INDIA'S NUCLEAR AND SPACE PROGRAMS: Defense or Development?

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MORE than a decade has passed since India exploded its first atomic device in May 1974 in the Rajasthan desert, thereby raising several international and domestic issues regarding the ultimate purpose and the level of technological capabilities of India's nuclear program. The explosion drew attention to the thin line that separates the domestic civilian nuclear energy program from India's potential nuclear weapons capability. Of related interest, but subject to less international scrutiny, is the country's space program. While the growing capability in space technology is directed toward improving domestic telecommunications and meteorological forecasting systems, it also points to the latent development of India's strategic nuclear delivery vehicles.

Whether originally intended or not, nuclear and space programs serve dual purposes. They are perceived as significant symbols of successful development planning while at the same time the ability to produce nuclear weapons and delivery systems represents power and prestige in the international community, even if the country is still considered to be a developing one. China is an example.

The purpose of this article is to examine the case of India. In particular, we will inquire into the defense and development motivations that underlie high technology programs and the manner in which they interact and further increase the level of technological capabilities.

The Dimensions of the Problem

TYPOLOGY OF POTENTIAL NUCLEAR PROLIFERATORS

A study of the Indian case indicates the need to draw a distinction between development-oriented and defense-oriented potential nuclear

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weapons proliferators. Threshold nuclear weapon states that fall into the first category are those whose primary motivation is the production of nuclear energy for civilian needs. In this case, nuclear weapons are incidental to, or a spinoff from, civilian nuclear development programs. No external threats are expected to be resolved through their acquisition. Nuclear weapons may be sought for reasons of national pride and international prestige, or simply because the capability exists to produce them. No doubt, if one of these states chooses to acquire nuclear weapons, neighboring states may feel threatened; if there is a rival state with sufficient resources and motivation, a regional nuclear arms race may ensue. In such a case, problems of security are the result of earlier non-security decisions to acquire a nuclear weapons capability.

Argentina and Brazil are examples of states whose nuclear programs are primarily development-oriented. There are no major disputes or serious threats that are likely to lead to war. Some security motivations may exist in the case of Argentina after the 1983 Falkland Islands war with Britain; in the wake of defeat and humiliation at the hands of a nuclear weapons power, Argentina might conceivably feel provoked into acquiring a nuclear weapons capability. Such a decision, however, is more likely to cause a nuclear arms race with Brazil than with Britain—even though there appear to be no regional disputes that would justify it. In fact, both Brazil and Argentina have embarked on major nuclear energy programs, and both have the capability to make nuclear weapons as well. Thus, if either Brazil or Argentina made a decision to acquire nuclear weapons, it would more likely be based on considerations of international prestige than on security motivations.

In the second category are states that have embarked on a "dedicated path" toward acquiring nuclear weapons because of serious problems of security. A feeling of encirclement may prevail, and fears that the state may be dismembered or eliminated as a political entity may influence the decisions of its leaders. Nuclear weapons are perceived as the ultimate solution for survival. In some cases, the development of nuclear energy is an afterthought—or a cover for a nuclear weapons program. Of course, if it could be shown that nuclear energy constituted a commercially viable alternative to conventional sources of energy, it would be difficult to argue that the sole purpose of nuclear energy projects was the development of clandestine nuclear weapons. In those cases, the domestic debate invariably focuses on the external threat and the necessity of a nuclear weapons program to meet it, whether nuclear energy is viable or not.

Examples in this category are Israel, South Africa, and Pakistan. Both

Israel and the Republic of South Africa are essentially intrusive European communities in the Middle East and Africa who perceive themselves as surrounded by hostile Arab or Black African states, and who consider their ultimate means of survival to be the ability to acquire nuclear weapons and to threaten the massive destruction of those who would seek their annihilation. To a lesser extent, Pakistan may perceive nuclear weapons to be an effective way to correct the military imbalance on the subcontinent that is currently in favor of India. Pakistani fears remain strong that India may seek to undo the 1947 partition of India or may encourage the further dismemberment of Pakistan, as in the creation of Bangladesh in 1971. And, as in the case of Israel and South Africa, the survival of the state is perceived to be at stake; nuclear weapons may be considered a deterrent to prevent that ultimate catastrophe.

In these three countries, the risk of not possessing nuclear weapons may be seen as greater than the risk of possessing them. Although in recent years all three have sought to develop nuclear energy programs for presumably legitimate civilian purposes, their policies have followed concerted efforts to acquire a nuclear weapons capability short of demonstration. In this respect, they are no different from the existing nuclear powers who produce nuclear weapons for security reasons, whether nuclear energy is viable or not.

India, Taiwan, and South Korea fall somewhere in between. Like Pakistan, Israel, and South Africa, all three face serious regional security problems. During times of intense crises, the possession of nuclear weapons may be seen as useful for deterring an attack, though not necessarily as crucial to the state's survival. As long as India faces a nuclear threat from China only, it may be managed through diplomacy or by soliciting intervention on its behalf from the Soviet Union or the United States. Even if the credibility of external nuclear guarantees provided by the superpowers is low, there appears to be no issue at present between India and China that would invite a massive nuclear attack by China. Thus, the risk of not having nuclear weapons seems to be lower than the risk of possessing them.

South Korea and Taiwan perceive themselves as threatened by China and the Soviet Union. Nevertheless, they may believe that attempts to achieve an independent nuclear deterrent are not feasible or carry an even greater security risk. Continued acceptance of the American nuclear umbrella, however weak, may seem preferable to a provocative nuclear arms buildup that may invite preemption. Under these circumstances, the desirability of acquiring nuclear military capability remains ambiguous.

India, Taiwan, and South Korea, like Brazil and Argentina, have embarked on nuclear energy programs that are said to be independent of military needs. These civilian programs have generally preceded attempts to acquire a nuclear weapons capability. Limited domestic energy resources, costly dependence on oil imports, and vulnerability to shocks in the international energy market are usually given as rationales for developing nuclear energy. No doubt these reasons are also valid in the case of Israel, Pakistan, and South Africa. In fact, South Africa's inability to import oil from the OPEC nations has prompted it to embark on a nuclear energy program for reasons similar to those of India. While Brazil and Argentina, at one end of the spectrum, can do without nuclear weapons, Israel, and to a lesser extent, Pakistan and South Africa at the other, tend to perceive the acquisition of nuclear weapons capability on short notice as a matter of strategic necessity or even of survival. India, South Korea, and Taiwan lie in between; they are faced with various interlocking alternatives that carry both economic and defense objectives.

Table 1 places these countries, as well as Libya, Egypt, Iraq, and the Philippines, in three categories.

TABLE 1

TYPES OF NUCLEAR DEVELOPMENT IN THE THIRD WORLD

Defense-Oriented	*Development-Oriented*	*Defense and Development-Oriented*
Israel	Brazil	India
South Africa	Argentina	Taiwan
Pakistan	Philippines	South Korea
Libya		Egypt
		Iraq (?)

Classifying countries by whether their nuclear programs are defense- or development-oriented may be helpful in determining the type of policies needed to weaken incentives for acquiring nuclear weapons and to strengthen incentives for confining nuclear programs to peaceful purposes. States facing serious security problems should be encouraged to provide conventional defense alternatives and to resolve disputes in the region. States whose main motives are developmental should be aware of the greater security risks of acquiring nuclear weapons.

