GAUGING U.S.-INDIAN STRATEGIC COOPERATION

Edited by
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FOREWORD

The following volume consists of research that the Nonproliferation Policy Education Center (NPEC) commissioned and vetted throughout 2006. For at least half of the chapters, authors presented versions of their work as testimony before Congressional oversight committees. Among them are some of the sharpest critics and staunchest boosters of U.S.-Indian nuclear and strategic cooperation. No matter what one's point of view, though, these chapters deserve close attention since all are focused on what is needed to assure U.S.-Indian strategic cooperation succeeds. The volume offers U.S. and Indian policy and law makers a detailed checklist of things to watch, avoid, and try to achieve.

Funding for this project came from the Catherine D. MacArthur Foundation. Ashley Tellis and George Perkovich of the Carnegie Endowment, Gary Schmitt of the American Enterprise Institute, Gary Samore from the Council on Foreign Relations, Robert Einhorn of the Center for Strategic and International Studies, a select number of officials within the U.S. Executive Branch, and numerous aides serving on Capitol Hill provided guidance and assistance.

Special thanks is due to Ali Naqvi, NPEC's project manager, who was saddled with the responsibility of arranging the many dinner seminars at which each chapter was shared with Capitol Hill and Executive Branch Staff, embassy officials, policy analysts, and the press. Finally, this is the eighth in a series of edited volumes NPEC has produced with the Strategic Studies Institute (SSI). To the book's authors, the SSI staff, and all those who made this book possible, NPEC and SSI are indebted.

HENRY SOKOLSKI
Executive Director
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CHAPTER 1

NEGOTIATING THE OBSTACLES TO U.S.-INDIAN STRATEGIC COOPERATION

Henry Sokolski

As this volume goes to press, the Henry J. Hyde U.S.-India Atomic Energy Cooperation Act of 2006 became the law of land. Passage of this legislation, which was 16 months in the making, was heralded by its backers as the most significant U.S. strategic development since the end of the Cold War. In at least three respects, though, the law has yet to be implemented and its strategic implications are still unclear.

First, U.S. nuclear cooperation—the lynch pin of U.S.-Indian strategic cooperation, according to the deal's supporters—has to navigate several necessary steps. India has not yet negotiated a nuclear cooperative agreement with the United States. This will take several months. The key issues here include nuclear testing and the sharing of nuclear fuel technology. In the first instance, India objects to congressional demands that all nuclear cooperation be terminated if India tests; in the second, Congress opposes such sharing unless the transfers are part of a larger nonproliferation effort.

Also, because India has not signed the Nuclear Nonproliferation Treaty (NPT) and refuses to open all of its nuclear facilities to international inspections, it is not yet eligible to import controlled nuclear goods from the United States or any other of the 44 members of the Nuclear Suppliers Group (NSG). To change this, the NSG must agree by consensus to make an exception for India. It is unclear how this might work. China (an NSG member) has offered nuclear cooperation to India, but has argued that any exception for India should be framed in such a way also to allow nuclear transfers to Pakistan as well. Several NSG members, including Sweden, also seem uncomfortable approving civilian nuclear cooperation unless India does more to restrain its nuclear weapons program.

In any case, before the NSG is likely to approve any exception for India, it must reach at least a tentative agreement with the International Atomic Energy Agency (IAEA) regarding the inspection of eight additional civilian Indian reactors. India is insisting that these plants only be inspected if and when they contain foreign fuel. IAEA officials, meanwhile, are resisting this proposal for fear that it will become a new lower standard for IAEA inspections for other countries. In addition, several NSG members are anxious to do nothing that might let India believe that it can test nuclear weapons and continue to receive civilian nuclear assistance. Finally, under the legislation President Bush recently signed, a U.S. nuclear cooperative agreement must be completely negotiated, an NSG waiver agreed to, and all of the legal steps necessary to conclude an IAEA safeguards agreement implemented *before* Congress can consider approving U.S nuclear cooperation with India.

Assuming all of these conditions will be met, U.S.-Indian strategic cooperation will proceed. A new raft of questions, however, will then immediately arise. Will nuclear cooperation expand or—as some Indian and American critics have predicted—become effectively dead due to a lack of mutual nuclear interest? To what extent will Indian nuclear supporters who have pushed nuclear power as an energy independence effort be interested in buying foreign reactors? Will Congress see the merit of guaranteeing Export-Import Bank loans for major U.S. nuclear sales? Will U.S. nuclear vendors demand that India establish a credible nuclear insurance pool or provide them with immunity from possible legal claims due to future accidents or acts of nuclear terrorism? Shortly after the July 11, 2006, Mumbai terror bombing, Indian officials announced they were doing all they could to assure Indian nuclear plants would be safe against terror attacks. Will the Indian government be able to do enough?

Then there are the additional challenges the United States and India face assuming nuclear cooperation does proceed. Will U.S. and other foreign sales of nuclear fuel and nuclear technology to India directly or indirectly assist India's nuclear weapons program and so implicate the United States and others in violating Article 1 of the NPT (which prohibits such assistance to any state that did not have nuclear weapons before 1967)? The legislation President Bush recently signed into law makes it clear that Congress is keen to avoid such violations. The Hyde Act states that it should be U.S. policy to strengthen the NPT, IAEA, and NSG, and encourage India to limit the expansion of its nuclear strategic forces. The act also makes clear Congress' desire for India to abide by the Missile Technology Control Regime (MTCR) and that satellite launch assistance, which the United States also offered to India, will only be used for peaceful purposes. Critics of the deal worry that India will secure special treatment by the IAEA and NSG that will lower existing control standards. Key proponents of strategic cooperation and the nuclear deal, meanwhile, insist that India should be allowed—even encouraged—to build up its strategic nuclear missile forces to serve as a counterweight to China. Might New Delhi expand its nuclear forces but choose not to cooperate closely with the United States?

This immediately raises the question of Iran. The Hyde Act requires the President to report whether India, which struck a high-technology-diplomatic-intelligence-military-training strategic cooperation agreement with Iran in 2003, is working actively with the United States to isolate and sanction Iran for its nuclear misbehavior. The question is will India do so? India has close ties to Iran to help it outflank Pakistan. It also has clear cultural sympathies (India has 150 million Muslims, and Iran has recognized Kashmir as a legitimate part of India), and even clearer economic interests (India is a major refiner of Iranian oil and views Iran's oil and natural gas as an energy option to service is own economy). India has allowed sensitive nuclear and rocket technology transfers to be made to Tehran and was reported to have discussed space launch cooperation with Iran, which would have direct application to Iran's development of missiles capable of hitting Europe and the United States. Can the interests India might develop with the United States override its attraction to improving its ties to Tehran?

This brings us to the last concern: How well will India and the United States be able to balance their differing strategic goals? In the near term, the United States wants help from India in isolating and sanctioning Iran. It is doubtful, however, if India will go very far to achieve this aim. The United States would also like India to help in the reconstruction of Iraq. But this too is unlikely. Some Indian officials, meanwhile, are anxious to block what they see as its increasing encirclement by China. India not only has reached out to cooperate and support Vietnam, Indonesia, and Singapore, but

Burma—a regime the United States opposes. Beyond this, many Indian officials seem just as concerned about being encircled by the United States in Central Asia, the Persian Gulf, and the Indian Ocean as they are about undue Chinese influence in these regions. For these reasons, India recently announced that it and China would engage in joint military, energy, economic, and nuclear cooperation. The question is, will this cooperation assure that the two nations achieve what Indian Prime Minister Singh described as "reshaping the world"? If so, how might key U.S. interests fair? The Indians currently are demanding that the United States provide them with some of the most advanced, classified U.S. defense technologies. Will this and other demands be the set "price" the United States must pay to secure India's strategic cooperation or will India merely play the United States off against China and visa versa indefinitely? China and India recently agreed to increase their mutual trade to record levels over the next decade. The United States and India, meanwhile, have agreed to reduce barriers to increasing U.S.-Indian trade. Will U.S. trade with India prosper in the next decade and prove more important to India than trade with China, or will India's trade with China prove to be more significant?

All of these questions are addressed in this book. There is a detailed study of India's electrical future from two analysts working at one of America's most prominent economic developmental advisory groups; a history of the Indian civilian nuclear program by a leading Indian nuclear analyst and commentator; and an analysis of the relationship between civilian and military nuclear programs by an international panel of nuclear scientists that includes leading Pakistani, Indian, and American experts. Also, there is a detailed nuclear terrorism risk assessment of India's civilian nuclear program by one of the leading American nuclear terrorism experts; an arms control analysis from the most authoritative historian of India's nuclear weapons program; and a missile technology analysis of India's missile programs by an original architect of the MTCR. Finally, there is an assessment of what we can expect of our strategic partnership with India from the Bush administration's key advisor on U.S.-Indian affairs; a detailed analysis of India's strategic partnership with Iran by one of America's leading Indo-Iranian observers; and a review of what the United States might do to assure a stronger strategic friendship with India than was secured with China by the former China desk officer in the Rumsfeld Pentagon.

What are the bottom line recommendations of these analysts and of experts who reviewed their work? If the United States and India are serious about having a positive and fruitful strategic relationship, a number of minimal, specific, additional steps beyond merely striking a nuclear cooperative agreement with the U.S. government, will be necessary. Specifically:

1. The United States should begin negotiations now to reach a free trade agreement in due course with India. A potential problem with the United States developing sounder relations with India is the relatively lower level of trade that may be conducted between India and the United States as compared to trade between China and the United States. Indian regulations, bureaucratic fiat, and protectionism have played a heavy hand in reducing U.S. investment in and trade with India. The United States should take the lead to change this by beginning negotiations to establish a free trade zone with India and promising to conclude these talks when India removes its obstacles to increased U.S. bilateral trade. Working toward this end will do more to cement sound strategic economic and political relations with India than any military or nuclear cooperative venture could ever do alone. Congress can support this course of action simply by passing a sense of Congress resolution urging the Executive Branch to begin such negotiations. The Executive, meanwhile, can choose to begin talks on its own without waiting upon Congress to pass such a resolution.

2. The United States should do more to make it easier for Indian citizens to visit and work in the United States. At the end of the last Congress, House Republicans attempted to increase the number of business visas Indians might be able to secure to come to the United States. This initiative failed. It is worthy of resurrecting. The more Indians that can visit and work in the United States, the better both economically and politically for the United States and for India. Again, the strategic value of freeing the movement of peoples between India and the United States far exceeds anything that might be secured through any government-to-government space or nuclear cooperative project. As already noted, the House nearly passed a law expanding such visas. The Executive Branch and the new Congress should work together to make such an expansion occur.

3. Congress must enforce current law to assure that U.S.-Indian nuclear cooperation does not bring down the very nonproliferation institutions—the NPT, IAEA, an NSG—that the deal's backers claim it should fortify. India may not have signed the NPT, but the United States and the world's other key nuclear suppliers have. Technically, NPT weapons states cannot help any nation that did not have nuclear weapons before 1967 (including India) directly or indirectly to acquire nuclear weapons. That means that the United States cannot help New Delhi meet its nuclear reactor fuel requirements unless U.S. officials can be sure that doing so will not indirectly help India increase its nuclear weapons production. This will require a careful annual monitoring of the Indian civilian and military nuclear programs. It would help if a pledge could be secured from India that it will not increase its nuclear weapons production beyond current levels. Here, it would also be useful if the U.S.-Indian nuclear deal is implemented in a manner that will not undermine the NSG. The NSG was created to restrict trade to countries like India that refused to open all of their civilian nuclear facilities to international inspections and proceeded to make nuclear weapons and test them. Lest the NSG establish a new lower standard for nuclear trade that would encourage countries to think they could proceed to divert nuclear materials and test them, several NSG members have privately suggested that any Indian resumption of nuclear testing should cause all of the NSG membership to suspend nuclear cooperation until the NSG has had a chance to confer and agree on some other course of action. Finally, the IAEA should take care not to let its own safeguard standards be reduced any further. India wants safeguards only to apply if foreign fuel is present in its civilian reactors. The IAEA, so far, has been resisting accepting this looser standard. Several members of the NSG are refusing to consider opening nuclear trade with India until this matter is resolved. Under current U.S. law, both the NSG and the IAEA must complete their work in dealing with India before the U.S. Congress acts. This part of the law must be upheld to avoid any misunderstanding of what U.S.-Indian nuclear cooperation might entail and to increase the prospects that the most worrisome issues associated with civilian nuclear commerce with India are resolved properly.

4. Insist that India establish a credible nuclear accident insurance pool and cooperate to reduce nuclear terrorism risks before providing it with significant civilian nuclear exports. Most U.S. and foreign nuclear equipment vendors have to be concerned that India's current lack of a nuclear accident insurance pool would put them at risk of being held liable in the case of any nuclear accident involving their hardware. Currently, the Indian government does not allow any of its civilian nuclear facilities to be owned or managed by private entities. It therefore sees no need to provide for private insurance against nucelar accidents. If the United States is serious about wanting India to expand its use of nuclear power and to import the best technology it can from abroad, it has a direct stake in seeing India loosen the management and ownership reigns over nuclear power plants. For this purpose, going beyond the minimal protections that eventually will be afforded by the Vienna Convention on Civil Nuclear Liability Damage (which has not yet entered into force) will be essential. At a minimum, the United States should encourage India to develop an insurance pool equivalent to that afforded by the Price Anderson Act, which has been criticized in the United States for being far less than what would be required to cover a major nuclear accident. As for nuclear terrorism, India has voiced concerns that its own civilian nuclear facilities might be targeted by Muslim extremists and has offered to work more closely with Pakistan to reduce these risks. Many Indian nuclear officials, however, have voiced concerns about cooperating with the United States to reduce these threats for fear such cooperation might reveal secrets about India's nuclear weapons program. These misplaced apprehensions need to be overcome. Pushing India to provide for adequate nuclear insurance should help.

5. Restrict satellite launch cooperation with India to activities that avoid transferring even "safeguarded" MTCR-controlled know-how until New Delhi clearly ends its military and high-technology cooperation with Iran. Iran and India previously have discussed cooperation in space launch vehicle (SLV) technology. SLV technology, however, is interchangeable with intercontinental ballistic missile (ICBM) technology. If there should be any revelations that India has helped Iran develop long-range missiles that could threaten North Atlantic Treaty Organization (NATO) allies and the United States, this news would seriously undermine European and American public support for high-technology and defense cooperation with India generally. Meanwhile, the prospects that India will cut off its military-to-military cooperation with Iran in the near term is not very high. But, then, neither is India's need to develop its own satellite launch vehicle or ICBM. The former is cost ineffective as compared to launching satellites off other nations' existing space launch vehicles, and the latter is provocative militarily and self-defeating regarding sound relations with Pakistan and China. As long as the United States is eager to uphold and strengthen the MTCR, it would be wise do nothing to undermine its strictures against member states sharing satellite integration and satellite launch technology as it did in the commercial space satellite launch cooperation with China in the 1990s. The latter was supposedly "safeguarded." However, the effectiveness of such safeguards is limited and such protections are virtually useless if the recipient has a strong incentive to cheat. Here, careful, routine congressional oversight of the U.S. export licensing process regarding space-related transfers to India is the first order of business. Under no circumstances should the United States undermine existing MTCR restrictions for India or tolerate others doing so as the United States did in the case of China. On the other hand, the United States and other satellite launching nations can and should provide their launch services to India without discrimination and cooperate in space science ventures whenever possible. Until India demonstrates tight missile technology controls over its private and public entities (something it has so far failed to do in the case of Iran) and clearly severs its military and strategic cooperative ties with the Revolutionary Iranian government, the United States should oppose the sharing even of "safeguarded" space launch vehicle technology with New Delhi.

ATOMIC ENERGY

CHAPTER 2

WILL THE U.S.-INDIA CIVIL NUCLEAR COOPERATION INITIATIVE LIGHT INDIA?

John Stephenson
Peter Tynan

INTRODUCTION

The U.S. and Indian governments recently established an unprecedented strategic partnership on nuclear energy through the U.S.-India Civil Nuclear Cooperation Initiative, marking a significant shift in U.S. nonproliferation policy. To many observers, the choice before the U.S. Congress is now between "approving the deal and damaging nuclear nonproliferation, or rejecting the deal and thereby setting back an important strategic relationship."[1] In light of this important decision, it is vital to evaluate objectively the arguments and evidence that underpin the proposed change in policy. While many strategies and geopolitical arguments have been discussed throughout this book, it also is important to weigh this decision on an economic scale to see whether it is well-balanced. It is the aim of this chapter to test the economic arguments for the agreement against a rigorous fact base.

Proponents of the shift in U.S. foreign policy towards a stronger strategic partnership through civil nuclear cooperation with India put forth three main economic and resource arguments. The first is that nuclear energy will aid India in reducing its reliance on oil and gas. Secretary of State Condoleezza Rice asserted that "civilian nuclear energy will make [India] less reliant on unstable sources of oil and gas."[2] The second is that nuclear energy is necessary to sustain India's gross domestic product (GDP) growth rate of 8-9 percent. Without nuclear energy, it is argued, India may not be able to sustain its GDP growth and achieve its targets for economic development. The third argument is that nuclear energy can reduce greenhouse gas emissions and improve climate change by substituting for coal-based electricity generation.

