United States should explicitly or de facto place ISRO back on the "entities" list of destinations that require export licenses.[51]
- Congress should insist that the United States explain its "red lines" regarding space cooperation with India. If these lines are not drawn tightly enough, Congress should intervene.

3. Review carefully any cooperation with India's satellite programs. India reportedly is developing multiple nuclear warheads for its long-range missiles. If India develops an ICBM, the next step will be to develop countermeasures to penetrate U.S. missile defenses. Certain satellite technologies can help India with both of these developments.

- The United States should review its satellite cooperation to ensure that it does not aid India inappropriately in the technologies of dispensing or orienting spacecraft, of automated deployment of structures in space, or of other operations that would materially contribute to multiple warheads or countermeasures against missile defenses.

4. Stop using cooperation in dangerous technologies as diplomatic baubles. India is the current example of a broader, disfunctional tendency in bilateral relations to display trust and friendship by opening up the most dangerous forms of cooperation. The United States should not fall further into this trap with India—or with any other nation.

- India needs many other forms of economic and military cooperation more than it needs nuclear and space technology. If India insists on focusing technology cooperation in these areas, the United States should take it as a red flag.
- The U.S. removal of technology sanctions imposed after India's 1998 nuclear tests was an adequate—and perhaps excessive—display of friendship. Further technology cooperation should be limited to areas that do not contribute to nuclear weapons or their means of delivery.

Conclusion.

The target of an Indian ICBM would be the United States. The technology of an Indian ICBM would be that of a space launch vehicle—either directly via the PSLV or indirectly via the *Agni*, which is based on India's SLV-3. The United States should not facilitate the acquisition or improvement of that technology directly or indirectly. In this matter, U.S. clarity and restraint are what the world—and India—need.

The United States needs to divert from the present "glide path" and reorient itself and India onto a more productive course of cooperation. It would be a cruel irony if, in the hope of becoming strategic partners, we became each other's strategic targets.

ENDNOTES - CHAPTER 6

1. Glenn Kessler and Peter Slevin, "Washington Post Reporters Interview Powell," *Washington Post*, October 3, 2003, available at *www.washingtonpost.com/wpdyn/articles/A41977-2003Oct3.html*.

2. The White House, Office of the Press Secretary, July 18, 2005, "Joint Statement Between President George W. Bush and Prime Minister Manmohan Singh," available at *usinfo.state.gov*.

3. For early reports, see *Islamic Defence Review*, Vol. 6, No. 4, 1981; Maurice Eisenstein, "Third World Missiles and Nuclear Proliferation, *The Washington Quarterly*, Summer 1982; "Liquid Fuel Engine Tested for PSLV," *Hindustan Times*, New Delhi, December 13, 1985, p. 1; "Growing Local Opposition to India's Proposed National Test Range at Baliapal, Orissa," *English Language Press*, October 1986; and "India Faces Rising Pressure for Arms Race with Pakistan," *Christian Science Monitor*, March 9, 1987, p. 1.

4. Madhuprasad, "Boost to Indian Armed Forces' Deterrence Arsenal; India to Develop Intercontinental Ballistic Missile," *Bangalore Deccan Herald* in English, August 25, 2005.

5. Vivek Raghuvanshi, "Indian Scientists Poised To Test-Launch Country's First ICBM," *Defense News*, April 30, 2001, p. 26.

6. International missile nomenclature defines as ICBM as a ballistic missile with a range of 5,500 km or greater. However, Indian commentators have tended to exaggerate their missiles' capabilities by bumping missiles into the next higher range classes.

7. The low-end ranges for the *Agni* family commonly are reported, for instance, in Robert Norris and Hans Kristensen, "India's Nuclear Forces, 2005," *Bulletin of the Atomic Scientists*, Vol. 61, No. 05, September/October 2005, available at *www.thebulletin.org/article_nn.php?art_ofn=so05norris*. The high-end *Agni* range figures are more uncertain but are representative of figures appearing in the Indian press. In the case of *Agni-3*, the high-end range figures may relate to later *Agni* models or even to the *Surya*. *Surya* ranges are reported in Raghuvanshi, whose figures agree with Russian estimates in Moscow Agentstvo Voyennykh Novostey internet news service in English, 1252 GMT, November 1, 2004. *Agni* dimensions are reported in Arun

Vishwakarma, "*Agni*—Strategic Ballistic Missile," April 15, 2005, formerly available at *www.bharat-rakshak.com/MISSILES/Agni.html*. *Surya* diameters are those of the PSLV, and *Surya* lengths are approximations based on the lengths of the PSLV and GSLV missile stages. These space launch vehicle dimensions are reported in *www.bharat-rakshak.com/SPACE/Images/launcher-family-big.jpg*. For a different description of India's ICBM technology see Vishwakarma. This appears to be the only report stating that India is developing a 1.8 meter diameter solid fuel rocket that will extend the *Agni* to intercontinental range and that could be the basis for a longer-range ICBM. The 1.8 meter diameter rocket represents a combination of PSLV and *Agni* technology. Such a lighter ICBM makes far more military sense than a PSLV-sized missile. The lighter ICBM might be mobile and able to survive a first strike. However, Vishwakarma consistently reports far higher ranges for the existing *Agni* missiles than have been reported elsewhere. Given this reporting bias, Vishwakarma may be describing the wishlists of Indian engineers—or programs that have not yet been funded. The PSLV exists. The existence of 1.8 meter diameter missile has not yet been reported except by Vishwakarma.