A major problem lies in the fact that there is little difference between a defense-oriented and a development-oriented nuclear program. If all states assert that they are following the Indian example, then the above distinctions may seem ambiguous and of dubious value. However, our classifications are based not only on the types of nuclear programs, but on an examination of the states' strategic environment and their security perspectives. For example, Pakistan's motives seemed apparent in the late 1970s and early 1980s, when it sought to acquire a uranium enrichment plant and a waste fuel reprocessing plant (both of which can be diverted to nuclear weapons production) even before a serious nuclear energy program had been established. Allegations that Israel possesses "bombs in the basement" continue to prevail. Today, even Pakistan is following the example of India by maintaining an ambiguity of purpose between defense and development in the nuclear sector. Similarly, Israel has begun to show some interest in acquiring a nuclear energy program although the obvious risks from suicidal terrorist attacks on its reactors should be apparent.

Finally, the development of space programs in the Third World has received little attention as part of the nuclear proliferation issue. One reason is that most of the potential nuclear proliferators do not need missile delivery systems to reach the strategic targets of their present or potential adversaries. The exception has been India, where perceptions of a Chinese nuclear threat have been one of the driving motivations for acquiring a nuclear weapons capability. Since most major Chinese cities and industrial bases are beyond the reach of Indian combat aircraft, an independent and survivable Indian nuclear deterrent against China would require the development of intermediate and long-range missiles capable of delivering warheads up to 6,000 miles away from southern launch bases in India. (At present, India's only rocket-launching base is at Thumba on the southern tip of the Indian peninsula—almost 3,000 miles from the Chinese border.)

Like the peaceful nuclear energy program, the peaceful space program may carry a double effect. Advances in rocket technology and capabilities not only improve India's satellite telecommunications and meteorological systems, but also provide it with potential ballistic missile delivery systems. A rocket need only be sent on a ballistic trajectory to hit targets on earth, while the weight of the satellite will determine the potential payload of warheads the missile may carry. An examination of the Indian space program should provide further insights on how defense and development objectives tend to interact. The Indian case, in turn, will furnish clues to the behavior of other threshold nuclear weapons states and the problems that must be faced in dealing with them.

THE INDIAN CASE

The policies and programs of India's Department of Atomic Energy and Department of Space suggest linkages between domestic economic policy and external strategic purpose, and between civilian development programs and military capabilities. First, the domestic-strategic linkages point to the external constraints on India's nuclear energy and space programs. The technological progress of the Atomic Energy and Space Department carries implications for the regional strategic balance and for global concerns regarding nuclear proliferation. Hence, there have been external efforts to limit or supervise India's development in these fields. Second, the civilian-military linkages point to the interdependence of economic development and defense programs in India, especially in the fields of nuclear energy and space. As noted earlier, development arguments in these fields may conceal a strategic rationale.

In view of these linkages, we are concerned with the domestic and strategic motivations and the civilian and military capabilities underlying India's nuclear and space programs, and with their implicit development and defense arguments.[1] The level at which these motivations interact determines the technological pace or momentum at which India's nuclear and space programs and capabilities may be expected to progress. Those interactions are depicted in Figure 1. (My perception of India's actual technological momentum is suggested in parentheses.)

This simple matrix hypothesizes four levels of technological momentum and growth that may be expected in India's nuclear and space programs based on the interaction of defense and development motivations. Since there are no technological "fixes" that can prevent the

		Defense Motivation	
		low threat	high threat
Development Motivation	cost-efficient	1 Moderate (Strong)	2 Strong (Intense)
	cost-inefficient	3 Weak (Moderate)	4 Moderate (Strong)

Figure 1
Determinations of India's Technological Momentum

[1] In a similar approach, Onkar Marwah conceived three potential strategic choices: (a) technical and managerial decisions and policies that generate capabilities allowing for a choice between a civilian and military nuclear and space program; (b) financial and economic decisions based on national priorities and opportunity costs; and (c) political and strategic decisions stemming from the growth of the civilian program. See Marwah, "India's Nuclear and Space Programs: Intent and Policy," *International Security* (Fall 1977), 97.

conversion of civilian nuclear programs into military programs, the incentive to push nuclear and space programs will depend on two factors: perceptions of the level of external threats that may be resolved through a buildup of nuclear weapons and missile delivery capabilities, and assessments of the commercial viability of civilian nuclear energy and rocket and satellite programs. The higher the perceived threat, the greater the need to establish strong technological capabilities for defense purposes. Similarly, the more cost-efficient the civilian program, the greater the impetus to achieve technological capabilities for development purposes. When the military and civilian conditions interact, the technological momentum in nuclear and space programs is strong (square 2).

The converse situation—a combination of low external threats and cost-inefficient civilian nuclear and space programs—will produce a weak technological momentum (square 3). Where the threat is low and the civilian nuclear program is cost-efficient, or where the threat is high and the civilian nuclear program is cost-inefficient, offsetting tendencies may be expected to produce a moderate technological momentum (squares 1 and 4, respectively).

The Indian experience suggests, however, that the technological momentum is greater at every level than suggested above. (See parentheses in the diagram.) In square 2 (high threat and cost-efficient), it is likely to be intense rather than merely strong. This situation is expected to prevail toward the end of the century. In square 3 (low threat and cost-inefficient), the momentum, as reflected in the period before the 1964 Chinese atomic test, appears to be moderate rather than weak. And in squares 1 and 4 (offsetting threats and costs), the momentum is likely to be strong rather than moderate. Square 4 reflects the present situation, in which Pakistan is attempting to acquire a nuclear weapons capability while the nuclear energy program in India still seems to be cost-inefficient compared to traditional sources of energy.

Reasons for the higher technological momentum at all levels are not hard to find. Before the 1962 Sino-Indian war and the Chinese atomic test in 1964, India's nuclear and space programs proceeded at a moderate pace. The primary objective during this period was development for long-term civilian needs. Growth in technological capabilities was partly independent of defense and perhaps of development needs; it was caused by the flood of technical manpower that has been released into the job market by Indian institutions of higher learning.[2] Among this group

[2] It has become a commonplace observation that India has the largest pool of scientists and engineers after the United States and the Soviet Union. Although the general quality

are a large number of highly qualified nuclear and space scientists and engineers who, unless they are absorbed by local development projects in their areas of expertise, may leave India for the industrialized West. Under these circumstances, it may be argued that it is technological availability that tends to determine the size of both development and defense programs, rather than the other way around.

Thus, although conceptually the technological momentum should appear to be moderate under squares 1 and 4 in the matrix (low threat/cost-efficient and high threat/cost-inefficient), in practice the Indian case suggests a strong rather than a moderate technological momentum. The difference between square 2 and squares 1 and 4 is that in the latter cases, there may be greater domestic controversy and debate before funds are allotted to nuclear and space programs.

The technological momentum is likely to be reduced if there are substantial external political pressures and technological constraints. Particularly after the Indian atomic test of 1974, the United States and other Western powers put considerable pressure on the government not to proceed further with its nuclear explosives program (peaceful or otherwise). Canada halted its technological cooperation with India, while the United States, under the self-imposed constraints of the Nuclear Non-Proliferation Act of 1978, sought to terminate its collaboration in the operation of the American-built nuclear reactor near Bombay. But these constraints may slow down the technological momentum only temporarily. If the civilian program is perceived to be cost-efficient and the external threat is perceived to be high (square 2), it is unlikely that external pressures and constraints will produce moderation in the long run. On the contrary, past external efforts to stem or stop the Indian nuclear program because of its allegedly covert military purposes have tended to produce a greater determination to go it alone.