The ultimate question given the debate around U.S.-Indian civil nuclear cooperation is whether nuclear generation is needed to meet the electricity needs of India in the medium and long-term and whether it contributes meaningfully to environmental improvements and energy independence to justify an expansion of nuclear power in India. In evaluating the validity and strength of the arguments for the agreement, this chapter will: (1) assess the current and future demand for electricity in India in the medium-term to 2016 and the long-term to 2032 to determine the gap between current supply and future demand; and, (2) review energy supply options by evaluating total potential capacity, relative costs, pace of development and technical constraints, the location of supply and demand, environmental issues, and the impact on energy independence.

WHAT IS INDIA'S CURRENT AND FUTURE DEMAND FOR ELECTRICITY?

Numerous factors are involved in estimating future energy requirements and it is important to place electricity demand within the context of India's total future energy needs. The Government of India's Planning Commission highlights in its August 2006 *Integrated Energy Policy* that:

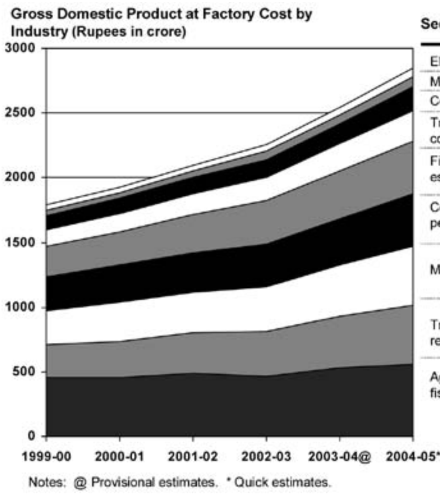
> long-term projections for energy requirements are based on assumptions vis-à-vis the growth of the economy, population growth, the pace at which "non-commercial energy" is replaced by "commercial energy," the progress of energy conservation, increase in energy efficiency as well as societal and lifestyle changes.[3]

The demand for electricity in India undoubtedly will increase significantly, but the country is still largely reliant on traditional forms of energy, including traditional biomass such as firewood and cow dung. In 2000, firewood and chips constituted 59 percent of total energy needs, dung cake another 22 percent, and electricity only 6 percent.[4] Long-term strategies for India's development need to focus on the entire energy picture of which electricity production is but a small part. In examining the economic arguments for an expansion of nuclear generation, this chapter focuses on electricity but recognizes the still marginal contribution electricity plays toward fulfilling India's energy needs.

The major driver of electricity demand is the GDP growth rate, with most estimates forecasting the Indian growth rate between 5 to 9 percent.[5] This wide variation demonstrates the high level of uncertainty inherent in projections about GDP growth. Historically, India's GDP has grown at 5.3 percent from 1978-2003,[6] but most analysts forecast a higher rate of growth due to improvements in the structure of the economy and benefits derived from globalization. According to David Victor of the Council on Foreign Relations, "India's economy enjoyed an average annual growth rate of around 7 percent from 1994-2004 . . . [and] most analysts expect growth to be sustained at 8 percent over the next few years, if not longer."[7] The Planning Commission based its energy supply scenarios for its *Integrated Energy Policy* on 8 percent and 9 percent GDP growth rates, constituting a suitable upper bound when estimating future energy requirements. If less ambitious GDP growth is realized and less electricity is needed, the conclusions drawn by this report, especially with regards to the role of nuclear generation, should continue to hold true.

Indian Sector Composition.

The sectoral composition of GDP growth has a considerable effect on the *demand* for electricity both in terms of absolute and total gigawatts required as well as the composition of electricity supply sources, i.e., centralized versus decentralized generation. As seen in Figure 1, while "agriculture, forestry, and fishing" contribute the most to India's GDP, currently at 20 percent, the growth rate is only 4 percent. By contrast, "manufacturing," historically a large consumer of electricity, comprises another 16 percent of GDP and is growing at 11 percent. Generally, "economic growth is expected to cause a shift in the Indian economy away from energy-intensive manufacturing and also engender investments that make the economy more efficient in its use of energy."[8] The Government of India has focused on lowering the energy intensity of GDP growth through greater efficiency with the result that "the energy intensity of India's growth has been falling and is about half of what it used to be in the seventies."[9] But while a reduction in energy intensity could result in as much as 25 percent less electricity needed per unit of GDP than current levels,[10] most analyses forecast a growth in the overall demand for electricity and required generation capacity at approximately the same rate as the economy.[11]



Sector	% GDP	'99-'05** CAGR
Electricity, gas & water supply	2%	6%
Mining & quarrying	3%	13%
Construction	7%	12%
Transports, storage & communication	8%	13%
Financing, insurance, real estate & business services	14%	12%
Community, social & personal services	14%	9%
Manufacturing	16%	11%
Trade, hotels & restaurants	16%	13%
Agriculture, forestry, & fishing	20%	4%

Source: Government of India, Ministry of Statistics and Programme Implementation. Available at: *www.mospi.nic.in/31jan06_s3_1.htm*

** Compound Annual Growth Rate

Figure 1.

Changes in electricity demand across industrial, domestic, and agricultural sectors also may have implications for the appropriateness of supply sources. The shift in the relative consumption of electricity by sector has seen considerable growth in the share of domestic and agricultural sectors along with a significant drop in the share of industrial consumption (see Figure 2). The industrial share of electricity consumption has decreased over the last half-century from a peak of 69 percent in the 1960s to current levels of roughly 34 percent of total electricity consumption. Agricultural consumption of electricity steadily increased over the last half-century, from roughly 4 percent in the 1950s to more than 24 percent in 2003 and domestic consumption increased from roughly 13 percent in 1950 to approximately 25 percent during the same period. Agriculture increasingly is being modernized, and the need for water pumping is driving the demand for electricity in the sector. The combined shift in relative electricity consumption from industrial to domestic and agricultural suggests an increased demand for decentralized, distributed generation. While urbanization may counter the decentralization of domestic consumption, with an urban population rising from 28 percent in 2001 to 48 percent in 2020,[12] electricity consumption in general could be less decentralized than in India's history due to the share of agricultural consumption and the policy goal of providing electricity to rural populations.

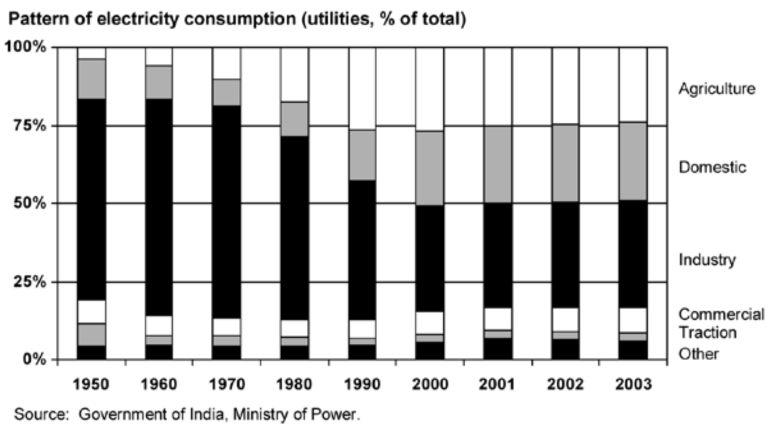


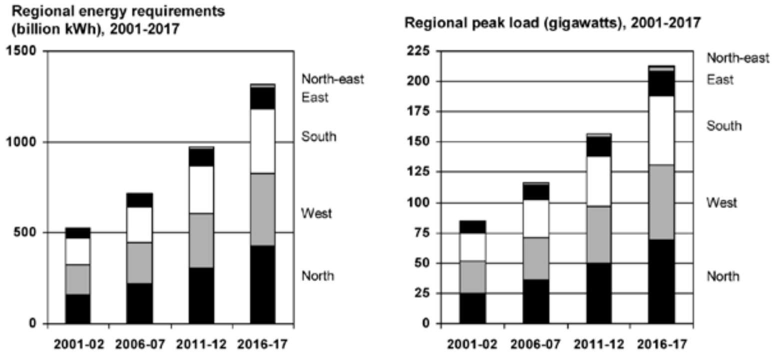
Figure 2.

Population Growth.

The growth in electricity demand also is due to population growth and a policy of improving electricity access to the entire population. Population growth is approximately 1.7 percent per year with the total population "expected to touch 1.9 billion by 2010 and 1.41 billion by 2020."[13] Concurrently, the government has the goal of meeting "the lifeline energy needs of all citizens" which necessitates increasing "electricity generation capacity/supply by 5 to 6 times [that] of their 2003-2004 levels."[14] As of 2000, approximately 57 percent of rural households and 12 percent of urban households did not have access to electricity.[15] The policy goal of reaching more of the population with electricity will result in significant increases in consumer demand for electricity and will also make non-grid, decentralized approaches such as renewable energy sources, more appropriate. With a large rural population, even in light of urbanization trends, much of India's population does not live close to transmission and distribution lines.

Geographic Distribution.

Geographically, electricity demand is concentrated in the North, South, and Western regions of India (see Figure 3). The Northeastern and East regions comprise only approximately 11-12 percent of the electricity demand of the country, whereas the other three regions each comprise 27-33 percent of total demand. As such, meeting GDP growth targets will require meeting electricity demand primarily in these areas and determining how best to share energy resources from the Northeastern and Eastern regions which are well-endowed with hydropower and coal resources respectively.

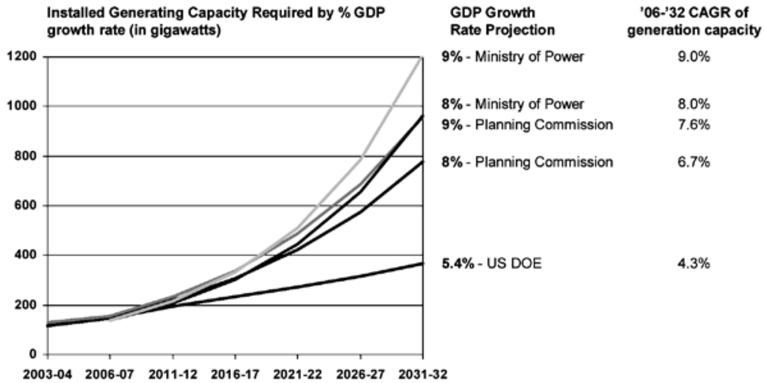


Source: Kakodkar, Dr. Anil. “Nuclear Power in India: An Inevitable Option for Sustainable Development of a Sixth of Humanity,” World Nuclear Association Symposium, 4-6 September 2002, London.

Figure 3.

Electricity Demand Projections.

Given strong forecasted GDP growth, population growth, and policy goals of improving access to electricity for the entire population, India’s electricity demand and corresponding electricity generation capacity to meet that demand will grow significantly. On the demand side, whereas India’s 2003-04 per capita consumption of electricity was 553 kilowatt hours (kWh), GDP growth of 8-9 percent would suggest per capita consumption at 2,471 kWh in 2032, a five-fold increase over 25 years. Placed in a global context, this per capita consumption would be just over the world average in 2003, at 2,429 kWh per capita; and India’s 2031-32 level would constitute only 19 percent of the American 2003 per capita consumption of 13,006 kWh. On the supply side, to satisfy India’s forecasted electricity consumption based on GDP growth rates of 8-9 percent, the Government of India’s Planning Commission projects a need of 306-337 gigawatts of total *generation capacity* by 2016-17 and 778-960 gigawatts by 2031-32 (see Figure 4). With current generation of 127 gigawatts, this means closing a gap of 180-211 gigawatts by 2016-17 and 652-834 gigawatts by 2031-32. We use these GDP growth rate projections of 8-9 percent as the basis for this chapter's analysis of electricity demand and supply to ensure that any conclusions drawn will also remain valid at lower rates of realized GDP growth.



Sources: U.S. Department of Energy. *International Energy Outlook, 2006,* Energy Information Administration, Office of Integrated Analysis and Forecasting, Washington, DC, June 2006; Government of India, Planning Comission. *Integrated Energy Policy: Report of the Expert Committee*, New Delhi, August 2006.

Figure 4.

WHAT ELECTRICITY SUPPLY OPTIONS ARE AVAILABLE TO INDIA?

Historically and currently, the majority of India's electricity has been supplied by domestic coal. In 2006, coal constituted 54 percent of total installed capacity, with hydro supplying 26 percent, gas 11 percent, renewables 5 percent, nuclear 3 percent, and diesel generation 1 percent.[16] The fastest growing generation source has been natural gas, which increased 16 percent from 1971-98, with coal and nuclear growing at 8-9 percent, hydro growing at 4 percent, and oil growing at only 1 percent.[17] Overall, the forecasts to sustain an 8-9 percent GDP growth rate suggest 6-8 percent growth in total installed capacity from 2006-32. The total potential sources for additional electricity generation in India are both vast and diverse. Coal will most likely remain the primary source given its availability and low cost, but India's hydro potential is significant, natural gas is sizable, and both renewables and nuclear also are options.

In considering the different generation options to meet the required growth rates for electricity generation, a number of factors must be considered by government officials and private investors. These include:

1. the total potential capacity of a given supply option;

2. the relative cost, including upfront investment and ongoing operational costs;

3. the pace of development, technological innovation, and technical constraints;

4. the location of supply and efficient distribution to electricity demand centers;

5. environmental issues and costs associated with the supply source; and,

6. national issues of energy independence.

Each of these factors is prioritized by different stakeholder groups. Investors interested in deciding between particular projects focus on the relative costs to find the highest net present value (NPV) projects for providing electric power to the most stable demand centers. The pace of development, technological innovations required for exploitation, linkages of supply to electricity demand centers, and energy independence typically are focused on by policymakers who have the national interest to consider and must make political and economic trade-offs. Environmental issues tend to be emphasized by those populations disrupted by, or within proximity to, supply sources such as hydro dams, coal plants, or nuclear power plants, although climate change makes carbon emissions a global concern. Proponents of specific supply options often focus on a single criterion to justify support for their preferred generation supply. By looking at these multiple criteria across the range of supply options, this chapter seeks to highlight the relative benefits and the feasibility of developing these generation sources.

In choosing an optimal mix of electricity generation to meet forecasted demand, it also is important to keep in mind the differences between *peak and base load capacity* as well as *centralized and decentralized generation*. Base-load generating capacity is operated throughout a 24-hour period to meet minimum loads using mechanically and thermally efficient equipment to reduce operating costs and provide consistent, low cost electricity. Other resources, like natural gas, are reserved primarily for meeting peak loads. Peak and base loads vary throughout a 24-hour period and can fluctuate seasonally based on increases or decreases in end user demand.[18]

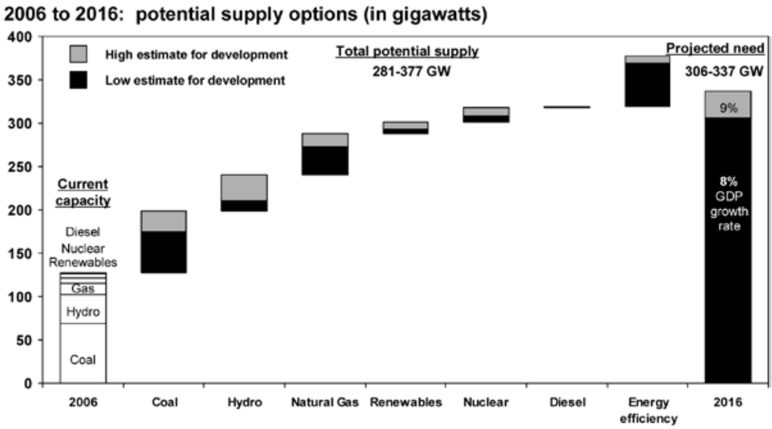
Centralized versus decentralized generation also is dependent on the characteristics of end user demand. Centralized generation leverages large plants to serve sizable and consistent demand centers, such as cities. Electricity is delivered over transmission lines and distributed to end users, whether industrial, commercial, or domestic. Decentralized generation links smaller demand centers with discrete generating capacity that does not link up to a state, regional, or national grid. Renewables such as mini-hydros are a good example of decentralized generation with the ability to satisfy a cluster of villages' electricity demands or local commercial centers. With current constraints to effective transmission and distribution in India, decentralized generation often offers the only option for certain populations.

With these issues in mind, we now examine the supply options along the six criteria detailed above to develop an understanding of the likely contribution of each option towards meeting the electricity demand in 2016 and 2032.

Total Potential Capacity.