8. Gary Milhollin, "India's Missiles—With a Little Help from Our Friends," *Bulletin of the Atomic Scientists*, November 1989, available at *www.wisconsinproject.org/countries/india/misshelp.html*; and Sundara Vadlamudi, "Indo-U.S. Space Cooperation: Poised for Take-Off?" *The Nonproliferation Review*, Vol. 12, No. 1, March 2005, p. 203, available at *taylorandfrancis.metapress.com/index/K366012388318X11.pdf*.

9. Vishwakarma. The impending test of the *Agni*-3 may reveal whether a 1.8 meter diameter rocket stage—which could make possible a mobile ICBM—has been developed. See editorial "Missile Plan," *Bangalore Deccan Herald*, November 26, 2005; Rajiv Nayan, "*Agni* Three missile: Sino-Centric?" *Bangalore Deccan Herald*, December 12, 2005; and Sayan Majumdar, "Defense Developments for 2006," New Delhi, India Defence Consultants, January 13, 2006.

10. Moscow Agentstvo Voyennykh Novostey; and Vishwarkarma, a publication of more uncertain quality. It is possible that either or both of these references have conflated the *Surya*-1 with the *Agni* program.

11. Wilson John, "India's Missile Might," *The Pioneer* in English, New Delhi, July 13, 1997, p.1, available as Foreign Broadcast Information Service (FBIS)-TAC-97-195 BK1407155097, July 14,

1997. John is identified in the article, perhaps incorrectly, as a DRDO official. At any rate, he has an extensive reporting career based on access to high levels of India's defense establishment.

12. For example, Brahma Chellaney, "Value of Power," *The Hindustan Times* in English, May 19, 1999.

13. Vadlamudi.

14. Milhollin.

15. *Ibid*.

16. *Ibid*.

17. Vadlamudi.

18. Alexander Pikayev, Leonard Spector, *et al*., "Russia, the US and the Missile Technology Control Regime," Adelphi Paper 317, London: International Institute for Strategic Studies, March 1998.

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20. V. G. Jaideep, "India Building ICBM with 8,000-Plus Km Range," *The Asian Age* in English, February 8, 1999, pp. 1-2; and Barbara Opall-Rome, "*Agni* Test Undercuts U.S., Angers China," *Defense News*, April 26, 1999, p. 17.

21. Vivek Raghuvanshi, "India To Develop Extensive Nuclear Missile Arsenal," *Defense News*, May 24, 1999, p. 14.

22. Canadian Security Intelligence Service, "Ballistic Missile Proliferation," Report #2000/09, March 23, 2001, available at *www.cisiscrs.gc.ca/eng/misdocs/200009_e.html*.

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25. Raghuvanshi.

26. National Intelligence Estimate, "Foreign Missile Developments and the Ballistic Missile Threat Through 2015," December 2001, available at *www.cia.gov/nic/special_missilethreat2001.html*.

27. Cf. Moscow Agentstvo Voyennykh Novostey in endnote 10.

28. Madhuprasad.

29. Richard Speier, *The Missile Technology Control Regime: Case Study of a Multilateral Negotiation*, manuscript funded by the United States Institute of Peace, Washington, DC, November 1995.

30. *Ibid*.

31. Pikayev, *et al*.

32. *Ibid*.

33. "*Agni* IRBM 'Built to Carry Nuclear Warhead'," J*ane's Defence Weekly*, April 28, 1999.

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35. C. Raja Mohan, "US Gives Space to ISRO," *The Hindu* in English, September 30, 2002, p. 11.

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38. The White House, Office of the Press Secretary, Statement by the President on India, "Next Steps in Strategic Partnership with India," January 12, 2004, available at *www.whitehouse.gov/news/releases/2004/01/20040112-1.html*.

39. Cf. endnote 3.

40. For an official Indian history of relations as of 2002, see *www.indianembassytehran.com/india-iran.html*.

41. Barbara Opall-Rome and Vivek Raghuvanshi, "India's Balancing Act," *Defense News*, September 15, 2003, p. 1; Sultan Shahin, "India Sticks with Iran, for now," *Asia Times*, approximately September 20, 2003; Patricia Nunan, "US Signals Concern About India-Iran Pipeline Project," *VOA News.com*, March 17, 2005, available at *www.voanews.com/burmese/2005-03-17-voa14.cfm*; Vivek Raghuvanshi, "India, U.S. To Boost Tech Flow," *Defense News*, December 12, 2005, p. 42; "India and US Risk Losing Impetus on Nuclear Deal," *FT.com*, January 26, 2006, available at *www.nytimes.com/financialtimes/business/FT20060126_20323_12183.html*.

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