The square 3 condition (a weak or moderate technological momentum) has not prevailed in India since the first Chinese atomic test of October 1964. Because of the perceived Chinese nuclear threat, India's defense policy makers have refused to give up their nuclear weapons option, which could be brandished explicitly or implicitly under conditions of crisis on the subcontinent. In fact, the Bangladesh crisis of 1971, when Chinese intervention was feared in an Indo-Pakistani war, may have led to India's decision to explode the first atomic device in May 1974.

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of much of this pool may not be comparable to Western standards, there is a core group—especially in the Departments of Atomic Energy and Space—that compares well with the best in the world.

On the domestic civilian level, Indian planners are convinced that nuclear energy will constitute the long-term solution to India's energy needs. There are few important dissenters on this official position. According to Raja Ramana, Director of the Bhabha Atomic Research Center and Secretary of India's Department of Atomic Energy,

> Looking at it with the experience of the past and the terrifying energy problems of the future, I can think of no other source of energy that has been discovered to date except nuclear energy, which can solve the energy problems of this country during the next 25 years and beyond.[3]

The hypothetical situation projected in square 3—a low level of threat and cost-inefficient development—remains the desired objective of U.S. nuclear nonproliferation policy abroad. The ability of the United States and other powers to persuade India to slow down or discard its "weapons-convertible" nuclear and space programs depends on two future conditions. First, it depends on the degree to which India's relations improve with its two traditional adversaries, Pakistan and China. In particular, perceptions of nuclear threat from these two directions would have to be reduced: Pakistan would have to give up its threat to become a nuclear power and China would have to start cutting back on its nuclear weapons development. Second, it depends on the demonstration that the recent failures of nuclear energy programs in the United States and elsewhere are of a permanent nature. India has been especially suspicious that Western claims of heavy cost overruns and safety hazards in the development of nuclear energy are partly based on the need to curb nuclear proliferation rather than on an objective assessment of nuclear energy's long-term contribution to civilian energy needs.[4]

Defense and Development Motivations

THE DEFENSE MOTIVATION

Two major phases may be discerned in India's efforts to acquire nuclear weapons capability. The Sino-Indian war of October 1962 and the testing of China's first atomic bomb two years later raised the issue of a nuclear threat from the north and brought about the debate over

[3] Ramana, "Inevitability of Atomic Energy in India's Power Programme," in Rajendra K. Pachauri, ed., *Energy Policy for India* (Delhi: Macmillan Company of India, 1980), 221-38, at 221.

[4] For the present, at least, there is little slowing down of India's technological momentum even though nuclear power plants have had to be shut down at Tarapur because of delays in the shipment of enriched uranium from the United States, and at Rajasthan because of the lack of heavy water.

whether to exercise India's nuclear option. This phase may be termed the traditional nuclear threat perspective. India first considered entering the second phase around the time of the 1971 Bangladesh crisis. When Sino-American rapprochement began to raise questions about the credibility of external nuclear guarantees against a possible Chinese nuclear threat, India tested its first atomic device. This second phase, beginning about 1974, may be termed the revised nuclear threat perspective.

The traditional nuclear threat perspective. Between the first Chinese atomic test in 1964 and the Indo-Pakistani war of December 1971, there was considerable debate in India on whether the nation should proceed to develop its own nuclear weapons. The Chinese military ultimatum to India during the Indo-Pakistani war of 1965, and the continuation of Chinese atomic tests thereafter, reinforced the case of the pro-bomb lobby in India. The basic argument was that, even if Chinese nuclear weapons development was directed mainly against the Soviet Union, there was no guarantee that China would not resort to (perhaps veiled) nuclear blackmail during times of crisis on the subcontinent.[5] Especially in view of the unexpectedness of the Sino-Indian war of 1962, proponents of the bomb maintained that the nuclear contingency should be taken into account in Indian defense preparations: according to this argument, maintaining ten mountain divisions—as India has done since 1963—may prove to be futile if the conventional threat from the north were to escalate to a nuclear level in future Sino-Indian confrontations.

The pro-bomb lobby—led in parliament at the time mainly by the Jan Sangh party—did not find many adherents. A nuclear India was considered more likely to increase the Chinese nuclear threat than to reduce it. Besides, the growing intensity of the Sino-Soviet rift, together with the continuing hostility of the United States toward the communist government in Beijing, held promise that one or both superpowers would restrain China from resorting to nuclear threats against India. Above all, nuclear weapons would serve no defensive or deterrent purpose while India lacked the delivery capabilities to attack Chinese nuclear launching systems or Chinese industrial centers. The Indian space program had started only in 1963 and was still a long way from developing its own rocket systems that could be converted into a ballistic missile delivery system.

While the government of India rejected the case for building nuclear weapons, it also rejected proposals that advocated the renunciation of

[5] For this argument, see General J. N. Chaudhuri, *India's Problems of National Security in the Seventies* (New Delhi: United Services Institution of India, 1973), 16-20.

nuclear weapons for moral reasons. Proponents of this alternative were found mainly among those who considered themselves disciples of Mahatma Gandhi. One of the more important of these was Morarji Desai, who was finance minister under both Nehru's and Indira Gandhi's Congress governments and later became prime minister in the Janata government. Although Desai had called upon the nation to make every sacrifice for the defense of the country after the 1962 Sino-Indian war, his subsequent attitude toward nuclear weapons—especially during his term as prime minister—suggested a preference for unilateral renunciation.[6]

India's nuclear policy during the years before the Bangladesh crisis of 1971 lay between these two extremes and may be termed the strategy of maintaining a nuclear weapons *option*. Under this policy, India did not actually make nuclear weapons, but constantly threatened to do so. Such a posture served a primary and specific, as well as a secondary and general, purpose. First, in view of the commitment of the two superpowers to stop the spread of nuclear weapons, both would presumably be anxious to provide India with credible nuclear guarantees against the Chinese nuclear threat in order to prevent it from carrying out its veiled threats to become a nuclear power. Second, India's threat to become a nuclear power was intended to pressure the existing nuclear "haves" into reducing and eventually eliminating their existing nuclear stockpiles.

While the first objective took care of the problem of the immediate Chinese nuclear threat, the second was expected to improve the general climate of international security and to provide benefits for India at the same time. Thus, by wielding the nuclear weapons option, India avoided the vulnerability of unilateral renunciation of nuclear weapons on the one hand, and the increased dangers involved in embarking on a nuclear arms race with China on the other. This approach proved to be a useful policy between the extremes of inaction (unilateral renunciation) and action (a nuclear weapons program).

The revised nuclear threat perspective. The traditional nuclear policy was discarded temporarily in May 1974, when the "option" was in fact carried out—i.e., when an underground atomic test was conducted at Pokharan in the Rajasthan desert. India thus joined the nuclear club, which until then had been confined to the five permanent members of

[6] Desai again reiterated this position in 1981, two years after the Janata government fell from power, when he called upon Prime Minister Indira Gandhi to renounce nuclear weapons. Ironically, Desai's preference for unilateral renunciation of nuclear weapons had been rejected earlier even by the majority of his colleagues in the Janata government. See *New York Times*, June 3, 1981.

the U.N. Security Council. Although the 1974 atomic test was officially declared to be for peaceful purposes, there were certain strategic and domestic political reasons for the decision. In its wake, new external reactions have arisen—especially in Pakistan—and have further transformed India's nuclear environment.