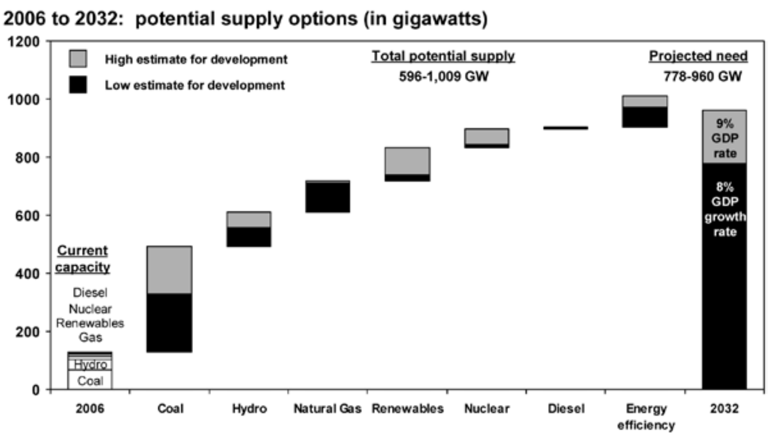
Given the forecasted requirements to meet electricity demand in 2016 and 2032, India must build installed capacity using a range of supply options. The required total installed capacity by 2016 is 306-337 GW (see Figure 5) and the range for 2032 is 778-960 GW (see Figure 6). Various scenarios from the Government of India's Planning Commission and the U.S. Department of Energy (DoE) employ ambitious or conservative growth rate estimates for the supply options, both of which are captured in Figures 5 and 6. To meet the targets for 2016 and 2032, at least a few of the options will likely have to meet their maximum potential.

Most likely, it is through a mix of coal, hydro, natural gas, nuclear, renewables, diesel, and energy efficiency improvements that sufficient generation capacity can be developed to meet demand in both 2016 and 2032. While there are trade-offs in the sequence of developing energy resources, nearly all options need further development to meet demand and GDP



Sources: U.S. Department of Energy. *International Energy Outlook, 2006,* Energy Information Administration, Office of Integrated Analysis and Forecasting, Washington, DC, June 2006; Government of India, Planning Comission. *Integrated Energy Policy: Report of the Expert Committee*, New Delhi, August 2006.

Figure 5.



Sources: U.S. Department of Energy. *International Energy Outlook, 2006,* Energy Information Administration, Office of Integrated Analysis and Forecasting, Washington, DC, June 2006; Government of India, Planning Comission. *Integrated Energy Policy: Report of the Expert Committee*, New Delhi, August 2006.

Figure 6.

growth targets and "no single energy resource or technology constitutes a panacea."[19] To extend coal resources past 45 years and to offset carbon emissions, all other energy sources like hydro, natural gas, nuclear, and renewables need development.[20] However, if exploitation and development of any of these supply sources lags, coal-based generation will likely be the backstop. Significantly, *energy efficiency efforts* offer an opportunity to "virtually generate" gigawatts in excess of what nuclear could provide in the same timeframe.

It is notable that nuclear energy will constitute a marginal contribution through 2032 and is not critical to meeting the GDP growth targets. If the development of all other options were maximized, it could be possible to meet the generation capacity required for 9 percent GDP growth with only minimal development of nuclear power. Nuclear's contribution will only become sizable in 2050 and then only if significant technological obstacles are overcome. Even though nuclear is not itself critical to meet the electricity demand projections for 8-9 percent GDP growth, full development at a later stage would probably warrant some level of development as would a prudent energy supply strategy based on diversification to mitigate risk.

The total potential capacity of each supply option is discussed in detail.

Coal. No matter what other energy sources are available, coal will continue to dominate electricity generation due to its abundance, suitability for base load needs, and relatively low cost. Coal has a variety of energy uses, but in 2006 approximately 78 percent of coal was used for power generation.[21] The total extractable coal reserves are roughly 22,540 million tons of oil equivalent (Mtoe). The current utilization of coal supply sources is approximately 184 Mtoe, and the range of utilization of coal in 2032 is expected to between 573 and 1,082 Mtoe.[22] Given current production rates and barring technological advancements, the extractable reserves could last 80 years and if "all inferred reserves also materialize then coal and lignite can last for over 140 years at the current rate of extraction."[23] Other estimates suggest that at current consumption and production rates India's coal could last as many as 200 years.[24] But with a moderate projected growth rate of 5 percent in domestic production, currently extractable coal resources may be exhausted in approximately 45 years. The extent of extractable coal reserves may rise in the future, however, since only about 45 percent of the potential coal bearing area has been covered by regional surveys.[25] Given the abundance of Indian coal, all estimates and projections for future installed generation capacity suggest coal will remain the major supply for electricity generation until 2032 and possibly beyond.[26]

Hydro. India has a significant large-scale hydro power potential of roughly 150 gigawatts.[27] Only about 33 gigawatts have been installed as of 2006,[28] leaving 117 gigawatts available, of which roughly 5-8 percent is currently being developed.[29] While hydro comprises a significant percentage of current generation capacity—approximately 26 percent of 127 total gigawatts generated—full exploitation of the resource by 2032 would reduce the contribution of hydro to the total installed capacity to 16-19 percent of 776-960 total gigawatts. India could further expand its hydropower generated electricity by importing from neighboring Nepal or Bhutan, "whose combined economically feasible potentials is estimated to be in excess of 55,000 MW."[30] Given the absolute size of the hydropower potential, and its benefits, it will remain a significant contributor to India's electricity generation and is seen as particularly useful given its flexibility and suitability to meet peak demand.[31]

Natural gas. India has limited, but considerable, natural gas reserves and currently generates 11 percent of total current electricity from gas. To date, 90 percent of natural gas demand has been met by domestic sources[32] and discoveries of 700 bcm over the last decade "hold promise for gas reserves in India,"[33] such as the discoveries in the Krishna-Godavari basin which "have added to the gas reserves substantially."[34] Gas reserves have grown from 62 bcm to 1100 bcm from 1970 to 2006 and production has risen from 1.4 bcm to 32.2 bcm in the same period. With a total need of 100-197 Mtoe of natural gas for the various scenarios laid out by the Planning Commission, India could require imports ranging from 0-49 percent of its total natural gas demand by 2032.[35] But in all the scenarios developed by the Planning Commission, even when "pushed for power generation, only 16 percent of the power generated comes from gas."[36] This is true even when the scenario supplements natural gas with coal-bed methane, *in-situ* gasification of coal, and natural gas imports.

The potential natural gas resource available for power generation is constrained by strong demand from other sectors. Natural gas is used to produce fertilizers and chemicals and cannot be economically substituted for those uses.[37] The Planning Commission has emphasized that "gas should be used for power generation only after it meets the above demand"[38] and suggests that gas be made available "to those end-uses that best extract its economic value . . . such as fertilizer, petrochemicals, CNG vehicles, and power in that order."[39] With such competition for end-uses, natural gas power generation may be constrained during the time period that coal is readily available, at least through 2032.

Nuclear. India has quite limited domestic uranium resources but vast thorium resources for potential nuclear power generation. The available uranium resources of 61,000 tons can fuel only about 10 gigawatts using Pressurized Heavy Water Reactors.[40] The current estimate of yearly demand for uranium is roughly 475 tons, while production has only reached 300 tons per year.[41] Imports of uranium potentially could come from "stable countries such as Canada and Australia, so interruptions to supplies are unlikely."[42] But with the three stage process of nuclear development planned by the Department of Atomic Energy in India, the hope is to generate 500 GW capacity "based on plutonium bred from indigenously available uranium."[43]

A much greater potential exists if the domestic thorium reserves of 225,000 tons can be used commercially to generate extremely large amounts of electricity.[44] This could constitute a vast source for electricity generation, but the technological advancements needed for this to take place prevent nuclear generation from dominating the electricity supply in the 2016 or 2032 timeframes. Full exploitation of India's domestic thorium resources will likely not occur until after 2050. With only 3.9 gigawatts generated by nuclear power in 2006, or approximately 3 percent of total generating capacity,[45] the most optimistic scenarios for nuclear power generation put its contribution at 20 gigawatts by 2016 and 68 gigawatts by 2032. As such, nuclear generation likely will not exceed 9 percent of the total generation in 2032. While the potential for nuclear generation is large, tapping this potential is not likely for some time.

Renewables. The potential for renewable energy resources to generate electricity is not insignificant in India, which already has proven itself committed to exploiting these resources. Currently, renewables provide more electricity than nuclear, with 6.2 gigawatts and 5 percent of the total.[46] While estimates vary, it generally is believed that the total potential includes 45 gigawatts of wind power, 15 gigawatts from small hydro, 19.85 gigawatts from biomass power/cogeneration, and 10 gigawatts from solar.[47] As such, over 90 percent of the potential has yet to be harnessed. The Planning Commission has recognized the importance of renewable energy resources and has emphasized the importance of building capacity. However, even achieving ambitious targets for renewables' contribution to the electricity supply, they will only account for only about 5-6 percent by 2032.[48]

ENERGY EFFICIENCY: VIRTUAL RESOURCES OF "NEGAWATTS"

In addition to the potential of new installed capacity, as discussed above, significant "virtual resources" also exist to enhance the likelihood that India will meet its ambitious targets for generation capacity to sustain 8-9 percent GDP growth. These include efforts to improve industrial, end-user, and generation efficiencies as well as reducing system losses. Currently India's Bureau of Energy Efficiency reports that potential efficiency savings in the industrial sector alone amount to 15 gigawatts and another 3-5 gigawatts are possible by making households more efficient.[49] Thermal generation of electricity also is not as efficient as it could be. With current generation efficiencies in India of about 30.5 percent, experts believe that an increase to 42 percent could produce significant savings.[50] By moving to 36.5 percent by 2016, 20-25 gigawatts may be virtually generated and by moving to 42 percent by 2032, 40-65 gigawatts may be virtually generated.[51] The

Indian government understands the need to lower the energy intensity of GDP growth and argues that:

> Lowering energy intensity through higher efficiency is equivalent to creating a virtual source of untapped domestic energy. It may be noted that a unit of energy saved by a user is greater than a unit produced, as it saves on production losses as well as transport, transmission and distribution losses. Thus a "Megawatt," produced by a reduction of energy need has more value than a Megawatt generated. . . . It is possible to reduce India's energy intensity by up to 25 percent from current levels.[52]

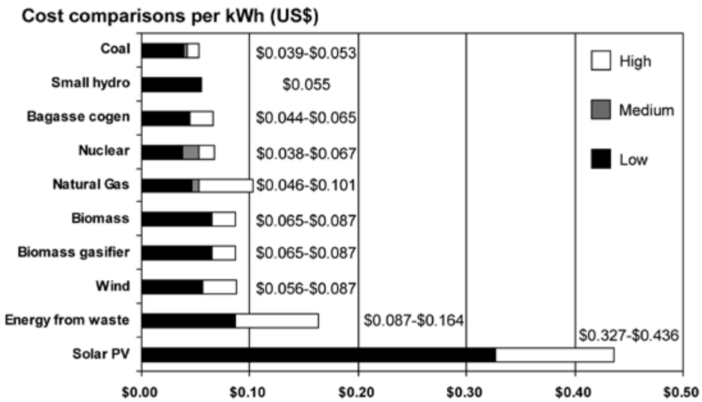
Similarly, India's transmission and distribution system losses are quite high and could be improved. Some experts put current system losses at 20-30 percent[53] while others, including the Planning Commission, highlight that "losses which include theft, nonbilling, incorrect billing, inefficiency in collection, and transmission and distribution losses, exceed 40 percent for the country as a whole."[54] A 5 percent reduction in such losses could offer 11-15 gigawatt savings by 2016, with an additional 5 percent between 2016 and 2032 offering 25-39 gigawatts. A 10 percent reduction in each time period could yield 22-30 gigawatts in 2016 and an additional 50-78 gigawatts by 2032. In total, combining energy efficiency efforts and reducing system losses, 49-58 gigawatts could be virtually generated by 2016 and an additional 67-106 gigawatts could be virtually generated by 2032.

RELATIVE COSTS

The decision to develop certain energy supplies most often will center on the issue of relative costs. Cost estimates range widely but suggest that coal, nuclear, hydro, and natural gas generated electricity possibly can be produced for roughly the same amount on a per kWh basis, depending on discount rates and the cost of fuel (see Figure 7, which includes both India and U.S. cost benchmarks to show relative costs). Nuclear and hydro options require large upfront investments, and so their relative cost depends greatly on the financing available. The International Energy Agency recently calculated that "at current levels, . . . nuclear power is cheaper than gas and almost as cheap as coal," but one concern is that "new reactors, based on unproven technology, will cost more than expected to build and run."[55] Coal and nuclear also need to take into account environmental externalities, which do not often factor into project cost estimates. For renewables, there are no fuel costs and upfront costs are low in absolute terms. High per kWh costs of renewable sources should not preclude development, as demonstrated by successful business models around the world that pair micro-finance and renewable technologies to provide self-financed, decentralized electricity generation for remote populations. Ultimately, meeting India's sizable demand in 2016 and 2032 will require development of almost all supply options, with very little room for trading one supply alternative completely for another. Even if one option were significantly and continuously cheaper than all others, a risk mitigation strategy would preclude over-reliance on one resource.

Coal.

The primary use of coal for generation can be attributed partly to the fact that it is one of the cheapest forms of generation. The estimates for the cost per kWh range from 3.9 U.S. cents to 5.3 U.S. cents (see Figure



Sources: Energy Information Administration. *Annual Energy Outlook, 2006*. DOE/EIA-0383(2006), Washington DC, February 2006. Government of India Planning Commission. *Integrated Energy Policy: Report of the Expert Committee*, New Delhi, August 2006. Victor, David G. "The India Nuclear Deal Implications for Global Climate Change," Testimony before the U.S. Senate Committee on Energy and Natural Resources, July 18, 2006. Available at: *www.cfr.org/publication/11123/india_nuclear_deal.html.*

Notes: For the levelized cost comparison of coal, natural gas (advanced combined cycle), the low estimate for wind, and nuclear, the cost comparison is for U.S. plants that would come online in 2015. The high end nuclear estimate includes the fact that "India is extractinf Uranium from extremely low grade ores . . . . This makes Indian nuclear fuel 2-3 times costlier than international suppliers." Planning Commission, *Integrated Energy Policy*, page 35. For the nuclear generation estimates by David Victor, for Light Water Reactors: the lowest at 3.8 US cents comes from Bharadwaj, Anshu; Rahul Tongia, and V.S. Arunachalam (2006). "Whither Nuclear Power?" *Economic and Political Weekly* 41(12): 1203-1212. The medium cost of 4.2 cents per kWh and 6.7 cents per kWh ceom from Massachusetts Institute of Technology (2003). *The Future of Nuclear Power: an Interdisciplinary Study*. Using the US DOE's levelized costs and incorporating the fact that Indian fuel is 2-3 times costlier, a cost of 6.6 cents per kWh is estimated.

Figure 7.

7). India's abundance of coal makes it particularly inexpensive to exploit, even though the calorific content is only about two-thirds that of imported coal.[56] Coal plant capital costs typically are more expensive than natural gas, but are significantly less expensive than nuclear.[57] Comparative fuel costs are just the opposite, with coal being less expensive than natural gas and more expensive than nuclear.[58] Adding in environmental externalities, or including research and development costs for clean coal technologies, would increase per kWh costs but would be unlikely to make coal uncompetitive.

Hydro.

Despite high upfront investment costs, hydropower offers one of the least expensive sources of power generation. The cost estimates for small hydropower are roughly $0.055 per kWh, and large hydro is considerably less. Estimates for the costs of large hydro in the United States range from 0.55-0.85 U.S. cents per kWh.[59] Additionally, hydropower has one of the best energy conversion efficiency rates, turning nearly 90 percent of the available energy into electricity.[60] The large upfront investment needed for developing hydro resources often includes associated costs of relocating populations and mitigating environmental damage. Additionally, adequate planning to ensure access to demand centers is needed to ensure cost recovery, which often requires significant additional infrastructure investments in transmission and distribution lines.

Natural Gas.

Natural gas plants have low upfront investment costs, but large fluctuations in fuel prices can make them uncompetitive. Natural gas plants generally are used for peak load generation rather than base load generation "in which case [they] will have to compete against alternative sources of peaking power, . . . the cheapest alternative most likely would be a coal-based plant."[61] For the Government of India's Planning Commission scenarios, natural gas was found to not be economically viable when prices were U.S.$4.5 per MMBtu or higher for peaking power when coal remained at or below U.S.$2.27 per MMBtu, or $45 per ton of imported coal at 6,000 kcal/kg.[62] Energy analysts expect that delivered prices will remain high, probably in the range of $7-$8 per MMBtu.[63] Rising prices of natural gas would only make it increasingly unattractive for use in the power sector.[64] As India's Ministry of Finance commented, "it has not been possible to harness the advantages of gas/LNG as a fuel for power generation effectively, primarily because of its limited availability and lack of price competitiveness vis-à-vis coal. Fuel price, constituting about 60 percent of the total cost of thermal power generation, is a critical determinant of long-term sustainability of a thermal plant."[65] With natural gas prices likely to remain high, natural gas generation could remain uncompetitive for large scale development.

Nuclear.

Nuclear has the potential to be relatively low cost. The cost estimates for nuclear range from 3.8 to 6.7 U.S. cents per kWh. However, India's limited uranium resources come from particularly low grade ore (as low as 0.1 percent compared to 12-14 percent),[66] thereby making the cost of fuel for nuclear generation 2-3 times that of international nuclear fuel. Also, due to its capital intensiveness, the cost of nuclear power varies considerably with financing options. Analysis of the levelized cost of electricity from different power plants in India found that nuclear power was cheaper than coal power at a 2 percent discount rate, roughly equivalent at a 3-4 percent discount rate, and more expensive at a 5-6 percent discount rate. At the lower discount rates, nuclear power was no more than 18 percent less expensive, while at the higher discount rates, it was more than 30 percent more expensive than coal. Analysts have noted that with "multiple demands on capital for infrastructural projects, including for electricity generation, such low discount rates are not realistic."[67]

Nuclear power is even less competitive if externalities and additional costs are taken into account. The methodology used did not include the costs of managing radioactive waste[68] or the cost of reprocessing in India which "would increase the unit cost by roughly one cent."[69] India also lacks "insurance liability against accidents,"[70] the provision of which would increase the per kWh costs; and the high costs of eventual decommissioning of nuclear reactors often is ignored. Finally, India is pursuing unproven nuclear technologies which could increase the cost to both build and run nuclear power plants.[71]

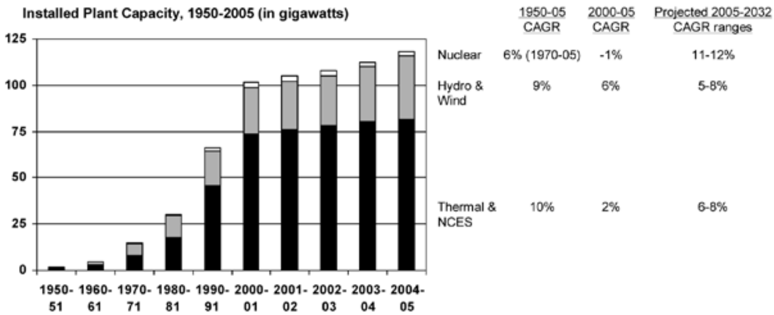
Renewables.

On a per kWh basis, renewable energy remains an expensive source for electricity. Solar power can cost more than $0.30 per kWh and wind power typically starts at the high end of the price range for coal, gas, and nuclear. Some analysts argue and have demonstrated, however, that "new nuclear plants and central coal- or gas-fired power plants are all uncompetitive with various decentralized renewables, combined heat and power installations, and efficient end use of electricity."[72] Whether renewables are cheaper on a per kWh basis or not, the low upfront investment costs make renewables an attractive option for nongrid connected rural populations. Numerous sustainable business models have been demonstrated throughout the world that combine micro-finance and renewable energy technologies, such as Grameen Shakti in Bangladesh. Systems can begin meeting local demand for electricity in a few months for a few thousand dollars, as opposed to the years and millions (or billions) of dollars it requires for traditional plants.

PACE OF DEVELOPMENT AND TECHNOLOGICAL INNOVATION

Nearly all of the electricity supply options face challenges in the pace of development to 2016 and 2032 and require technological innovation for full exploitation. Coal resources must be made cleaner and more fully exploitable economically; hydropower must avoid environmental and social disruptions; full exploitation of nuclear must overcome significant technological challenges; and renewable energy technologies need improvement to increase adoption rates. Historically, India's generation capacity has grown by 5.87 percent each year over the last 25 years.[73] During the same period, improvements in efficiencies have enabled the total supply of electricity to grow at 7.2 percent.[74] As detailed above for the given scenarios of 8-9 percent GDP growth, total generation capacity will need to increase 6-7 percent per annum from 2006-32, which means the pace of development for most supply options will have to be hastened through technological innovations.

Thermal generation has grown the fastest, historically at 10 percent compound annual growth rate (CAGR) (see Figure 8), while nuclear generation has grown the slowest at 6 percent. One determinant of the pace of development is the extent to which the private sector is involved. The private sector has been a major factor in the development of natural gas capacity, which has increased its contribution to electricity at a 16 percent growth rate from 1971-98.[75] In those areas where the private sector participates more, the pace of development can be faster. Where the public sector retains a monopoly, the pace of development will not likely be as fast.



Source: Government of India, Ministry of Power. Available at *indiabudget.nic.in*. "NCES" indicates nonconventional energy sources other then wind. Projected CAGR reanges based on analysis in Figures 7 & 8.

Figure 8.

Privatization offers considerable advantages over public sector development of generation capacity. Recognizing this, reform in the Indian energy sector has been emphasized, including a need to bring prices closer to global market levels; ensuring the sector operates on a fiscally sound basis; and increasing private sector participation.[76] Privatization can only help unlock development and also can enable India to maximize its potential gains from efficiency and system loss reduction. For example, the power sector of Delhi was privatized and distribution companies were expected to reduce Aggregate Technical and Commercial (AT&C) losses by 17 percent over 5 years. With a sound financial incentive to do so, the companies have exceeded their targets over a 3-year period, with some having reduced losses to 33.79 percent.[77] Additional improvements include higher quality power with significant reductions in load shedding, and full payment being made to central power sector utilities for the electricity purchased and distributed.[78] Of course, other factors influence the pace of development for different resource options and the technological innovations needed for full exploitation, and these will be examined in greater detail for coal, hydro, and nuclear.

Coal.

Given India's abundance of coal, the pace of development and contribution of coal to the electricity supply has been strong, at approximately 9 percent.[79] Relatively fewer constraints hinder the development of coal generation, and it is acknowledged by the government that to the extent other alternatives do not develop "as projected . . . coal-based generation will need to fill the gap."[80] In recent years, there has been some concern about the production of domestic coal "not keeping pace with the growing demand for coal in the power sector."[81] These production concerns need to be addressed to ensure that domestic coal-based generation can fill the gap if the development of other resources falters in order to meet future demand.[82]

Technological innovation could enhance and extend significantly the timeframe for India's coal resources as well as make it cleaner. *In-situ* coal gasification "can tap energy from coal reserves that cannot be extracted economically based on available open cast/underground extraction technologies."[83] While commercial development has not yet occurred,[84] the technology has garnered greater attention worldwide largely due to significant increases in natural gas prices.[85] Such technologies would increase India's extractable coal reserves considerably.

Hydro.

Hydro power generation has grown at a rate of 4.2 percent per annum. Projections suggest that an estimated 45 gigawatts will be added within the next 10 years,[86] while more conservative estimates suggest 50 gigawatts will be added in the next 20 years.[87] This pace is significantly below the historical growth rate. To maximize the exploitation of the full 150 gigawatts by 2032, hydro power will have to grow at approximately 6 percent per year. The pace of developing hydropower often can slow due to social and environmental considerations. As highlighted by the Planning Commission, "the need to mitigate environmental and social impact of storage schemes often delays hydro development thereby causing huge cost overruns."[88]

The technologies involved in hydropower generation are generally well-developed and new technologies are not required for the full exploitation of the 150 gigawatt potential. However, new "run of the river" schemes are being developed to reduce the impact of hydropower generation on the environment and local populations. Of the 50 gigawatts planned for the medium-term, nearly 62 percent are run of the river schemes to mitigate potential environmental and social risks.[89]

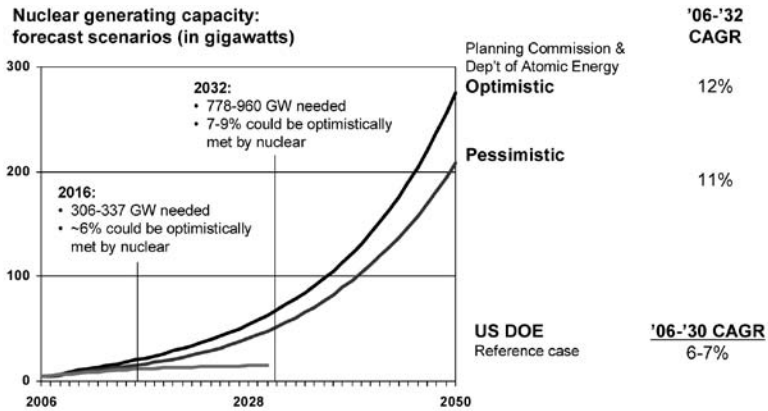
Nuclear.

The historical pace of development of nuclear power in India has been marked by ambitious projections and slow actual development. Twenty-five to 30-year projections made in the 1960s suggested that India would have an installed nuclear capacity of 20-25 gigawatts by 1987 and 43.5 gigawatts by 2000.[90]

Instead of meeting these projections, India had only 600 megawatts by 1980, 950 megawatts in 1987, and 2.7 gigawatts in 2000,[91] or roughly 5-8 percent of the projected capacity. While current projections are extremely ambitious, there is cause for concern that the actual technological development going forward may be more difficult than the development thus far, and therefore fall even shorter than expected.

The current Planning Commission projections for installed capacity of nuclear power, predicated on a number of crucial assumptions about technological innovation and development, are 15-20 gigawatts by 2016, 52-68 gigawatts by 2032, and 208-275 gigawatts by 2050 (see Figure 9). The assumptions are threefold. First, Fast Breeder Reactor technology must be demonstrated successfully by the 500 megawatt installation currently being constructed. Second, new uranium mines must be opened and provide fuel for additional Pressurized Heavy Water Reactors. And third, India must import and assimilate Light Water Reactor technology, including nearly 8 gigawatts over the next 10 years (in the optimistic scenario), as well as develop Advanced Heavy Water Reactors to use thorium by 2020.[92] The full development of nuclear power in India requires exploitation of its vast thorium resources and therefore requires significant technological advancement to commercialize thorium-based production. Nuclear power in India requires "robust technologies . . . for both the front end and back end of the fuel cycle" and until thorium-based generation becomes commercialized "the nuclear energy programme will be uranium based"[93] and significantly constrained.

This list of assumptions is considerable, and analysts argue that chances of achieving the targets are slim.[94] One major criticism is the focus on Fast Breeder technology which, some argue, has proven "unreliable in most countries that have experimented with it."[95] Given the technological hurdles, the growth rate may be slower, rather than faster, than historical trends.



Sources: Energy Information Administration, Annual Energy Outlook, 2006, DOE/EIA-0383(2006), Washington, DC, February 2006; Government of India, Planning Commission, Integrated Energy Policy: Report of the Expert Committee, New Delhi, August 2006.

Notes: Percentages of nuclear potential contribution to installed capacity needs based on Planning Commission 8% and 9% GDP growth rates. Both the optimistic and pessimistic scenarios are based on a number of important assumptions: "These estimates assume that the FBR technology is successfully demonstrated by the 500 MW PFBR currently under construction, new Uranium mines are opened for providing fuel for setting up additional PHWRs, India succeeds in assimilating the LWR technology through import and develops the Advanced Heavy Water Reactor for utilising Thorium by 2020." For the optimistic scenario, "it is assumed that India will be able to import 8,000 MW of Light Water Reactors with fuel over the next ten years."

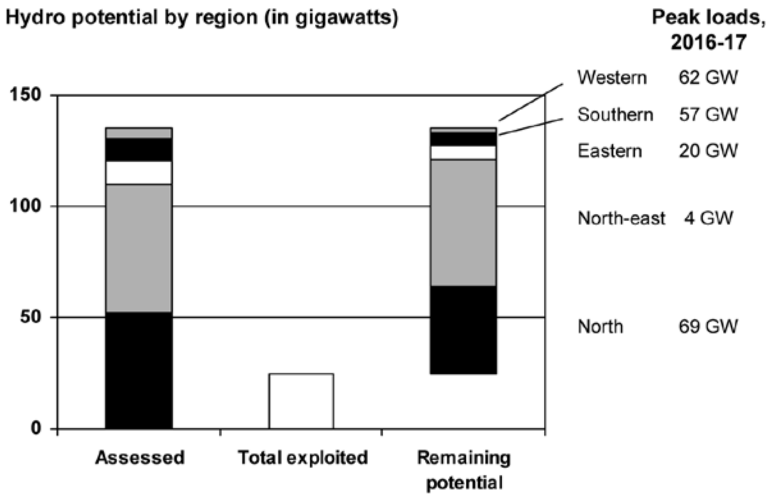
Figure 9.

From 1950 to today, nuclear power capacity increased at a rate of 6 percent,[96] from 1980 to 2000 it increased at 8 percent per annum,[97] and in recent years growth has slowed considerably. Despite this, current projections require a growth rate of 11-12 percent from 2006 to 2032. Although there have been some indications that nuclear development has improved recently, such as the 540 MW PHWR unit at Tarapur that went critical 8 months ahead of schedule,[98] it remains unlikely that development will outpace historical rates significantly and achieve the targets. Furthermore, even if these ambitious targets are met, nuclear power will still provide only 6-7 percent of India's capacity in 2016 and 8-9 percent in 2032. Only by 2052 will nuclear power represent a significant portion of India's total installed capacity, at potentially 20 percent.[99]

LOCATION OF SUPPLY AND DEMAND

In addition to the issues previously highlighted, a range of electricity supply options should be pursued due to the locations of supply and demand. The largest demand centers are in the North, South, and West (see Figure 3). The Northeast and East have the potential to be electricity exporters, if the Northeast fully exploits its considerable remaining hydropower potential and the East continues to supply coal throughout India (see Appendix C). The demand in the North increasingly can be supplied by its available hydropower, and the South and West have the ability to import coal economically after domestic reserves decline. Renewables and nuclear can contribute throughout the country, with renewables focused on decentralized demand centers and rural areas.

Integral to matching supply with demand throughout the country is greater investment and attention to improving and extending the transmission grid. Five strong regional grids currently exist and an envisioned "National Grid" seeks to increase interregional transmission capacity "from its present 9.450 MW to about 37.150 MW by 2012."[100] As in distribution and generation, private sector participation increasingly is being encouraged, with the Ministry of Power finalizing policy guidelines for private investment.[101] This will help enable the country to benefit uniformly from the electricity supply options available. In the case of coal, reserves are concentrated in certain areas of the country,[102] and while there are thermal power plants throughout India (see Appendix B), the majority of the coal supplied originates in the East. India recognizes the need to improve the interstate and intrastate transmission system to ensure more equitable sharing of resources like domestic coal, and to prevent high transportation costs. Similarly, matching the supply of hydropower to demand centers will require better transmission to ensure economical development of the potential. As seen with the case of the Northeast region, significant remaining potential exists far in excess of that regions future peak demands (see Figure 10).



Source: Government of India, Ministry of Power. Available at *powermin.nic.in/generation/accelerating_development.htm.*

Figure 10.

Improving distribution also presents a key challenge for meeting demand. Although 70 percent of India's population lives in rural areas, they use just 13 percent of power from the grid.[103] Nation-wide, only 55 percent of Indian households have grid connections. One solution to this issue is to approach the issue through decentralized generation, which highlights the importance of renewable energy resource generation. The distributed nature of renewable energy technologies enables widespread electrification of even remote and rural areas. While many of the technologies require specific environmental and geographical conditions for optimal efficiency, renewables generally can provide supply closer to demand in areas far from the grid. By producing electricity "by distributed generation [it] flows shorter distances to consumers, . . . [and] is cheaper than relying on a vast transmission and distribution network."[104] Given the policy initiatives to provide electricity to rural populations and the greater relative consumption of electricity by decentralized domestic and agricultural end-users (see Figure 2), decentralized generation options are increasingly important.

The supply of natural gas is of particular concern to both India and to the United States. Although most of India's current gas needs have been met from domestic sources, "India has . . . been energetic in seeking out long-term gas deals"[105] with countries including Iran, Qatar, Australia, Malaysia, Oman, and Turkmenistan. Cross-border gas pipelines originating from some of these countries, such as Iran, would introduce political obstacles and potential vulnerabilities as the pipe would transit through Pakistan.[106] Bangladesh also has been a focus of Indian efforts to obtain gas supplies, but these efforts have not "materialized, partly because of political pressures in Bangladesh."[107] Some analysts argue that the potential solution is liquefied natural gas (LNG) in lieu of cross-border pipelines,[108] but it is acknowledged that "considerable technological progress . . . has to be made in terms of extraction, transportation, and delivery of LNG."[109] While vast gas reserves exist in Iran, the best technology for LNG remains in the United States and Great Britain.

In terms of nuclear, power plants technically are not constrained by the location of any fuel resource. Nuclear power plants "can be built close to populations they serve, without risk of interrupted supply of fuel."[110] However, they generally are better positioned to serve higher population densities rather than decentralized communities. As some experts argue,

> Installing a centralized nuclear reactor or thermal plant and extending the grid to cover distant villages is an inefficient way of providing lighting to the primarily rural societies that characterizes India. . . . Such communities are better served by distributed renewable energy systems based on a number of different technologies and sources—micro hydel plants, windmills, photovoltaics, and biomass based power. [111]

As such, efficient development of nuclear power generating capacity may require alignment with concentrated demand centers rather than rural electrification and distributed demand like agriculture.