The initial motive for proceeding with plans to conduct an atomic test goes back to the Bangladesh crisis and the Indo-Pakistani war of 1971. During that prolonged crisis, efforts by President Nixon and Secretary of State Kissinger to seek the normalization of U.S. relations with China suddenly raised doubts about the credibility of external nuclear guarantees against China. The signing of the Indo-Soviet Treaty in August 1971 may be interpreted as the immediate Indian reaction to these global developments.[7]

In spite of the treaty, doubts remained about the long-term effects of the new Sino-American relationship on India's nuclear security. The nuclear indemnity provided by both superpowers against China before 1971 now seemed to have been reduced to a more dubious Soviet nuclear guarantee. Because the superpowers were perceived to neutralize each other with their retaliatory strike capabilities, potential Chinese nuclear threats appeared to be more credible. India's 1974 atomic test therefore may be seen as a delayed Indian response to the evolving global realignments.

In addition, the timing of the atomic test in May 1974 suggests a more immediate domestic political rationale. With the signing of the Simla Agreement between India and Pakistan in 1972, and simultaneous Indian efforts to normalize relations with China, the urgency of exercising the nuclear option had actually receded. On the other hand, by spring of 1974, Mrs. Gandhi faced serious economic and political problems at home. Inflation, crop failures, and the oil crisis had caused the economy to become sluggish.[8] The detonation of an atomic device in May 1974 may thus have been directed at the domestic political audience, to dampen the stirrings of political unrest and to generate national pride and solidarity.

[7] This treaty was intended as a deterrent against Chinese intervention. Articles 8, 9, and 10 carried clauses of a quasi-military nature, which pledged both sides not to assist each other's adversaries during times of conflict, and to enter into consultations during such times. Article 9 in particular suggested the possibility of Soviet military assistance to India during crisis conditions. For the full text of the Indo-Soviet Treaty, see *Current Digest of the Soviet Press* 23 (September 1971), 5.

[8] In 1973, the consumer price index had risen by 17.8% over the previous year, while the food price index had risen by 21.3%. In 1974, the inflation in consumer prices was running at 28% and in food prices at 31%, largely because of the drastic increases in the price of oil imports and the failure of the monsoon rains in 1973. Figures obtained from Surjit S. Bhalla, "India's Closed Economy and World Inflation," in William R. Cline and Associates, *World Inflation and the Developing Countries* (Washington, DC: Brookings Institution, 1981), 137.

Whatever the motives, the Indian atomic test triggered a Pakistani commitment to develop what Prime Minister Zulfikar Ali Bhutto called a "Muslim bomb." According to Indian assessments, the Pakistani nuclear bomb was being developed with indirect Libyan and perhaps Saudi financing, uranium supplies from Niger, and the clandestine transfer of equipment from Western Europe and North America.[9] The implications of these developments are far-reaching. Even if India's present dilemma stems from its decision to test a "peaceful" nuclear device, New Delhi may find the traditional policy of only threatening to exercise the nuclear weapons option to be unacceptable as long as Pakistan remains on the brink of nuclear weapons capability.[10] Pakistan's efforts to acquire a uranium enrichment plant and a reprocessing plant in response to India's 1974 test imply that both countries are already engaged in a covert nuclear arms race.

If the government of India chose to proceed along the seemingly irreversible path of a nuclear weapons program, it would have to take into account the effects on both a nuclear China and a nuclear Pakistan, especially in the context of the quasi-alliance that existed—and perhaps still exists—between the two. The question then would be whether the decision to embark on a nuclear weapons program would enhance or reduce India's security. Arguments may be advanced on both sides. In the case of China, the traditional Indian posture of only threatening to exercise the nuclear option seemed to ensure that China's nuclear arsenal would continue to be directed at the Soviet Union instead of India. With the proposed new Indian nuclear policy, China may be expected to direct some of its nuclear weapons at India; in fact, China would possess a credible deterrent against India based on a retaliatory strike capability.

The counterargument suggests that the growth of India's rocket and space programs, which in effect provides India with Intermediate Range Ballistic Missile (IRBM) capability, would soon produce a condition of mutual nuclear deterrence between China and India.[11] Even if the Indian

[9] A joint company, the Pakistani-Libyan Holding Company, set up in late 1978 by the Libyan and Pakistani governments for promoting industrial development in Pakistan, is considered by Indian observers to be the conduit for Libyan financing of Pakistan's nuclear bomb program. The Libyans, in turn, had purchased about 450 tons of unenriched uranium from the government of President Seyni Kountche of Niger, from where more such purchases are likely. See *Hindustan Times*, December 31, 1980, and *Washington Star*, April 14, 1981.

[10] There were indications in 1981 that Pakistan already had the capacity to test a nuclear device. See reports in the *New York Times*, April 28 and 30, 1981, and the *International Herald Tribune*, May 14, 1981. For a more recent report that Pakistan may have a nuclear weapons capability, see the *Washington Post*, February 10, 1984.

[11] Rodney Jones estimates that by the year 2000, India could possibly deploy 20 to 30 IRBMs as a counter-city deterrent capable of reaching China's urban interior, if not the

deterrence against China does not appear credible, the situation is not fundamentally different from the present one—namely, that India is dependent on Soviet nuclear guarantees against a nuclear China aligned with the United States—a situation that makes the Soviet nuclear guarantee weak. On the other hand, a nuclear India backed by a friendly Soviet Union and a nuclear China backed by a friendly United States would produce a symmetrical relationship between India and China that would be more stable.

In the case of Pakistan, the argument against producing nuclear weapons rests on the greater likelihood of an Indo-Pakistani nuclear war irrespective of rational policies of deterrence pursued by either side. Because of the intensity and emotion surrounding major Indo-Pakistani disputes and the history of three wars between the two countries, nuclear weapons are more likely to be used under conditions of mutual paranoia. In other words, even if a stable mutual deterrent situation could be established in theory (with both India and Pakistan possessing retaliatory strike capability), deterrence could break down in practice under conditions of extreme stress. Instead of pure deterrence, both sides may be tempted to adopt a nuclear war-fighting posture, which may in fact lead to nuclear war. Moreover, if war broke out, these weapons might be directed at civilian targets, especially nuclear power plants near densely populated areas, and could cause massive human suffering.

On the other hand, the argument for a nuclear weapons program in India rests on the assumption that Indian and Pakistani decision makers are no less rational and responsible than Soviet, American, or Chinese decision makers. On the contrary, the development of nuclear weapons by both India and Pakistan might eliminate direct wars between the two sides altogether, both nuclear and conventional.[12] The parallel here would be the absence of direct conventional wars between the United States and the Soviet Union because of the fear of escalation to nuclear levels. Similarly, on the subcontinent, there would be a tendency on the part of both India and Pakistan to avoid conventional wars because of the risks of escalation to nuclear levels. Besides, a nuclear arms race on the subcontinent would probably lead to Indian nuclear dominance and control—not unlike the situation between the Soviet Union and China, where the Soviets dominate the Chinese.

Pacific coast. See Jones, *Small Nuclear Forces*, The Washington Papers/103 (New York: Praeger Special Studies, 1984), 44.

[12] See T. T. Poulose, *Nuclear Proliferation and the Third World* (New Delhi: ABC Publishing House, 1982), 4-12, and Donald L. Clark, "Could We Be Wrong?" *Air University Review* 29 (September-October 1978), 28-37.