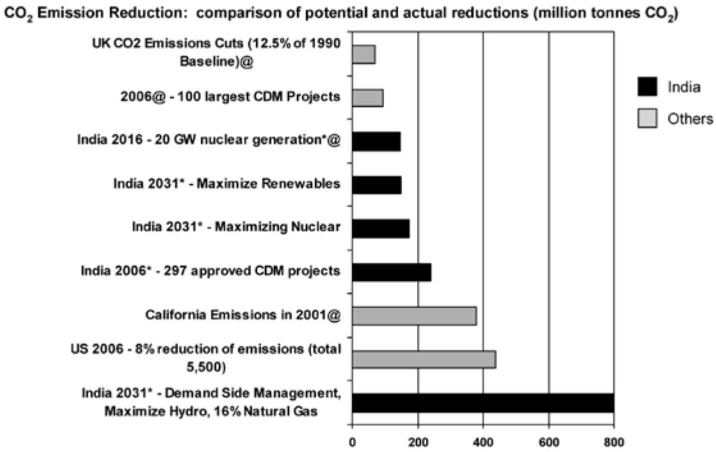
ENVIRONMENTAL CONSIDERATIONS

With increasing concern about climate change, environmental considerations have become integral to discussions of energy and electricity generation in India. As emphasized by William Rosenberg of Harvard University, "an energy policy also is an environmental policy also is an economic policy. They are not separate policies."[112] As such, strategies to reduce carbon emissions from fossil fuel generation, or replace fossil fuel generation with zero-emission generation, have been highlighted as desirable policy goals. To make prudent tradeoffs, the scope and potential impact of the alternatives need to be examined. In light of the U.S.-India Civil Nuclear Cooperation Initiative, the focus of this analysis will be on coal and nuclear and the likelihood that nuclear would substitute for coal-based generation.

Coal produces the majority of carbon dioxide emissions in India, comprising 68 percent of the total in 1990 and 65 percent in 2003. With electricity generation the major consumer of coal,[113] the environmental impact of coal-based electricity is a serious concern. The dominant role that coal plays in all projections of electricity generation at least until 2032 suggest a strong need to mitigate the risks to climate change by pursuing clean coal technologies. The Planning Commission acknowledges this and highlights the need for research and development of clean coal technologies for "improving the efficiency of energy conversion and limiting emissions."[114] *In-situ* gasification is especially beneficial to the environment by eliminating the issues of "overburden removal and ash disposal faced by conventional coal mining" as well as enabling sequestration in the mine or "pump[ing] back in oil or gas fields to enhance oil or gas recovery."[115] These techniques could enhance the clean exploitation of coal resources and extend the exploitation of this domestic resource.

Efforts to reduce coal-based carbon emissions are exceedingly important, but contributions should be put into global and historical perspective. India's coal-based carbon dioxide emissions were 22 percent of U.S. coal-based carbon dioxide emissions in 1990 and 32 percent in 2003. Whereas the United States produced 7.2 metric tons of coal-based carbon dioxide emissions per capita, India produced 0.62. In absolute terms, the United States produced 2,100 million metric tons of carbon dioxide emissions from coal in 2003, compared to India's 666 million metric tons. Using the DoE reference case for projecting coal-based carbon dioxide emissions, India could produce 1,372 million metric tons of coal-based emissions in 2030, which is approximately 65 percent of what the United States produced in 2003. On a per capita basis, India's 2030 projected coal-based carbon emissions are just 0.95 metric tons, or just 13 percent of what the United States produced on a per capita basis in 2003.[116] As Michael Levi and Charles Ferguson of the Council on Foreign Relations point out, "absent much broader efforts on that front . . . modest reductions in Indian emissions will have little effect."[117]

Examining India's options for carbon emission reduction in relative terms helps to contextualize the possible gains (see Figure 11). The estimates of carbon off-set for nuclear's substitution ranges from 145 million tons of carbon emissions by developing 20 GW[118] of nuclear generation capacity to a more conservative total of 175 million tons for 68 GW by 2032.[119] The Planning Commission analyses suggest nuclear alone would reduce emissions from a coal-dominant scenario by only 6 percent. By comparison, demand side management, maximizing hydro, and natural gas generation would reduce emissions by as much as 800 million tons,[120] constituting an additional 28 percent reduction from a coal-dominant scenario (see Figure 12). Given the technological limitations of the development of nuclear and the dominance of coal at least through 2032, "burning coal more cheaply and more cleanly would do more for India's economy and the environment than would expanding the country's nuclear power capacity."[121]



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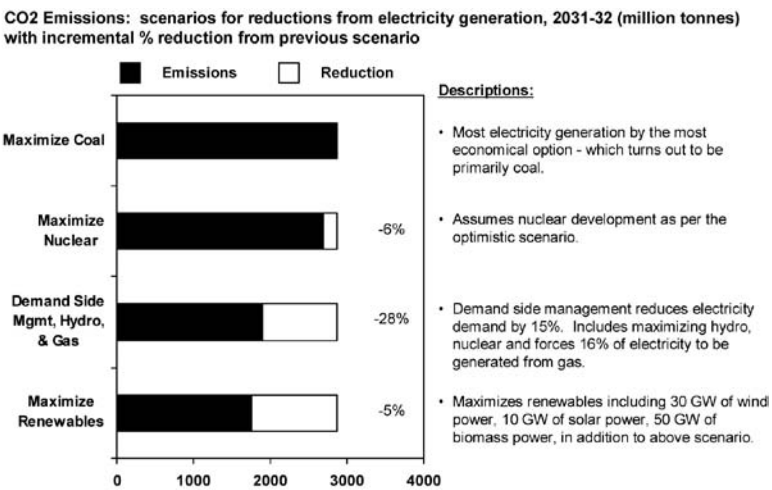
Notes: Emissions are visual approximations of the contributions from electricity as depicted in the graph on page 50 og the Integrated Energy Policy report. India's 297 approved CDM projects from the Integrated Energy Policy, page xxix. India's 20 GW nuclear generation substitution effect on emissions based on David Victor's data and compared to the optimistic scenario of hitting 20 GW, which is 2016.

Figure 11.



Sources: Dalberg analysis; Government of India, Planning Commission, *Integrated Energy Policy: Report of the Expert Committee*, New Delhi, August 2006.

Notes: Emissions are visual approximations of the contributions from electricity as depicted in the graph on page 50 of the *Integrated Energy Policy* report.

Figure 12.

Nuclear power's substitution effect with carbon emitting generation options can be minimal, and nuclear is not without its own unique environmental concerns. For some countries, an increase in nuclear generation did not occur commensurate with a decrease in carbon emissions. In the case of Japan, nuclear generation capacity increased by 40 gigawatts from 1965 to 1995, and carbon emissions rose from 400 to 1,200 million tons at the same time.[122] For a country like India which ambitiously seeks an increase in electricity consumption to 2,741 kWh per capita by 2032, it may not be an "either-or" scenario. The coal resource offers economical and technologically accessible electricity generation that will not be substituted for directly. And to the extent that any of the other options fail to meet their growth targets, coal-based generation likely will fill the gap. With regard to other environmental considerations, nuclear reactors "produce a lot of highly radioactive waste . . . for which safe storage for the tens of thousands of years required for it to become harmless is yet to be found."[123] While disposal can be done in a safe and effective manner, the environmental concerns are not insignificant.

ENERGY INDEPENDENCE

The issue of energy independence is particularly important for the Government of India, which seeks to limit international supply risks by leveraging domestic resources to the greatest extent possible. Although an understandable and a theoretically worthwhile goal, some would argue that a strict focus on energy independence is unattainable; would actually drive prices up; and would disrupt market access needed for meeting energy demands efficiently. Despite these arguments against a strict focus on energy independence, it is interesting to evaluate the best option for attaining this goal. Through 2016 and 2032, energy independence is reinforced mostly through coal-based generation and by exploiting fully the hydropower potential. Only in the very long term does nuclear energy hold the promise to provide energy security and independence which,[124] as described above, requires significant technological advancements in thorium-based production and will not occur before 2050.

Abundant coal resources provide a degree of energy independence in the near- and medium-terms, but exhaustion of these resources will require increasing reliance on coal imports or other forms of energy. The degree to which India will rely on coal imports in the future will depend on the extent to which it can develop hydropower, natural gas, nuclear, and renewable alternatives as well as initiate demand side management and energy efficiency efforts. The coal-dominant energy scenario developed by the Planning Commission suggests as much as 45 percent of the coal required to be imported in 2032 with 8 percent GDP growth, while the least coal dependent scenario suggests 11 percent could come from imports.[125] The cost of imported coal remains economically competitive for power generation in certain areas of India due to the low calorific value of domestic coal. With domestic coal having a calorific value of 3,500 kcal/kg versus 6,000 kcal/kg for imported coal, the cost of imported coal transported under 500 km is cheaper than domestic coal transported greater than 1,400 km.[126] As such, the exhaustion of coal resources could reduce the energy independence of the country, but only in the long term and only if technological innovations do not occur to prolong the life of the resource.

Full exploitation of domestic hydropower would contribute meaningfully to a policy of energy independence. When fully exploited, hydropower could comprise 16-19 percent of total generation capacity by 2032. Maximizing the hydro potential in some regions well-endowed with the resource could offset the use of other resources, like coal, and extend its availability to areas less well-endowed with hydro. Once domestic resources have been fully tapped, potential also exists to import some of the 55 gigawatts of hydropower from neighboring Nepal and Bhutan.[127] While importing hydro could degrade the degree of energy independence somewhat, India's neighbors offer less political instability than some of India's options for natural gas.

The contribution of natural gas to energy independence will depend greatly on the extent and continuation of domestic reserves. As the Planning Commission's scenarios project, imports of natural gas could range from 0-49 percent of total demand for the resource in 2016-32. Although many neighboring countries, such as Iran, Turkmenistan, Bangladesh and Myanmar, have large resources of natural gas, the option to utilize cross-border pipelines creates concerns about energy security[128] where India "may face potential supply disruption if political issues emerge."[129]

Finally, while nuclear has been emphasized as a key to India's energy independence, this is not likely to happen before 2050. If thorium-based production technologies are not found, India would become dependent on uranium imports to fuel its nuclear power plants. Increasing the installed nuclear capacity under this scenario would impinge significantly on India's energy independence. The uranium shortage already has forced India "to operate even the small nuclear generation capacity that we have at a load factor below what is technically possible."[130] The promise of energy independence based on nuclear power, then, is predicated on successful development of thorium-based production and will not take place until well beyond 2050.

CONCLUSIONS

It has been argued that the recent U.S.-India Civil Nuclear Cooperation Initiative makes considerable sense from an economic and resource perspective. Among these arguments are the assertions that: it will make India less reliant on unstable sources of oil and gas; that India requires nuclear energy to meet its GDP growth targets; and that nuclear energy can improve the environment significantly and enhance energy independence. Strategic and geopolitical justifications notwithstanding, the economic and resource arguments are overstated. In this analysis, we have sought to assess the central question of whether nuclear energy will meet India's future energy needs by analyzing the demand for electricity and evaluating each supply option: i) total potential capacity; ii) relative costs; iii) the pace of development, technological innovations, and technical constraints; iv) locations of supply and efficient distribution to electricity demand centers; v) environmental considerations; and vi) impacts on energy independence.

In the final assessment, this report finds that nuclear energy likely will not reduce India's dependence on oil and gas, will play a marginal role in sustaining economic growth through 2032, and is either not the most significant option for reducing greenhouse gas emissions or is unlikely to reduce such emissions. In terms of lessening India's dependence on imported fossil fuels, nuclear energy does not fulfill the same end uses as the majority of imports of foreign fossil fuels and therefore will not substitute for them. As Dr. Ashton Carter of Harvard University succinctly underscored:

> Nuclear power can play a part in helping India address these problems, but it will not make a critical difference. Electricity in India will be mostly produced by coal-burning power plants for the foreseeable future; even under the most extravagant projections, nuclear plants will provide less than ten percent of India's electricity . . . . [As such, nuclear power] can do little to slake the thirst of the principal consuming sector in India—transportation—because cars and trucks do not run off the electrical grid and will not for a long time.[131]

Michael Levi and Charles Ferguson of the Council on Foreign Relations reinforce this point by highlighting that "most Indian oil is used by cars and trucks, not by power plants, so nuclear power will not significantly change the demand for oil."[132]

In terms of the electricity supply, estimates generally agree that India will depend primarily on domestic coal and hydropower, providing roughly 60-80 percent of electricity through 2032. In the most optimistic scenarios, natural gas generation could reach 16 percent, and nuclear energy could constitute 9 percent of generation capacity by 2032. But if the development of hydro, natural gas, or nuclear generation is delayed, coal-based generation will fill the gap. In general, India has considerable domestic resources—in the form of coal, hydro, efficiency improvements, and renewables—to meet demand for the next 10-25 years and most likely the next 45 years. The electricity demands of economic growth can be met with India's diverse and vast resource base, of which nuclear will remain a marginal contributor at least through 2050.

In terms of energy independence and environmental improvements, coal also dominates the scenarios through 2032. Although domestic coal could be exhausted in 45 years if additional technologies or reserves are not found, imported coal can be economical for a significant portion of India, and technological improvements could extend the coal resource base and significantly enhance energy independence. Since India lacks sufficient domestic sources of uranium, an increase in nuclear generation would result in greater dependence on imports of ore and technology until India's abundant domestic resources of thorium can be commercialized for significant production of electricity, which is not likely until after 2050. In terms of environmental improvements, the development of nuclear generation has not necessarily led to a reduction in greenhouse gases, and the dominance of coal in the energy mix well through 2050 means that clean-coal technologies, hydro power, demand side management, and renewables could do more to reduce carbon dioxide emissions than nuclear generation.

In sum, the economic and resource arguments for the U.S.-India Civil Cooperation Initiative are overstated. Nuclear energy will not reduce India's reliance on foreign fossil fuels significantly, is not vital to sustain India's economic growth through 2032, and does not necessarily provide the best option for environmental improvements and energy independence.

APPENDIX A

KEY FINDINGS BY CRITERION

Criterion	Key findings
Total potential capacity	• Coal will contribute the majority of electricity for the next 45+ years • Hydropower remains significant, at ~16-20 percent of 2032 demand • Nuclear potential optimistically contributes only 8-9 percent by 2032
Relative costs	• Relative costs may impact the sequence of development, but all supply options are necessary to some degree to meet future demand • Hydropower is currently among the cheapest, coal and nuclear are potentially equivalent, depending on discount rate, natural gas is potentially expensive if fuel prices remain high and renewables remain expensive per kWh but small installation costs make them accessible for rural populations
Pace of development, technological innovation, and technical constraints (continued)	• Nuclear has historically fallen short of projections and current estimates employ many assumptions

Criterion	Key findings
Pace of development, technological innovation, and technical constraints (continued)	• Optimistic nuclear projections require overcoming significant technological hurdles (e.g., commercializing thorium)
Pace of development, technological innovation, and technical constraints (concluded)	• Hydropower is often hindered by social pressures and current plans are slower than historical rates of development through 2016 • Clean use of coal and extending the life of coal resources face significant technological hurdles (e.g., *in-situ* gasification), but exploitation for next 45 years does not • Significant technological hurdles are needed to make renewables cheaper on a per kWh basis
Locations of supply and linkages to demand	• Hydropower potential remains primarily in those areas where importation of coal would not be economically competitive • Transmission and distribution network improvements are vital • Decentralized generation can help meet the policy goals of increasing electricity access among rural populations

Criterion	Key findings
Environmental considerations	• Demand side management, improving coal efficiency, and full exploitation of renewables contributes more to CO² reductions than optimistic nuclear projections • Unlikely that nuclear would substitute for coal-based generation
Energy independence	• Extending coal resources reinforces independence the most • Hydropower contributes meaningfully to independence until fully exploited • Uranium-based nuclear power makes India *dependent* due to limited domestic resources • Nuclear contributes meaningfully to energy independence only after thorium generation is realized and ramped up, probably after 2050

APPENDIX B

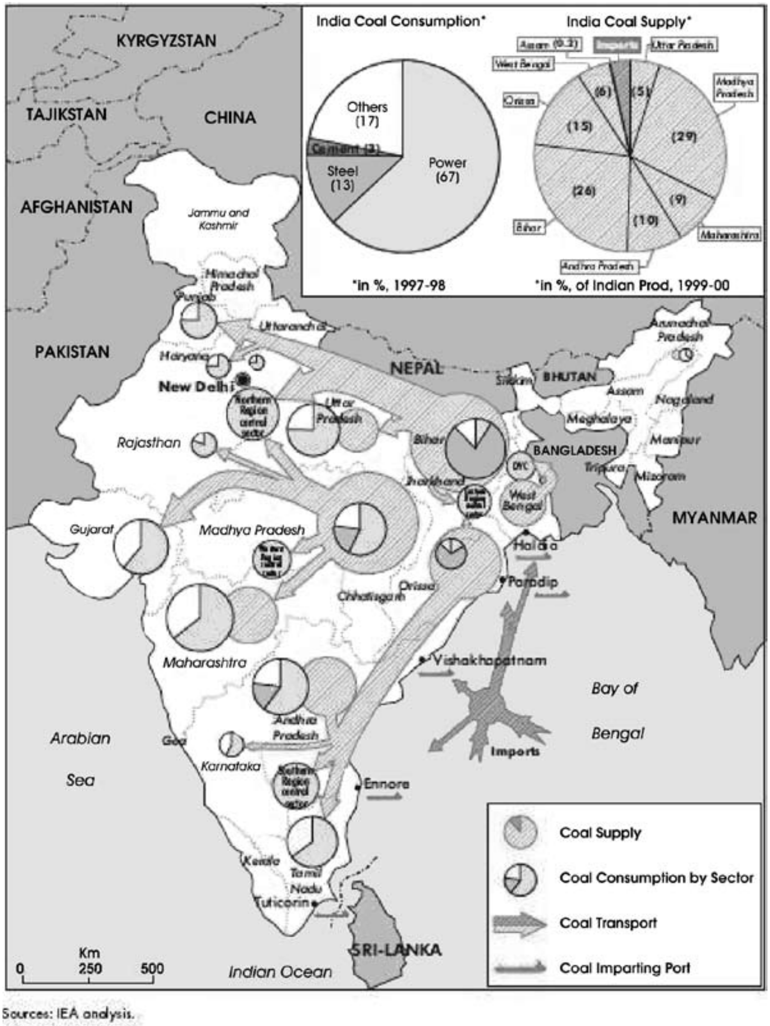
MAIN POWER PLANTS IN INDIA

Source: TERI, 2000.

Source: International Energy Agency. *Electricity in India: Providing Power for the Millions*, OECD/IEA, Paris, 2002.

APPENDIX C

COAL PRODUCTION, USE AND IMPORTS



Source: International Energy Agency. *Electricity in India: Providing Power for the Million*s, OECD/IEA, Paris, 2002.

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4. *Ibid*., p. 8.

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23. Planning Commission, p. 34.

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29. KPMG, p. 4; Ministry of Power.

30. Planning Commission, p. 38.

31. *Ibid.*, p. xxii.

32. KPMG, p. 16.

33. *Ibid.*, p. 4.

34. Planning Commission, p. 34.

35. *Ibid.*, p. 45.

36. *Ibid.*, p. 48.

37. *Ibid.*, p. 40.

38. *Ibid.*, p. 51.

39. *Ibid.*, p. 75.

40. *Ibid.*, p. 35-36.

41. M. V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future," p. 24, available at *www.npec-web.org/Frameset.asp?PageType=Writings*.

42. "Nuclear Power: Half Life," *The Economist*, November 11, 2006, p. 71.

43. Kakodkar, p. 12.

44. Planning Commission, p. 36. The estimates for gigawatts of electricity are simply described as "very large."

45. Ramana, p. 9.

46. Ministry of Power; KPMG, p. 4.

47. Ministry of New and Renewable Energy (MNES) website; KPMG; Weiss, p. 21.

48. Planning Commission, p. xxiii.

49. Weiss, p. 21.

50. KPMG, p. 7. The Planning Commission puts the potential figure a bit lower, at 40 percent. Planning Commission, p. xxi.

51. Based on projected high and low estimates of coal-produced electricity.

52. Planning Commission, p. xx.

53M. V. Ramana, "A Question and Answer Session with M. V. Ramana on His Presentation, 'Nuclear Power in India: Failed Past, Dubious Future'," before a dinner hosted by The Nonproliferation Policy Education Center (NPEC), Washington, DC, May 10, 2006. Available at *www.npec-web-org/Frameset.asp?PageType=Writings*.

54. Planning Commission, p. 4.

55. "Nuclear Power: Half Life," p. 71.

56. Planning Commission, p. 11. "Indian coal has a high ash content and low calorific value—an average of 4000 kcal/kg compared to 6000 kcal/kg in imported coal. The average calorific value of coal burnt in India's power plants is only about 3500 kcal/kg."

57. Energy Information Administration.

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62. *Ibid.*, p. 46.

63. Victor.

64. Planning Commission, p. 124.

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71. "Nuclear Power: Half Life."

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76. CSIS.

77. Ministry of Finance, p. 180.

78. *Ibid*.

79. International Energy Agency, p. 34.

80. Planning Commission, p. 22.

81. Ministry of Finance, p. 177.

82. Planning Commission, p. 45.

83. *Ibid*., p. 34.

84. *Ibid*.

85. Lory Hough, "King Coal Comes Clean," *John F. Kennedy School of Government Bulletin*, Cambridge: Harvard University, Summer 2006, p. 17.

86. KPMG, p. 4.

87. Planning Commission, p. 38.

88. *Ibid.*, p. 33.

89. *Ibid.*, p. 38.

90. Ramana, "Nuclear Power in India," p. 7.

91. *Ibid.*

92. Planning Commission, p. 37.

93. KPMG, p. 4.

94. Ramana, "Nuclear Power in India," p. 9.

95. *Ibid.*

96. Government of India, Ministry of Power. See Figure 10.

97. Ramana, "Nuclear Power in India," p. 7.

98. Kakodkar, p. 12.

99. Ramana, "Nuclear Power in India," p. 9.

100. Ministry of Finance, p. 179.

101. *Ibid.*

102. Planning Commission, p. xv.

103. Weiss, p. 21.

104. *Ibid.*

105. CSIS.

106. KPMG, p. 17.

107. CSIS.

108. KPMG, p. 17.

109. CSIS.

110. *Ibid.*, p. 14.

111. Ramana, "Nuclear Power in India," p. 23.

112. Hough, p. 17.

113. Planning Commission, p. xiv.

114. *Ibid.*, p. 12.

115. *Ibid.*, p. 34. Hough, p. 17.

116. Energy Information Administration, pp. 93, 96.

117. Levi and Ferguson, p. 9.

118. Victor.

119. Planning Commission.

120. *Ibid*., p. xxix.

121. Ashton B. Carter, "America's New Strategic Partner?" *Foreign Affairs*, Vol. 85, No. 4, July/August 2006, p. 41.

122. Ramana, "Nuclear Power in India," p. 21.

123. CSIS, p. 14.

124. Planning Commission, p. xxii.

125. *Ibid*., p. 45. These estimates are for total coal requirements. The percentage of domestic coal currently used for power generation is 78 percent (p. xiv), while various estimates for future usage suggests 60-75 percent used for power generation (p. 25).

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127. *Ibid*., p. 61.

128. *Ibid*., p. 60.

129. KPMG, p. 17.

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CHAPTER 3

NUCLEAR POWER IN INDIA: FAILED PAST, DUBIOUS FUTURE

M. V. Ramana

The general assumption underlying the July 2005 agreement signed by President George Bush and Prime Minister Manmohan Singh seems to be that nuclear power will be an important component of India's energy future. As we shall show both by examining the history and performance of the Indian nuclear power program so far and analyzing problems with some of the plans for its growth, nuclear power in India has not been and will not be a major source of power for many decades at least, if even then. The negative consequences far outweigh any energy benefits that may accrue from a larger nuclear sector in India.

INITIATION

The Indian nuclear program was established in 1948, barely a few months after independence. The main personalities involved in determining its contours were Jawaharlal Nehru, the first Prime Minister of India; and Homi Bhabha, a physicist who first made his mark as a student at Cambridge University in the United Kingdom (UK). Nehru was of the view that if India had "to remain abreast of the world, [it] must develop this atomic energy" and was therefore very supportive of Bhabha's plans for nuclear energy in India.

The legislative bill enabling the creation of the Atomic Energy Commission (AEC), the apex body in charge of nuclear policy in India, made atomic energy the exclusive responsibility of the state and allowed for a thick layer of secrecy.[1] Nehru gave two reasons, both somewhat disingenuous, for the imposition of secrecy. "The advantage of our research would go to others before we even reaped it, and secondly, it would become impossible for us to cooperate with any country which is prepared to cooperate with us in this matter, because it will not be prepared for the results of researches to become public."

There was some criticism of the secrecy provisions in the assembly as Nehru introduced the bill. One member, Krishnamurthy Rao, compared the bill with the British and American acts and pointed out that the bill did not have mechanisms for oversight, checks, and balances as the U.S. Atomic Energy Act. Further, in the bill passed in the UK, secrecy is restricted only to defense purposes, and Rao asked if, in India, secrecy would be extended also to research for peaceful purposes. Though it may seem surprising for someone who has spoken so eloquently against nuclear weapons, Nehru had to confess: "I do not know how to distinguish the two [peaceful and defense purposes]." Nehru's dilemma is clear from his statements while introducing the bill. On the one hand, he said "I think we must develop it for peaceful purposes." But he went on, "Of course, if we are compelled as a nation to use it for other purposes, possibly no pious sentiments will stop the nation from using it that way."

The connection between developing nuclear energy and acquiring the capacity to build nuclear weapons was clear to Nehru as it was to many of the scientists and statesmen of that period. Indeed, it was perhaps more apparent then, in the immediate aftermath of the U.S. bombing of Hiroshima and Nagasaki, than today. Those developing the Indian nuclear program were no exception, and their plans accounted for the possibility that the facilities constructed and expertise gained could be used for military purposes.

ORGANIZATIONS AND STRUCTURE

The nuclear establishment in India enjoys unique access to political authority and is protected from external oversight. Unlike most policy matters where the cabinet has the ultimate authority, the AEC is under the direct charge of the Prime Minister. This structure makes it difficult for most politicians or bureaucrats, let alone the public, to challenge nuclear policies or practices.

The role of the AEC is to formulate the policies and programs. The actual execution of these policies is carried out by the Department of Atomic Energy (DAE), which was set up in 1954. The DAE has set up a number of associated or subsidiary organizations. These include five research centers, five government-owned companies ("public sector enterprises"), three industrial organizations, and three service organizations.

Among government-owned companies, the Nuclear Power Corporation is responsible for designing, constructing, and operating the nuclear power plants within the first stage nuclear power program (i.e., not breeder reactors, which are the responsibility of another government-owned company called BHAVINI), and the Uranium Corporation of India Limited is in charge of mining and milling of uranium. Industrial organizations include the Heavy Water Board, in charge of the many plants that produce heavy water; and the Nuclear Fuel Complex, which manufactures the fuel for the nuclear reactors. The best known research centers are the Bhabha Atomic Research Centre (BARC), the most important facility involved in nuclear weapons research; and the Indira Gandhi Centre for Atomic Research, where the breeder program was cultivated.

For a long time, the DAE did not have a separate safety division. It was only in 1972 that the DAE constituted an internal Safety Review Committee. In 1983, the Atomic Energy Regulatory Board (AERB) was set up to oversee and enforce safety in *all* nuclear operations. This was modified in 2000 to exclude nuclear weapons facilities.

The AERB reports to the AEC, which is headed by the head of the DAE. The Chairman of the Nuclear Power Corporation (NPC) is also a member of the AEC. Thus, both the DAE and the NPC exercise administrative powers over the AERB. This lack of independence is in direct contravention of the international Convention on Nuclear Safety, of which India is a signatory.

EXTERNAL INPUTS

Despite much rhetoric about self reliance and indigenous development, the AEC sought and received ample help from other countries. In June 1954, Bhabha requested Sir John Cockroft, an important figure in the British atomic program and a colleague of Bhabha's during his Cambridge days, to help India build a low power research reactor. A few months later Cockroft offered detailed engineering drawings, technical data, and enriched uranium fuel rods for a "swimming pool reactor." The AEC accepted with alacrity and the first "indigenous" reactor, Apsara, became critical in August 1956.

The second reactor to be set up was CIRUS—a 40 megawatt (MW) heavy water moderated, light water cooled, natural uranium fueled reactor using the same design as the Canadian NRX reactor. This deal involved another former Cambridge contemporary of Bhabha's, W. Bennett Lewis, then a senior official with Atomic Energy of Canada. It was supplied by Canada as part of its Colombo plan—a plan that was, in the words of Robert Bothwell, "premised on the relation between misery and poverty and communism." The occasion for the announcement of the gift was the 1955 Geneva conference on the peaceful uses of atomic energy. Based on the 1953 Atoms for Peace speech by President Dwight D. Eisenhower, the conference was the scene of much cold war-era maneuvering, as well as an opportunity for countries to exhibit their nuclear wares and woo potential customers.

A few Canadian diplomats realized that this could lead to potential acquisition of weapons useable plutonium by India. The NRX reactor was known to be an efficient producer of plutonium because of its high neutron economy. Nevertheless, the initiative went through because it was assumed that India would be able to acquire a reactor from some other source. Despite consistent efforts on the part of the Canadians, India, led by Bhabha, adamantly refused to accept any kind of voluntary controls or safeguards on the spent fuel produced.

When it suited his purposes, however, Bhabha did accept safeguards. Examples of this are the reactors at Tarapur (TAPS I and II) and Rawatbhata (RAPS I and II). Bhabha's speech in 1956 at a conference on the International Atomic Energy Agency's (IAEA) statute makes clear the strategy he adopted. Bhabha said,

> [T]here are many states, technically advanced, which may undertake with Agency aid, fulfilling all the present safeguards, but in addition run their own parallel programs independently of the Agency in which they could use the experience and know-how obtained in Agency-aided projects, without being subject in any way to the system of safeguards.

The construction of CIRUS also required help from the United States, which supplied the heavy water needed for the reactor. Likewise, it was an American firm, Vitro International, which was awarded the contract to prepare blueprints for the first reprocessing plant at Trombay. The plant was used to separate plutonium from the spent fuel rods irradiated at the CIRUS reactor; the plutonium was then used in India's first nuclear weapons test of 1974. Between 1955 and 1974, 1,104 Indian scientists were sent to various U.S. facilities; 263 were trained at Canadian facilities prior to 1971.[2]

Despite India terming the test a "Peaceful Nuclear Explosion" and launching a diplomatic offensive trying to prove that it was indeed peaceful, the 1974 test ended the period of extensive foreign support to the nuclear program. The international community, led by Canada and the United States, which were incensed by India's use of plutonium from CIRUS that had been given to India for purely peaceful purposes, cut off most material transfers relating to the nuclear program. It also resulted in the setting up of nuclear material multilateral control regimes. However, a little advertised fact is that various nuclear facilities still procured components from abroad, and foreign consultants continued to be hired for Indian nuclear projects, though only to a small extent. DAE personnel still had access to nuclear literature and participated in international conferences where technical details were discussed freely.

PROJECTIONS AND ACHIEVEMENTS

From the very beginning, plans for the Indian nuclear program were ambitious and envisaged covering the entire nuclear fuel cycle. Over the years, apart from nuclear reactors, India also developed facilities for mining uranium, fabricating fuel, manufacturing heavy water, reprocessing spent fuel to extract plutonium and, on a somewhat limited scale, enriching uranium. Investment in this wide range of activities often was uneconomical. But it was justified on the grounds of self-sufficiency, a theme popular in India.

The other justification often offered was a grand three-stage program, first announced in 1954, for the development of nuclear energy in the country. The three-stage program was, for example, the proffered justification for the early acquisition of reprocessing technology. The first stage of the three-phase strategy involves the use of uranium fuel in heavy water reactors, followed by reprocessing the irradiated spent fuel to extract plutonium. In the second stage, the plutonium from reprocessed spent fuel from pressurized heavy water reactors (PHWR) is used in the nuclear cores of fast breeder reactors. These nuclear cores could be surrounded by a "blanket" of either depleted uranium or thorium to produce more plutonium or uranium-233 respectively. So to ensure that there is adequate plutonium to fuel these second stage breeder reactors, a sufficiently large fleet of such breeder reactors with uranium blankets would have to be commissioned before thorium blankets are introduced. The third stage involves breeder reactors using uranium-233 in their cores and thorium in their blankets.

On the basis of this plan and assuming optimistic development times, Bhabha announced that there would be 8,000 MW of nuclear power in the country by 1980. As the years progressed, these predictions were to increase. By 1962, the prediction was that nuclear energy would generate 20-25,000 MW by 1987, and by 1969, the AEC predicted that by 2000 there would be 43,500 MW of nuclear generating capacity. All of this was before a single unit of nuclear electricity was produced in the country.

Reality was quite different. Installed capacity in 1979-80 was about 600 MW, about 950 MW in 1987, and 2720 MW in 2000. The only explanation that the AEC has offered for its failures has been to blame the cessation of foreign cooperation following the 1974 nuclear weapons test. At the same time, these sanctions also provided the DAE with an opportunity: Each development, no matter how small or routine, could be portrayed as a heroic success, achieved in the face of staunch opposition by other countries and impossible odds; while any failures could be passed off as a result of the determination of other countries to block and prevent India achieving technological advancement.