Can India's security motivations for acquiring nuclear weapons be curbed? Although the country may be willing to tolerate a nuclear China on its border simply because it has done so for 20 years, it is not likely to tolerate a nuclear Pakistan. The real issue then is whether Pakistan will accept an India with overwhelming conventional military superiority, or will seek nuclear weapons to offset it. The key to weakening the defense incentive in India would be to lessen security fears in Pakistan against a dominant India. This would be of greater importance than assuaging Indian security fears against a dominant China. However, as long as China continues to build its nuclear weapons capability, India is unlikely to pledge not to undertake any further nuclear tests. Such a renunciation would make India give up even its traditional strategy of maintaining the nuclear weapons option. Under these circumstances, current Indian policy must assume that the China-India-Pakistan nuclear chain is difficult to break. Thus, whether the civilian nuclear energy and space programs are viable or not, the continuation of these programs is perceived to be essential from the defense standpoint.

THE DEVELOPMENT MOTIVATION

Programs pursued under the aegis of the Departments of Atomic Energy and Space are not classified as defense-related programs. According to the official Indian position, all such programs are intended for peaceful purposes, even if there are latent military applications. For instance, according to the 1980-1981 official report of the Department of Atomic Energy,

> the atomic energy programme has as its objective [the] generation of electrical power from nuclear energy, and utilisation of radioactive isotopes for bringing about improvements in agriculture, medicine, industry, research and many other areas.[13]

The report of the Department of Space declared in the same year that

> the basic application objectives of the Indian Space Programme can be summed up as Satellite Communications and Resources Survey. All other activities like research and development of satellite and launch vehicle technologies, etc., are designed to contribute towards achieving the above goals.[14]

Even the first atomic test in May 1974 was declared to fall under the category of "peaceful nuclear explosions" with potential long-term applications in dam building, irrigation, and mining.

[13] *Report: 1980-81*, Department of Atomic Energy, Government of India, p. 3.
[14] *Report: 1980-81*, Department of Space, Government of India, p. 8.

For the most part, India's nuclear and space programs have been planned for civilian benefit, even though their growth has been reinforced by strategic arguments that emphasize the need to maintain the military options available through them. This has been particularly evident in the nuclear energy program, but is also implicit in the space program.

Nuclear energy and energy policy. At the end of the Fifth Five-Year Plan in 1979, India's nuclear reactors generated less than 3 percent of electricity for the urban and manufacturing sectors of the economy, compared to 38 percent generated by hydroelectric plants, 58 percent by coal-fired thermal plants, and one percent by oil-fired plants.[15] (See Table 2.) Oil is utilized mainly in the petrochemical industry and the transportation sector. Planned development of electricity-generating capacity until the year 2000 for the industrial and urban sectors gives relatively little weight to oil-fired power stations. Instead, Indian energy policy will continue to emphasize coal-fired thermal plants and hydroelectric generators, while nuclear energy will be used to make up critical shortfalls that may occur in the future.

The degree to which India will rely on hydro, thermal, and nuclear electricity-generating capacities respectively is based on various economic and technological arguments. Certain problems associated with hydroelectric and coal-fired plants tend to reinforce the arguments for developing nuclear energy. In the case of hydroelectric sources of power, the main constraints lie in the number and location of the major rivers in India, and the long and expensive gestation period between planning and commissioning, which can be as much as ten years.[16] Nevertheless, as the Planning Commission's report on energy policy in 1979 pointed out, hydroelectric power provides a cheap, clean, and self-renewable source of energy, and the river dams from which it is drawn furnish extended irrigation benefits for the region.[17] The Planning Commission's energy report also indicated that only 10 percent of India's hydroelectric generating capacity had been harnessed so far. The report stated that, while coal will remain in the ground for later use if unexploited, re-

[15] According to the report of the Indian Ministry of Energy, the electricity generated in 1981-1982 by coal-fired thermal plants was 63,644 million kilowatt hours (MKWH) or 56% of total generated; by hydro, 45,623 MKWH or 40.6%; and by nuclear power, 2,867 MKWH or 2.5%. From *Report: 1981-82*, Ministry of Energy, Department of Power, Government of India, p. 7. The figures in the text were obtained from Ramana (fn. 3), 224.

[16] See the *Estimates Committee, 1977-78*, Sixth Lok Sabha, 16th Report, Ministry of Energy (New Delhi: Lok Sabha Secretariat, 1978), 53.

[17] *Report of the Working Group on Energy Policy 1979*, Planning Commission, Government of India, 1979, p. iv.

TABLE 2
INDIA'S NUCLEAR ENERGY PROGRAM

A. COMPARISON OF INSTALLED ELECTRICITY GENERATING CAPACITY (MWE)

	Hydro	*Thermal*	*Nuclear*	*Total*
End of 5th Plan (1979)	11,610 (38%)	16,450 (58%)	1,095 (2%)	29,163

B. 1979 PROJECTIONS OF NUCLEAR POWER GENERATING CAPACITY

1981	1,740 MWe	(unrealized)
1991	8,620 MWe	(likely achievement: 5,000 MWe)
2000	10,000 MWe	(likely achievement: 8,000 MWe)

C. EXISTING NUCLEAR PLANTS
(Capacities installed or being completed in 1983)

Tarapur, Bombay	(TAPP-1 & -2)	400 MWe	(Light Water Reactors)
Kota, Rajasthan	(RAPP-1 & -2)	400 MWe	(Heavy Water Reactors)
Kalpakkam, Madras	(MAPP-1 & -2)	470 MWe	(Heavy Water Reactors)
Narora, U. P.	(NAPP-1 & -2)	470 MWe	(Heavy Water Reactors)
Total Capacity		1,740 MWe	

D. FUTURE PLANNED CAPACITIES
(All the reactors noted here are indigenous)

10 Narora-types to year 1990	235 MWe each (2,350 MWe)
12 New standardized design to the year 2000	500 MWe each (6,000 MWe)

E. HEAVY WATER PLANTS
(Installed capacities but not necessarily operational)

Kota, Rajasthan	110 metric tonnes per year
Baroda, Gujerat	67 metric tonnes per year
Tuticorn, Tamil Nadu	71 metric tonnes per year
Talcher, Andhra Pradesh	62 metric tonnes per year
Nangal, Punjab	14 metric tonnes per year

F. NUCLEAR RESEARCH REACTORS

Apsara, Cirus, Zerlina, Purnima
14 MW Fast Breeder Test Reactor
100 MW Thermal Research Reactor (Dhruva reactor)

G. PLUTONIUM EXTRACTION CAPACITIES

Tarapur	100 kilograms of plutonium per year
Kalpakkam	100 kilograms of plutonium per year
Cirus Research Reactor	40 kilograms of plutonium per year
Dhruva Research Reactor	100 kilograms of plutonium per year

Note: MWE = Megawatts of electricity generated.
Sources: Compiled by the author from the annual and *ad hoc* reports of India's Department of Atomic Energy, Ministry of Energy, Ministry of Information and Broadcasting, and from Indian and American newspaper reports.

newable hydroelectric potential is being lost annually because of the failure to harness India's rivers.

The continued heavy dependence on coal is due largely to the abundant availability of this resource in India. The total proven reserves of coal have been estimated at about 111.6 billion tonnes, composed of 89.1 billion tonnes of non-coking variety and 22.5 billion tonnes of coking variety.[18] The production of coal in 1981-1982 was estimated at 121 million tonnes, and was expected to rise to 165 million tonnes by the end of the Sixth Five-Year Plan in 1984. While there are indications that coal production may reach 470 million tonnes by the year 2000, a more realistic assessment, according to the Estimates Committee of the Lok Sabha, was about 350 million tonnes.[19] Despite the anticipated increased use of coal in the future, India is expected to have a comfortable supply for over a hundred years.