Such continued failures were not because of a paucity of resources. Practically all governments have favored nuclear energy, and the DAE's budgets have always been high. The only period when the DAE did not get all that it asked for (and therefore considers the dark years) were the early 1990s, a period marked by cutbacks on government spending as part of an effort at economic liberalization. But this trend was reversed with the 1998 nuclear weapons tests; since then the DAE's budget has increased from Rs. 18.4 billions in

1997-98 to Rs. 55 billions in 2006-07, i.e., more than doubled even in real terms.[3]

The high allocations for the DAE have come at the cost of promoting other, more sustainable, sources of power. In 2002-03, for example, the DAE was allocated Rs. 33.5 billions, dwarfing in comparison the Rs. 4.7 billions allocated to the Ministry of Non-conventional Energy Sources (MNES), which is in charge of developing solar, wind, small hydro, and biomass-based power. Despite the smaller allocations, installed capacity of these sources was 4,800 MW (as compared to 3,310 MW of nuclear energy). While their contribution to actual electricity generated would be smaller since these are intermittent sources of power, they have much lower operations and maintenance costs. Further, most of these programs, like the wind energy program, started in earnest only in the last decade or two, and there is ample scope for improvement.

Today, notwithstanding over 5 decades of sustained and lavish government support, nuclear power amounts to just 3,310 MW, less than 3 percent of the country's total electricity generation capacity. Over the next few years, this capacity is to increase, largely because of the importation of two 1,000 MW reactors from Russia. The DAE has only just started operating a reactor not fully based on an imported design, a 540 MW heavy water reactor, which is scaled up from the design of the 220 MW reactor that was imported from Canada.

Despite this less than modest history and the hand wringing about international sanctions, the DAE has continued to make extravagant predictions. The current projections are for 20,000 MW by the year 2020 and for 207,000 to 275,000 MW by the year 2052. The likelihood of these goals being met is slim at best. But even if they are met, nuclear power would still contribute only about 8-10 percent of the projected electricity capacity in 2020, and about 20 percent in 2052. There is thus little chance of nuclear electricity becoming a significant source of power for India anytime over the next several decades.

BREEDER REACTORS

One key element in the DAE's plans for the future of nuclear power in India is a large number of breeder reactors. While country after country has abandoned breeder reactors as unsafe and uneconomical, the DAE stubbornly has been ploughing a lone furrow, heroically in its own eyes as well as in the eyes of the handful of breeder enthusiasts elsewhere, but needlessly by most other counts. Reliance on an unproven technology, or more precisely a technology shown to be unreliable in most countries that have experimented with it, is another strategy that makes it likely that nuclear power will never become a major source of electricity in India.

Despite grand pronouncements for 5 decades about the three stage nuclear program where the second and third stages involve breeder reactors, all that the DAE has to show is a pilot scale Fast Breeder Test Reactor (FBTR). The DAE has claimed that the "technology for design, construction and operation of FBRs has been demonstrated at Kalpakkam with the establishment of the IGCAR, where over the past 25 years, a 40 megawatt thermal (MWt)/13 megawatt electric (MWe) FBTR and various research and development laboratories . . . have been set up." However, the FBTR has not been easy to build or operate, and the experience with it has only demonstrated how difficult breeder reactor technology is. Neither has it ever operated at the advertised 40 MWt; the best it has managed is 17.5 MWt (2.8 MWe), and that well over a decade after criticality.

Work on the FBTR started in 1971, and it was anticipated that the reactor would be commissioned in 1976. But the reactor attained criticality only in October 1985, at a fraction of the original design power. Since it was commissioned, the FBTR suffered numerous accidents and component failures. Some of the incidents and accidents involving the FBTR during just the first 5 years include the following:

- In 1987, there was leakage of Nitrogen in the flanges/valves of the preheating. Later that year "a complex mechanical interaction due to fuel handling error in the reactor damaged certain 'in-vessel' components." This took 2 years to rectify.
- In September 1988, problems of failure of the cores of the trailing cables were noticed during the process of retrieval of damaged sub-assemblies in the reactor.
- In February 1989, the load cell failed, and the Capsule Transfer Gripper (CTG) got damaged. This was rectified in April 1989.
- In July 1989, the reactor was shut down as the desired availability factor could not be achieved due to noise pick-up by the reactor protection logic and unsatisfactory operation of speed control system for primary sodium pumps.
- In November 1989, due to certain construction deficiencies, interference of the hangers with the complimentary shielding was observed in the primary sodium system.

The litany of accidents and incidents continued through the 1990s. It was only in 2000 that the FBTR even managed to operate continuously for 53 days.

On the basis of this experience, spotty at best, the DAE has started to build a 1,250 MWt breeder, the Prototype Fast Breeder Reactor (PFBR), scaling up the FBTR by a factor of about 70. Instead of the carbide fuel used in the FBTR, the PFBR will use plutonium and uranium oxide based fuel that the DAE has no experience with. All of this adds up to a recipe for cost and time overruns, as well as operational difficulties, with the PFBR.

The PFBR has been talked about for a long time. Plans have been made beginning over 2 decades ago. The first expenditures on the PFBR were made in 1987-88. In 1990, it was reported that the government had "recently approved the reactor's preliminary design and has awarded construction permits" and that the reactor would be on line by 2000. In 2001, the chairman of the AEC announced that the PFBR would be commissioned by 2008. Construction of the reactor finally was started in October 2004 and is now expected to be commissioned in 2010. There already may have been a further setback due to the disastrous tsunami of December 2004. Given that even the second stage of the three-stage nuclear program is yet to start, more than 50 years after the initial announcement, the third-stage—breeders involving thorium and uranium-233—is unlikely to materialize anytime in the foreseeable future.

Such delays may well be a blessing in disguise. Both safety and economical arguments weigh against breeder reactors. There are several reasons why accidents involving fast breeders are both more likely and could cause greater damage to public health than other power generation systems. One problem arises from the use of liquid (molten) sodium to transport heat from the reactor core. Sodium is highly reactive; it burns when exposed to air and reacts violently with water. Therefore there are risks associated with leaks, sodium fires, and explosive steam-sodium interactions.

Unlike small test reactors (such as the FBTR), large fast breeder reactors often have what is called a positive sodium void coefficient. What this means is that if for some reason the sodium were to heat up and vaporize, then it would increase the reactivity of the core of the reactor. If the operating system failed to insert control rods fast enough, the increased reactivity would, in turn, heat up the sodium further; this chain could ultimately cause a fuel meltdown into a supercritical configuration and a small nuclear explosion.

Another problem arises from the use of mixed oxide fuel (MOX) in the PFBR. Because the fuel contains plutonium that is about 30,000 times more radioactive than uranium-235, there are more severe health effects coming from exposure (especially through inhalation) to this fuel. Further, the spent fuel from FBR typically has a greater buildup of highly radioactive fission products. Thus, the impacts of a full-scale (beyond design basis) accident would be much more severe than in a light water or heavy water reactor.

The plutonium or uranium-233 (derived from thorium) that provides the basic fissile material required to drive the reactor is extracted by chemically treating highly radioactive spent fuel at reprocessing plants, producing large quantities of radioactive wastes during the process. Reprocessing is also prone to accidents. Indeed, it was an accident at the Kalpakkam Reprocessing Plant on January 21, 2003, when six workers were exposed to dangerously high levels of radiation, that has been described by the director of the Bhabha Atomic Research Centre as "the worst accident in radiation exposure in the history of nuclear India."

Reprocessing is also expensive. Based on the budgets allotted to the most recently constructed reprocessing plant at Kalpakkam, which is to serve as a standard design for future plants, we estimate that the cost of reprocessing each kilogram of spent fuel would be approximately Rs. 26,000 (approx. $600) with assumptions favourable to reprocessing, and close to Rs. 30,000 (approximately $675) under other assumptions.[4] These costs are lower than the corresponding figures for reprocessing plants in Europe, the United States, and Japan. As in their case, however, it is unlikely to be an economically viable method of waste disposal.

Since the fuel for breeder reactors is obtained through reprocessing, it will increase the costs of producing electricity at these reactors. There are further reasons to expect that electricity from breeder reactors will be very expensive. First, due to greater safety requirements, breeder reactors tend to cost more to construct than water moderated thermal reactors. The same also goes for associated fuel fabrication plants. Finally, as mentioned earlier, these reactors use molten sodium as coolant. Sodium is opaque and cannot be exposed to air or water. Hence, operating such reactors requires extensive precautions and even minor maintenance tasks become difficult. Thus, in comprison with other reactors, breeders will be capital-intensive, be fuelled at greater expense, and will have higher operations and maintenance costs, all of which will make electricity from these reactors costly.

EXPENSIVE POWER

Though perhaps not as costly as electricity from breeder reactors, electricity from the DAE's existing reactors has not been cheap either, especially in comparison with the staple source of electricity in India, namely coal-based thermal power. Since nuclear reactors clearly were much more expensive than thermal plants, the DAE's strategy was to compare nuclear power costs with thermal power plants that were situated far away from coal mines, thereby increasing the transport cost of coal and thus the fuelling costs of thermal power.

In 1958, Bhabha projected "the contribution of atomic energy to the power production in India during the *next 10 to 15 years*" and concluded that "the costs of [nuclear] power [would] compare *very favourably* with the cost of power from conventional sources in many areas" (emphases added). The "many areas" referred to regions that were remote from coalfields, which was estimated as 600 kilometers (km) in the early days. By the 1980s the DAE had changed this distance and stated that the cost of nuclear power "compares quite favourably with coal-fired stations located 800 km away from the pithead and in the 1990s would be even cheaper than coal fired stations at pithead." This projection was not fulfilled, and a 1999 NPC internal study came to the less optimistic conclusion that the "cost of nuclear electricity generation in India remains competitive with thermal [electricity] for plants located about 1,200 km away from coal pit head, when full credit is given to long-term operating cost, especially in respect of fuel prices."

Even this claim does not stand up to analysis. The costs of generating electricity at the Kaiga atomic power station and the Raichur Thermal Power Station (RTPS) VII—both plants of similar size and vintage—have been compared using the standard discounted cash flow methodology.[5] The coal for RTPS VII was assumed to come from mines that were 1,400 km away. The nuclear reactors were assumed to have an economic lifetime of 40 years (as against a much longer radioactive lifetime), but the coal plants were assumed to have an economic lifetime of only 30 years. The comparison showed that nuclear power would be competitive only with unrealistic assumptions; for a wide range of realistic parameters, nuclear power is significantly more expensive. These results are summarized in Figure 1, which shows levelized cost (the bare generation cost which does not include other components of electricity tariff like interest payments and transmission and distribution charges) of Kaiga I and II (operating nuclear reactors), Kaiga III and IV (nuclear reactors under construction; projected costs), and the Raichur VII (operating coal fueled thermal plant) as a function of the real discount rate (a measure of the value of capital after taking out the effects of inflation) at 80 percent Capacity Factor.

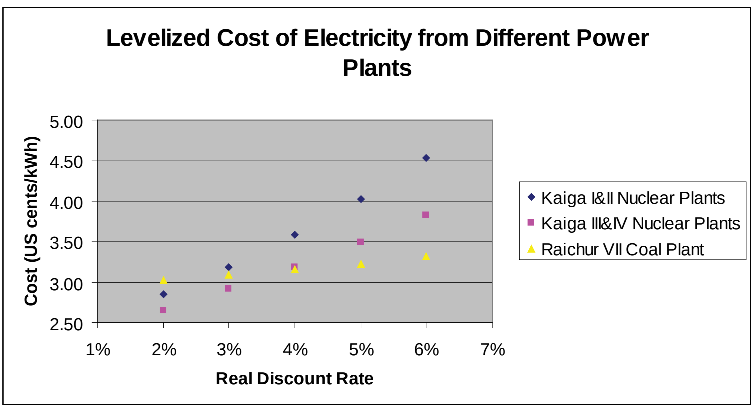

Figure 1. Levelized Cost of Electricity from Different Power Plants.

One particularly key variable is the discount rate, a measure of the value of capital. Nuclear power, because of its capital intensive nature, is competitive only for low discount rates. In a country where there are multiple demands on capital for infrastructural projects, including for electricity generation, such low discount rates are not realistic. The electricity sector in India, as elsewhere, is being reorganized to make it more economically viable. The 2003 national Electricity Act emphasizes competition as the basis for energy policy. The nuclear establishment has so far managed not to be put to the economic test, but this state of affairs could change.

This economic comparison is based largely on assumptions favorable to nuclear power. In particular, following the methodology adopted by the DAE, we have not included the costs of dealing with radioactive wastes from nuclear power. Since there is no credible solution to the problem of radioactive waste, the best that can be done is short-term management. The DAE treats spent nuclear fuel by reprocessing it and segregating the waste into different categories on the basis of their radioactivity. As mentioned earlier, reprocessing is expensive. If our estimate of the cost of reprocessing in India is included in the tariff for nuclear power, it would increase the unit cost by roughly 1 percent. This would make it even more expensive than thermal power from coal.

Neither does the comparison include any provision for insurance liability against accidents since the government has not required that of nuclear power plants. In the United States, private companies considering the construction of nuclear reactors were concerned that such an accident would likely bankrupt them and tried to get insurance coverage. No insurance company was willing to take on the risk of indemnifying against such a huge liability, nor could they commit to pay beyond their own resources. The U.S. Congress had to introduce the Price-Anderson act that allowed the Government to act as the ultimate insurer, offering in essence a subsidy to the nuclear industry. Such subsidies are not included in the quoted economic costs of nuclear power.

In India, the assumption seems to be that in the event of an accident, the government would deal with the consequences. There is not even the minimal insurance requirement that the Price-Anderson act imposes upon nuclear utilities. Including those requirements would only make nuclear power even less economical in India. However, this is, in part, the result of the NPC being a government-owned company. It is by no means clear what would happen if private companies were to start building or operating nuclear reactors.

ACCIDENTS AND INCIDENTS

There is reason, though, to be concerned about the safety of the DAE's reactors. Practically all the nuclear reactors and other facilities associated with the nuclear fuel cycle operated by the DAE have had accidents of varying severity. Other facilities associated with the nuclear fuel cycle also have had accidents. These are euphemistically described as incidents by nuclear establishments around the world in order to mollify justified public concerns. One can barely imagine the consequences of a Chernobyl-like accident involving the release of large quantities of radioactive materials in a densely populated country like India.

The observed safety problems seem to be systemic. In 1995 the AERB, which is supposed to oversee the safe operation of all civilian nuclear facilities, produced a detailed report that identified 134 safety issues, of which about 95 were considered "top priority." It is of greater concern that many of these problems had been identified in earlier DAE evaluations in 1979 and 1987 as items requiring "urgent action" but had not been addressed. Not surprisingly, the DAE has kept the AERB report a secret. Even now, not all of these safety issues have been addressed.

The most serious of the accidents at a nuclear reactor in India occurred on March 31, 1993, when two blades in the turbine generator of the first unit of the Narora Atomic Power Station snapped under accumulated stress and caused a major fire in the turbine room, nullifying all electrical safety systems. What saved the reactor from a potential meltdown was the timely action of some technicians, who flooded the reactor with a solution containing boron, a neutron absorber. This was considered "a last-level protection in the event of a prolonged station power blackout."

What is really cause for concern in the case of the Narora accident is that it came after the DAE had been warned by the manufacturer of the turbine blades that they were susceptible to fatigue failure. But the DAE ignored the warning. Further, at least two of the DAE's reactors had experienced major fires in the preceding decade: the Rajasthan 2 reactor in 1985 and the Kakrapar 1 reactor in 1991. In the latter, the fire led to a complete loss of emergency diesel power and a partial loss of D.C. power supply. And, finally, the DAE had ignored what reactor designers around the world had learned from the 1975 fire at the Browns Ferry nuclear plant in the United States: Always put electric cabling to emergency shut down and cooling systems in separate fire proof channels.

A further source of concern is that, as mentioned earlier, the AERB, which is supposed to oversee the safe operation of all civilian nuclear facilities, is not independent of the DAE. This is compounded by the AERB's lack of technical staff and testing facilities. As A. Gopalakrishnan, a former chairman of the AERB, has observed,

> 95 percent of the members of the AERB's evaluation committees are scientists and engineers on the payrolls of the DAE. This dependency is deliberately exploited by the DAE management to influence, directly and indirectly, the AERB's safety evaluations and decisions. The interference has manifested itself in the AERB toning down the seriousness of safety concerns, agreeing to the postponement of essential repairs to suit the DAE's time schedules, and allowing continued operation of installations when public safety considerations would warrant their immediate shutdown and repair.

Elsewhere, Gopalakrishnan has pointed to an example of direct interference from the AEC. This was in the context of the collapse of the Kaiga containment dome that was mentioned earlier.

> When, as chairman, I appointed an independent expert committee to investigate the containment collapse at Kaiga, the AEC chairman wanted its withdrawal and matters left to the committee formed by the NPC [Managing Director]. DAE also complained to the [Prime Minister's Office] who tried to force me to back off.

All of this suggests that the DAE is not an organization that can avoid accidents at its nuclear facilities reliably. Since generating nuclear power involves a complex technology where events can spin out of control in a very short time, even seemingly minor accidents should be cause for serious concern.