A major problem, apart from the well-known health and safety hazards of coal mining, arises with geographical location. The bulk of India's coal reserves is found in the three contiguous states of West Bengal, Bihar, and Orissa. This regional concentration of coal deposits raises the need for extensive railway transportation if that fuel is to be used in thermal plants throughout India. Estimates for the year 2000 indicate that between 15 and 20 percent of all railway traffic in India will be involved in hauling coal for power generation.[20]

Heavy reliance on coal-fired plants also raises a serious political risk—namely, that the powerful All-India Railwaymen's Federation could bring virtually all major industries to a halt by embarking on a prolonged strike. The seriousness of this internal threat is best exemplified by the crisis of 1974, when the Federation successfully launched a nationwide strike of nearly two million railway workers.[21] With most power plants stockpiling less than two weeks' coal supplies, power had to be severely rationed at major industrial cities which were dependent on electricity from coal-fired plants. Furthermore, as in the case of the supply of oil from Assam, which was often disrupted by political disturbances in that state between 1979 and 1983, West Bengal, Orissa, and Bihar could embark on political blackmail against the rest of India. All four eastern states would thus have undue political leverage through their ability to control the supply of much of India's energy needs.

[18] *Report: 1981-82* (fn. 15), 19. Quantities are in metric tonnes.

[19] *Estimates Committee* (fn. 16), 53.

[20] Pachauri (fn. 3), 15 and 32; also see *India: 1980*, Ministry of Information and Broadcasting, Government of India, p. 287.

[21] See Robert L. Hargrave, *India: Government and Politics in a Developing Nation* (New York: Harcourt Brace Jovanovich, 1980), 132.

Indian nuclear scientists and engineers have argued that coal-generated electricity is not necessarily cheaper than nuclear-generated electricity. According to Raja Ramana, the apparent higher cost of nuclear power over coal power arises from the nature of cost accounting applied to these two souces of energy.[22] In a nuclear power program, capital investment is needed in associated sectors such as the production of heavy water and the setting up of various projects that would establish control over the nuclear fuel cycle. The entire capital outlay is included in the assessment of the average cost of nuclear-generated electricity. Table 3 shows the comparative costs of power (based on 1977 figures) when similar accounting is applied to coal-generated electricity.[23]

TABLE 3
COMPARATIVE COSTS OF POWER PRODUCTION

Coal-fired		*Nuclear*	
Cost Component	*Investment Rs/KWe*	*Cost Component*	*Investment Rs/KWe*
Power station	4,500	Power station	5,000
Coal mines	750	Heavy water plants	495
Coal transportation	1,000	Uranium exploration	65
—	—	Uranium mining	295
—	—	Fuel fabrication	185
—	—	Fuel reprocessing	135
Total	6,250	Total	6,175

Note: Rs/KWe = Rupees per kilowatt of electricity generated.
Source: Ramana (fn. 3), 235.

The drawbacks of coal-fired and hydroelectric plants notwithstanding, these sources of energy will continue to generate the bulk of electricity in India for several decades to come. Nevertheless, the growth in these means of generating capacity is not expected to keep pace with industrial and urban demand. Projections beyond the year 2000 suggest shortfalls of up to 20 percent. The gap cannot be filled by oil. Almost all future oil procurements are expected to be absorbed by the petrochemical, household, and transportation sectors of the economy. Moreover, the cost of imported oil is high, and domestic oil reserves are too limited to meet industrial demand. Consequently, Indian nuclear scientists and

[22] See Ramana (fn. 3).

[23] *Ibid.*, 235. Another official discussion demonstrating the comparative advantages of nuclear power over coal-generated power may be seen in the brief section, "Economics of Nuclear Power," in *Performance Budget of the Department of Atomic Energy, 1980-81*, Department of Atomic Energy, Government of India, pp. 3-5.

economic planners believe that the projected gap between industrial demand and electricity-generating capacity can only be filled by nuclear energy.[24] Despite the present relatively small consumption, nuclear energy is therefore expected to play a critical role in India's development strategy.

In 1984, India had nuclear power stations at four locations—in the states of Maharashtra (Tarapur, Bombay), Rajasthan (Kotah), Tamil Nadu (Kalpakkam, Madras), and Uttar Pradesh (Narora). (See Table 2.) The Tarapur station has a capacity of 400 Megawatts of electricity (MWe), Rajasthan has a capacity of 400 MWe, and Kalpakkam and Narora have a capacity of 470 MWe each. When all these units are fully commissioned by the mid-1980s, India will have a total nuclear electricity-generating capacity of 1740 MWe. In 1981, the total installed nuclear capacity was 860 MWe.[25]

Further, there are plans to have ten Narora-type 235 MWe reactors in operation by the early 1990s, with twelve additional 500 MWe reactors on line by the year 2000. If these goals are attained, there will be 10,000 MWe of nuclear electric power in the power grids of India by the turn of the century. (According to assessments by the 1977-78 Estimates Committee of the Indian parliament and the Indian Planning Commission's 1979 Report of the Working Group on Energy Policy, however, major shortfalls are likely; actual installed capacity may be closer to 5,000 to 8,000 MWe.)[26] Development is expected to move from dependence on natural uranium-fueled heavy water reactors, to the use of fast-breeder reactors, and finally to the employment of primarily thorium-fueled fast-breeder reactors. Because India has vast quantities of thorium, the third stage of development is expected to make the nuclear energy program cost-efficient. Needless to say, all of these development rationalizations and programs would substantially increase India's nuclear weapons capability.[27]

[24] Octave J. Du Temple, "Nuclear Power in India: Responding to a Crying Need," *Nuclear News* 24 (February 1981), 64-66. Also see the views of R. Ramana (fn. 3), and M. T. Srinivasan, "Where Should All the Energy Come From?" *Times of India*, December 7, 1980. Ramana, as noted earlier, is Director of the Bhabha Atomic Research Center and Secretary to India's Department of Atomic Energy; Srinivasan is the Director of the power projects engineering division of the Department of Atomic Energy.

[25] *Nuclear News* (February 1981); *Estimates Committee, 1977-78* (fn. 16), 216-41.

[26] Assessments of nuclear electricity-generating capacity in the future vary. According to government forecasts, India will achieve installed capacity of 8,000 MWe by the year 1991, and 10,000 MWe by 2001. See especially *Report: 1980-81* (fn. 13), 3. The Estimates Committee, however, forecasts the attainment of only 6,000 MWe by 1991, while the Energy Policy report of the Planning Commission predicts only 5,000 MWe by 2001. Figures from *Estimates Committee, 1977-78* (fn. 16), 222, and *Report of the Working Group on Energy Policy, 1979* (fn. 17), 65.

[27] Apart from the nuclear energy program, research and development at the Bhabha

Civilian uses of the space program. Parallel strides have been made in India's space program. The Indian Space Research Organization has one of the country's largest and most successful groups of scientists and technocrats. For the decade 1980-1990, the government tentatively allotted Rs. 800 crores (about $1 billion at 1980 exchange rates) for the space program, an amount that is likely to be revised upward substantially in the years to come. As many as 23 satellites, including three major ones with payloads in the 450-600 kilogram range, are expected to be launched during the next ten years.[28] (See Table 4.) These satellites are part of the development program in telecommunications, meteorology, and resource survey. In addition, the development of space-launch vehicles is intended to reduce India's current dependence on Soviet, American, and European launch vehicles for locating these satellites in space.

The most important of the satellite development programs is the first-generation Indian National Satellite System (INSAT-1). This is a multipurpose system for domestic telecommunications and metereology that would allow nationwide direct television and radio broadcasting, network broadcasting, and weather forecasting.[29] The Department of Space has the responsibility for the establishment and operation of the INSAT-1 space segment; the Indian Posts & Telegraphs Department (under the Ministry of Communications) manages and utilizes the telecommunications ground segment of the operations; and the Indian Meteorological Department (under the Ministry of Tourism and Civil Aviation) manages and utilizes the meteorological ground segment. The responsibility for radio and television utilization rests with the Ministry of Information and Broadcasting.

India's other satellite series, Bhaskara-1 and Bhaskara-2 (also referred to as Satellite for Earth Observation SEO-1 and SEO-2), have been the means for conducting detailed studies of atmospheric processes relating

Atomic Research Center (BARC) promotes the development and application of radioactive isotopes and radiation in various fields such as medicine, agriculture, and industry. BARC's activities encompass the development of over 350 radioactive products that are supplied to some 500 institutions in India and abroad. These products range from radio isotopes for industrial radiography to those used in the diagnosis and treatment of diseases. During the year 1980-1981, BARC supplied over 44,000 consignments of radio isotopes within the country, and exported agrochemicals to Brazil, Indonesia, Sri Lanka, and Zambia. BARC also runs a plant for radiation sterilization of medical products; its services are offered to hospitals and to the manufacturers of medical products. Finally, BARC has set up a seismic station near Bangalore for the detection and identification of earthquakes and underground nuclear explosions, and a high-altitude research laboratory at Gulmarg. *Report: 1980-81* (fn. 13), 5.

[28] See *Hindustan Times*, December 15 and 30, 1980, and *Times of India*, December 15, 1980.

[29] From *Report: 1980-81* (fn. 14), 8 and 11-15.

TABLE 4
SUMMARY OF SATELLITES AND LAUNCH VEHICLES

Satellite	*Date of Launch*	*Launch Vehicle*
Aryabhata (360 kg.) Indian design and make	April 1975	Soviet rocket carrier
Bhaskara-I (444 kg.) Indian design and make	June 1979	Soviet Intercosmos spacecraft
Rohini-1 (35 kg.) Indian design and make	July 1980	Indian-made rocket SLV-3-E-02
Rohini D-1 (41 kg.) Indian design and make	May 1981	Indian-made rocket SLV-3-D-01
APPLE (670 kg.) Indian design and make	June 1981	European Space Agency's Ariane rocket
Bhaskara-II (447 kg.) Indian design and make	November 1981	Soviet Intercosmos spacecraft
INSAT-IA (1,050 kg.) Indian design; U.S. make	April 1982	United States Delta rocket carrier
INSAT-IB (1,193 kg.) Indian design; U.S. make	August 1983	United States space shuttle Challenger

Planned Future Satellites and Launch Vehicles (1984-1990)
(All projects are indigenous)

SATELLITES:
- Indian Remote Satellite (IRS-1): approximate weight, 600 kg.
- Stretched Rohini Satellite Series (SROSS)
- INSAT-II series and Proto-INSAT

SPACE-LAUNCH VEHICLES:
- Augmented Satellite Launch Vehicle (ASLV): payload, 150 kg.; altitude, 400 km.
- Polar Satellite Launch Vehicle (PSLV): payload, 600 kg.; altitude, 500-1000 km.
- Vikas rocket: payload, 600 kg.; altitude 900 km.

Source: Compiled by the author from the annual *Reports* of the Department of Space, Government of India.

to monsoons, cyclones, and other tropical weather disturbances. Estimates have been made of moisture content in the atmosphere and the rate of rainfall over oceans; the mapping of flooded and nonflooded areas during monsoons has been used for flood control and relief efforts. Three additional experimental Indian-made satellites have been launched. The Rohini Satellite (RS-1) and the Rohini Satellite for Development (RS-D-1) were intended to support the Indian rocket-launch vehicle program by conducting upper atmospheric research and space experiments. Both were launched by the indigenous and experimental Satellite Launch Vehicle (SLV-3-E-02) and the developmental Satellite Launch Vehicle (SLV-3-D-01). The third, the Ariane Passenger Payload Experiment (APPLE), was developed in India and launched by Ariane, the European space agency in France. The project provided the opportunity to develop Indian competence in building a three-axis stabilized geostationary telecommunications satellite. With the successful completion of the experimental phase of satellite development for remote sensing applications, the space program has started to develop a series of semi-operational Indian Remote Sensing satellites (IRS-1), which are to be completed and launched in the mid-1980s.

The Defense-Development Relationship

The above analysis raises two basic questions. First, are the Indian nuclear and space programs driven primarily by defense or by development objectives? Second, are these programs cost-efficient? The official assertion has been that they are part of the overall development effort, and that they carry significant civilian benefits. External critics have alleged that the allocation of funds to these programs is evidence of lopsided priorities in development planning, and that the programs are intended primarily to maintain India's nuclear weapons option and missile delivery capabilities.

Allegations of military motives behind India's nuclear energy development rest mainly on the comparative commercial viability of nuclear power as compared to coal-fired thermal and hydroelectric power available. Recent cost estimates in the United States, West Germany, Japan, France, and other Western states suggest that the early optimism about obtaining nuclear energy from light-water and heavy-water reactors, and subsequently from fast-breeder reactors, appears to have been misplaced. The scarcity and high cost of uranium resources, the high capital cost and growing technical complexities in nuclear plant design and operation, as well as fears of environmental hazards, are said to have greatly reduced the prospects of commercial nuclear energy.

The Indian answer to these assertions has been that much of the American pessimism regarding the future of nuclear energy is caused by fears of nuclear proliferation. It was no accident that decisions to slow down the nuclear power program and to forgo for the time being the development of fast-breeder reactors in the United States were adopted by the Carter administration, which was committed to a strict policy of curbing nuclear proliferation abroad. A demonstration in the United States of the long-term commercial viability of nuclear power would probably prompt several Third World countries to embark on nuclear power programs. Ultimate control of the nuclear fuel cycle by these countries through the acquisition of enrichment or reprocessing plants would enable them to gain a nuclear weapons capability. American domestic energy policy may therefore be partially dictated by the need to curb nuclear weapons proliferation abroad.

From the defense standpoint, a major argument suggesting the peaceful intent behind Indian nuclear energy development is that a nuclear weapons program would be much less cost-effective than the present conventional defense program. De Gaulle's idea that a nuclear weapons program could conceivably reduce the overall cost of France's defense effort by reducing the need for conventional forces does not appear to be relevant in the Indian case. In India, one of the major economic criteria of any defense program is whether it is labor-intensive or capital-intensive. In a country with an abundance of cheap labor, proposed defense programs that are capital-intensive require a convincing strategic justification. For this reason, labor-intensive army programs have generally consumed between 65 and 70 percent of the annual funds allocated to India's defense.[30] By comparison, the more capital-intensive air force and navy programs have received an average of about 20 and 10 percent, respectively, of the annual defense allocations. This type of defense planning has produced corresponding programs in Pakistan, thus providing a self-perpetuating strategic justification for emphasizing conventional army programs.

In light of these economic and strategic rationales, a nuclear weapons program would appear unattractive and self-defeating in India. It would employ only a small scientific community, which in 1981-1982 amounted to 19,158 scientific and technical personnel and 12,498 administrative and auxiliary staff in the Department of Atomic Energy, and 7,136 and 4,172 in the Department of Space.[31] Moreover, such a program could trigger nuclear responses in Pakistan and China, which would result in a costly nuclear arms race in South Asia—leading to less security at a higher price.

Unlike the nuclear energy program whose cost and performance can be assessed against alternative energy sources such as coal, oil, and

[30] For the rationales underlying the distribution of the Indian defense budget, see Raju G. C. Thomas, "The Armed Services and the Indian Defense Budget, *Asian Survey* (March 1980), 280-97.

[31] From *Report: 1980-81* (fn. 13), 5; and *Report: 1980-81* (fn. 14), 37.

hydroelectric power, the space program does not lend itself to comparisons. It would also be difficult to propose "alternative" space programs that would not carry military implications. Again, there are no technological "fixes" between civilian and military programs. Space programs are therefore simply deemed essential for India's development effort and seemingly justifiable within reasonable cost. There can be no substitution. Self-reliance in satellite and satellite-launch technology for telecommunications and related civilian purposes is merely part of the overall development strategy. The major constraining factor would appear to be the level of technological know-how available in the country.

One major difference between the development and defense sectors is the higher standard of production and efficiency demanded by the latter. The quality of equipment produced in India for the military must meet the standards of the equipment that India's adversaries can obtain from the advanced industrialized countries. This objective has been achieved generally in small arms and ammunition and light weapon systems such as tanks, armored personnel carriers, and artillery, but there is a considerable measure of dependence on external sources in the procurement of more sophisticated conventional weapon systems, such as combat aircraft, destroyers, submarines, and the like. India's modest defense and civilian research-and-development activities cannot keep pace with the technological growth of the advanced industrialized countries. Fortunately, India has thus far been able to obtain external technological assistance for the production of weapons at home, and to purchase weapons from abroad.

Because the level of scientific and technological capabilities needed in the nuclear and space programs—whether civilian or military—is high, these programs have been dependent on a large measure of external technological cooperation. Two basic and related differences exist, however, between conventional defense or defense-related civilian programs and the nuclear and space programs. First, the military purpose underlying conventional defense procurement has not curtailed technological and military assistance from abroad. In the case of nuclear and space programs, even suspicion that these might be intended for military purposes could terminate all foreign assistance. Second, because there is constant fear that foreign technical assistance may be suddenly cut off if there is a diversion from civilian to military purposes, the growth of indigenous technological capability in the nuclear and space programs has been much more rapid than in the conventional defense programs. The scientific and engineering community in the Indian nuclear and space programs consists of a highly elite group whose standards compare favorably with their counterparts in the advanced industrialized countries.

In the ultimate analysis, India's intentions may be judged simply from the level of technological capabilities, whether for development or defense purposes. Does the technology achieved in the civilian nuclear and space programs provide India with credible nuclear weapons and delivery systems? The answer to this question is yes—if not now, then at least in the near future.

At present the Tarapur and Kalpakkam nuclear reactors each carry reprocessing capacities of approximately 100 to 135 metric tonnes of spent uranium fuel, from which each can extract about 100 kilograms of weapons-grade plutonium.[32] The fissile plutonium-239 could also be extracted from the 40 MW Cirus research reactor built earlier with Canadian assistance. This reactor provided the plutonium for the first Indian atomic test in 1974. The 100 MW thermal research reactor, the Dhruva reactor built by Indian engineers, will provide the capacity to generate another 100 kilograms of plutonium a year. The Dhruva reactor by itself not only would provide India with enough plutonium to build about 12 bombs a year, but would also reduce the time needed to fabricate bombs from about two years (as in the first atomic test) to a matter of weeks.[33] In addition, the commissioning of fast-breeder reactors on a commercial scale in the 1990s would enable India to stockpile large numbers of nuclear warheads.

The dual development and defense purpose of India's nuclear program may be seen in the official announcement in August 1985 indicating the scheduled opening of the Dhruva reactor later in the fall. While Indian officials pointed out that the reactor was a research reactor that would help produce radioactive isotopes for use in industry, agriculture, and medicine, they simultaneously warned Pakistan not to embark on a nuclear weapons program because of the new Indian capability.[34] It is important to note that, unlike reactors built with Canadian and American assistance from which India could extract weapons-grade materials, the Dhruva reactor is entirely Indian-made and not subject to international inspection.

As to delivery systems, India can drop bombs on Pakistan with its

[32] See Leonard S. Spector, *Nuclear Proliferation Today* (New York: Vintage Books, 1984), 67. See also a report by *Los Angeles Times* correspondent Tyler Marshall, reproduced in the *Boston Globe*, March 1981, according to which the Tarapur and Kalpakkam reactors could generate about 880 lbs. of weapons-grade plutonium a year.

[33] *Wall Street Journal*, November 26, 1984.

[34] *New York Times*, August 11, 1985. During the construction stage, the Dhruva reactor was referred to as the R-5 facility.

newly acquired Anglo-French Jaguar aircraft—as can Pakistan on India with the French Mirage-III and more recently acquired American F-16 aircraft. This delivery capability will be increased when India acquires Soviet MiG-29s and French Mirage-2000s. The space program carries strategic relevance mainly with respect to China and the rest of the world. At present, the Indian-made SLV-3 rocket can be launched on a ballistic trajectory with appropriate boosters in the rocket's three stages so as to achieve an IRBM capability for carrying a small warhead. The development of the ASLV and PSLV rockets will further increase the ballistic range and payload. And, with the projected development of the SPSLV rocket by the mid-to-late 1990s, India will have an ICBM capability for carrying multiple warheads, with strategic implications for the superpowers as well.[35]

Conclusion

India's civilian nuclear energy and space programs, whether intended or not, provide the country with nuclear weapons and strategic nuclear delivery vehicles. In this respect, the nuclear and space programs are not different from several other developmental projects that have military implications. Development in the aeronautical, shipbuilding, automotive, electronics, metallurgical, mechanical, and civil engineering industries automatically carries indirect military benefits. The central point, therefore, is not whether India's motives are developmental *or* strategic. The rationale for India's nuclear and space programs is provided by the future combination of energy, telecommunications, and other development requirements in the civilian sector, and strategic necessities in the defense sector. The development sector provides the technological capability; the defense sector can utilize the latter if it demonstrates the need.

Real or potential nuclear threats from China and Pakistan, and the general lack of credibility of external nuclear guarantees, require that India maintain its nuclear weapons and strategic delivery capability options provided by civilian nuclear energy and space programs. This long-term defense imperative justifies the continuation of nuclear and space programs no matter what the current commercial viability of these programs. Finally, through circular reasoning, India could embark on nuclear weapons and missile programs on the grounds that they would involve only an *incremental* cost over civilian nuclear and space programs.

[35] See Anita Bhatia, "India's Space Program: Cause for Concern?" *Asian Survey* 25 (October 1985), 1013-30, and Jones (fn. 11).

Under such conditions, the nuclear weapons alternative would appear to be cost-effective when compared to current conventional military programs. Thus, while neither the civilian nor the military programs may appear cost-effective when considered separately, together they provide a mutually reinforcing defense-development justification that continues to propel India's technological capabilities in these areas at a rapid pace.