In studying the safety of nuclear reactors and other hazardous technologies, sociologists and organization theorists have come to the pessimistic conclusion that serious accidents are inevitable with such complex high-technology systems.[6] The character of these systems makes accidents a "normal" part of their operation, regardless of the intent of their operators and other authorities. In such technologies, many major accidents have seemingly insignificant origins. Because of the complexities involved, all possible accident modes cannot be predicted and operator errors are comprehensible only in hindsight. Adding redundant safety mechanisms only increases the complexity of the system allowing for unexpected interactions between subsystems and increasing new accident modes. All of this means that there is no way to ensure that reactors and other nuclear facilities will not have major accidents.

NUCLEAR POWER, CLIMATE CHANGE, AND THE ENVIRONMENT

A new argument in support of nuclear power that has become common is in the context of increasing global warming. Pro-nuclear advocates have offered nuclear power as a solution to global warming, and, given the gravity of the likely impacts of impending climate change, it is not surprising that many have started looking at it more favourably. Flailing nuclear establishments around the world, including India's, have grabbed this second opportunity and made claims for massive state investments in the hope of resurrecting an industry that has largely collapsed due to its inability to provide clean, safe, or cheap electricity. Some in the United States and elsewhere also have argued that India should be helped with technology and uranium to expand its nuclear sector so that it could decrease its greenhouse gas (GHG) emissions.

Two implicit but flawed assumptions underlie such claims about the significance of nuclear energy in controlling climate change. The first is that climate change can be tackled without confronting and changing Western, especially American, patterns of energy consumption—the primary causes and continuing drivers for unsustainable increases in carbon emissions and global warming. This is impossible; global warming cannot be stopped without significant reductions in the current energy consumption levels of Western/developed countries. Efforts by various developing countries, especially by elites within such countries, to match these consumption levels only intensify the problem.

The second flawed assumption is that the adoption of nuclear power makes sense as a strategy to lower aggregate carbon emissions. A good example is Japan, a strongly pro-nuclear energy country. As Japanese nuclear chemist and winner of the 1997 Right Livelihood Award Jinzaburo Takagi showed, from 1965 to 1995 Japan's nuclear plant capacity went from zero to over 40,000 MW. During the same period, carbon dioxide emissions went up from about 400 million tons to about 1200 million tons. In other words, increased use of nuclear power did not really reduce Japan's emission levels. The massive expansion of nuclear energy, then, was not motivated by a desire to reduce emissions. If indeed Japan was sincere about doing that, it would have adopted very different strategies.

There are two reasons why increased use of nuclear power does not necessarily lower carbon emissions. First, nuclear energy is best suited only to produce baseload electricity, which only constitutes a fraction of all sources of carbon emissions. Other sectors of the economy where carbon dioxide and other greenhouse gases are emitted, such as transportation, cannot be operated using electricity from nuclear reactors. This situation is unlikely to change anytime soon.

A second and more fundamental reason is provided by John Byrnes of the University of Delaware's Center for Energy and Environmental Policy, who observes that nuclear technology is an expensive source of energy and can be viable economically only in a society that relies on increasing levels of energy use. Nuclear power tends to require and promote a supply-oriented energy policy and an energy intensive pattern of development, and thus, in fact, indirectly adds to the problem of global warming.

As with Japan, nuclear power is unlikely to make much difference to carbon emissions from India. Just about every study on the subject has identified a host of other measures that are far more viable economically. These include running Indian coal plants better, including the use of coal washing and possibly more advanced combustion methods; increased energy efficiency measures in the domestic sector; and improving Indian energy intensity (energy consumption per unit of gross domestic product [GDP]). Increased investment on nuclear power only diverts attention and finances away from these measures.

The other choice that the Indian government has to make is whose electricity needs are met first. As energy analysts like Jose Goldemberg have argued, development and the mitigation of poverty require that energy services be directed deliberately and specifically toward the needs of the poor. Installing a centralized nuclear reactor or thermal plant and extending the grid to cover distant villages is an inefficient way of providing lighting to the primarily rural societies that characterize India, as they do most developing countries. Such communities are better served by distributed renewable energy systems based on a number of different technologies and sources such as micro hydel plants, windmills, photovoltaics, and biomass-based power.

Climate change may be a grave danger confronting humanity, but it should not blind us to other environmental hazards. Nuclear power is unique in many ways. One environmental consequence peculiar to nuclear power is that, among all electricity generating technologies, it alone produces waste that stays radioactive for tens of thousands of years, posing a potential health and environmental hazard to thousands of future generations. This is clearly iniquitous, since these generations would bear the consequences while we use the electricity generated by these reactors. Ethical dilemmas aside, no technology that generates such long lived radioactive wastes can be considered environmentally sustainable.

Further, different stages of the nuclear fuel chain release large quantities of radioactive and other toxic materials into the biosphere. Thus, claims of nuclear energy being environment friendly are absolutely baseless, and it should be considered a polluting source of electricity generation, albeit in a different way from fossil fuels.

NUCLEAR POWER AND THE INDO-U.S. NUCLEAR DEAL

The above history of unachieved promises explains why the demands from the DAE and other nuclear advocates to gain access to international nuclear markets have became louder and louder over the last decade. It is only with external help that the DAE can ever hope to grow rapidly. That is one primary motivation for the Indian commitment in the July 2005 agreement to separate its nuclear program into a civilian and a military one, which goes against its historical policy: India so far has refused to allow international inspections at any of its indigenously constructed reactors.

The other pressure driving this deal has been the DAE's failure to plan for an adequate supply of fuel for even the existing nuclear reactors. Apart from two very old imported U.S. reactors, Tarapur I and II, India relies on its domestic uranium reserves to fuel its nuclear reactors. As of May 2006, the total electric capacity of India's power reactors that were domestically fuelled was 2,990 MW—this includes the Rajasthan 1 and 2 reactors which are under safeguards but have to be fuelled by domestic uranium. At 80 percent capacity, all these reactors would require about 430 tons of natural uranium fuel per year. The weapons plutonium production reactors, CIRUS and Dhruva, consume about another 35 tons of uranium annually. The uranium enrichment facility would require about 10 tons of natural uranium feed a year. Thus, the total current requirements are about 475 tons of domestic natural uranium per year.

We estimate India's current domestic uranium production to be less than 300 tons/year, well short of its needs. It has had to rely on stocks of previously mined and processed uranium to meet the shortfall. But this might run out very soon. This was evident in the statement from an unnamed official to British Broadcasting Corporation soon after the U.S.-India deal was announced, when he said: “The truth is, we were desperate. We have nuclear fuel to last only till the end of 2006. If this agreement had not come through, we might as well have closed down our nuclear reactors and, by extension, our nuclear programme.”

The DAE has been trying desperately to open new uranium mines in the country. But it has been met with stiff public resistance everywhere. This local resistance stems from the widely-documented impacts of uranium mining and milling on public and occupational health. Nevertheless, it is quite likely that such public opposition will be steamrolled, and new mines and mills opened. However, even this expansion is unlikely to satisfy the uranium requirements of the nuclear program in the short to medium term.

While it is undeniable that for the DAE to meet its goals it will require external help, it is by no means clear that access to international nuclear technology will make a significant difference to nuclear power in India. Though the DAE’s nuclear reactor construction has been marked with time and cost overruns, overnight construction costs still are comparable to, if not cheaper than, reactors sold on the international market, primarily because of lower labor costs but also because licensing requirements are easier to deal with. In the case of French reactors which are typical of Western supplied power plants, M. R. Srinivasan, former head of the DAE, has stated that, “Recent cost projections show that if an LWR were to be imported from France, the cost of electricity would be too high for the Indian consumer. This is because of the high capital cost of French supplied equipment.” Unless foreign countries offer cheap loans to allow for the purchase of imported reactors, India is unlikely to be able to afford them. This is unlikely to be a viable way for a large scale expansion of nuclear power.

CONCLUSIONS

The experience of over 50 years of experimentation with nuclear power in India and elsewhere demonstrates that it cannot be considered a safe, economical, or environmentally sustainable source of electricity. Despite continued government patronage and much media hype, atomic energy is unlikely to be a major source of electricity for India. There are many who believe India and other countries would be better off giving up this costly and dangerous technology and finding ways of generating electricity that do not threaten their future or their environment.

It is testimony to the political power of the Department of Atomic Energy that it has continued to be the beneficiary of government largesse for decades, while producing so little electricity and that, too, at enormous cost. The only viable explanation for this lies in the DAE's role in designing nuclear weapons and producing the fissile material (plutonium and enriched uranium) to make them.[7] The DAE has, of course, realized that this—namely, the ability to produce fissile material—is the real source of its political power. This is why it has sought strenuously over the course of the negotiations of the Indo-U.S. nuclear deal to keep as large a part of its complex as possible outside of safeguards. As we have elaborated elsewhere, the deal will allow for the retention of a substantial capacity for the production of nuclear weapons useable material.[8] Thus, if it comes through, the nuclear deal will give a new lease on life to a flailing atomic energy establishment that is involved both in the production of an undesirable source of electricity and in the production of even less desirable nuclear weapons.

ENDNOTES - CHAPTER 3

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CHAPTER 4

PLUTONIUM PRODUCTION IN INDIA AND THE U.S.-INDIA NUCLEAR DEAL

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INTRODUCTION

On July 18, 2005, U.S. President George W. Bush and Indian Prime Minister Manmohan Singh issued a joint statement in Washington, DC, laying the grounds for the resumption of U.S. and international nuclear trade with India.[1] This trade has been restricted for about 3 decades because India is neither a signatory to the nuclear nonproliferation treaty nor allows International Atomic Energy Agency (IAEA) safeguards on all its nuclear facilities. The July agreement has generated political debate in the United States and India, and concern on the part of a number of other countries.[2] Among the issues is the fear that the agreement serves to normalize India's status as a nuclear weapons state and so weakens the Nuclear Non-Proliferation Treaty (NPT) and the larger nonproliferation regime. An important concern is that it may serve to expand India's potential nuclear weapons production capabilities and thus hinder international efforts to end the production of fissile materials for nuclear weapons.

The United States has started to amend its own laws and policies on nuclear technology transfer and to seek the necessary changes in the international controls on the supply of nuclear fuel and technology managed by the Nuclear Suppliers Group (NSG) of states so as to allow nuclear trade with India. In exchange for the lifting of these restrictions, India's government has identified several nuclear facilities that it will designate as civilian and will volunteer for IAEA safeguarding. Currently, India has four power reactors under IAEA safeguards, the U.S.-built Tarapur 1 and 2, and the Canadian-built Rajasthan 1 and 2. The two Koodankulam reactors that are under construction by Russia also will be subject to safeguards.

India has proposed that it will place eight additional reactors under safeguards between 2006 and 2014, each with a capacity of 220 MWe (see Appendix I). These reactors are:[3]

- Two Rajasthan reactors still under construction, RAPS 5 and 6, which would be made available for IAEA monitoring when they commence operation in 2007 and 2008 respectively,
- RAPS 3 and 4, which are already operating but would only be available for safeguards in 2010,
- The two Kakrapar reactors, which would be made available for safeguards in 2012, and

- The two reactors at Narora which would become available for safeguards in 2014.

Some of the facilities at the Nuclear Fuel Complex, Hyderabad, also have been identified as civilian and are to be offered for safeguards by 2008.[4] Other facilities to be declared civilian include three heavy water plants (leaving at least two out of safeguards), and the two Away-from-Reactor spent fuel storage facilities that contain spent fuel from the safeguarded Tarapur and Rajasthan reactors.

India would shut down the Canadian-build CIRUS reactor permanently in 2010 and also would shift the spent fuel from the APSARA reactor to a site outside the Bhabha Atomic Research Centre and make it available for safeguarding in 2010.

A significant proportion of India's nuclear complex would remain outside IAEA safeguards and continue to have a "strategic" function (see Appendix I). This military nuclear complex would include the Tarapur 3 and 4 reactors, each of 540 MWe capacity, the Madras 1 and 2 reactors, and the four power reactors at Kaiga.[5] Together, these unsafeguarded reactors have 2,350 MWe of electricity generation capacity. India also will not accept safeguards on the Prototype Fast Breeder Reactor (PFBR) and the Fast Breeder Test Reactor (FBTR), both located at Kalpakkam. Facilities associated with the nuclear submarine propulsion program would not be offered for safeguards. Reprocessing and enrichment facilities also are to remain outside safeguards.[6] Finally, under the deal, India retains the right to determine which future nuclear facilities it builds would be civilian and open to safeguards and which would not.

At the March 2006 summit in New Delhi between President Bush and Prime Minister Singh, it was announced that the U.S. Government was satisfied with this proposed Indian plan to separate its program into a civilian and a military component.[7] However, the final shape and status of the deal still is unclear since the U.S. Congress has not agreed on amendments to existing laws and may attach conditions that India may not accept. There also needs to be a consensus among the NSG countries in support of making an exemption to its rules for India.[8]

Technical issues related to fissile materials that are involved in these concerns about the agreement are discussed below.[9] First India's current plutonium production and stockpiles are estimated. The significance for India's future weapons-useable plutonium production capabilities of the line India has drawn between its civilian and military facilities are then assessed.

INDIA'S NUCLEAR PROGRAM

Established in 1948, India's Atomic Energy Commission turned to the United Kingdom (UK) for the design and enriched uranium fuel for its first nuclear reactor, Apsara. Similarly, the CIRUS reactor was supplied by Canada, while the heavy water used in it came from the United States. India's first power reactors at Tarapur and Rawatbhata were supplied by the United States and Canada respectively. A U.S. design was used for its first reprocessing plant in Trombay. Some of these technologies and materials contributed to the production and separation of the plutonium used in India's 1974 nuclear weapons test. Due to this test and the subsequent refusal to give up its nuclear weapons and sign the nuclear nonproliferation treaty (NPT), India has been kept largely outside the system of trade of nuclear technology that has developed over the past 3 decades.

India over the years has built a nuclear power program, with 15 reactors [Appendix I] providing an installed capacity of 3,310 megawatts electric (MWe), which accounts for about 3 percent of India's installed electricity generation capacity. Thirteen of the reactors are Pressurized Heavy Water Reactors (PHWRs), the first two of which were supplied by Canada. The other PHWR reactors are based largely on the Canadian design. The latest evolution of the design has increased the capacity from 220 to 540 MWe. The other two power reactors are Boiling Water Reactors supplied by the United States.

Only the four foreign supplied reactors currently are under IAEA safeguards. Two 1,000 MWe reactors being built by Russia under a 1988 deal also will be safeguarded. These two large reactors will increase India's nuclear capacity by over 50 percent in the next few years. Figure 1 shows the development of India's safeguarded and unsafeguarded nuclear capacity and how it will evolve in the coming years, including the effects of the U.S.-India nuclear deal.

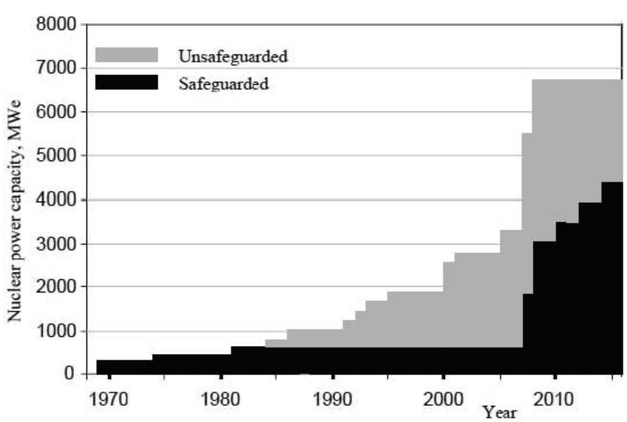

Figure 1. The Evolution of India's Installed Nuclear Electricity Generation Capacity.

For decades, India's Department of Atomic Energy (DAE) has pursued an ambitious fast-breeder reactor development program. This involves separating plutonium from the spent fuel produced in natural uranium reactors and using it to fuel fast-neutron breeder reactors, which in turn could be used to produce U-233 that eventually would serve to fuel breeder reactors operating on a Th-U-233 closed fuel cycle.[10] These efforts have made halting progress: The first breeder reactor to be built, the Fast Breeder Test Reactor, was due to become operational in 1976 but started only in 1985 and has been plagued with problems.[11] The 500 MWe Prototype Fast Breeder Reactor is not expected to be completed until 2010, if all goes according to plan. India also has begun work on a prototype plutonium-thorium-uranium-233 fuelled Advanced Heavy Water Reactor (AHWR) to gain experience with the thorium and uranium-233 fuel cycle.[12]

India conducted its first nuclear weapons test in May 1974. There were another five tests in 1998, involving fission weapons and a thermonuclear weapon. There are reports that at least one test used plutonium that was less than weapons grade.[13] India is believed to have a stockpile of perhaps 40-50 nuclear weapons, and one report cites plans for 300-400 weapons within a decade.[14]

FISSILE MATERIALS IN INDIA

India is producing plutonium for its nuclear-weapons programs. Along with Israel, Pakistan, and perhaps North Korea, it may be the only state currently doing so. The five NPT nuclear weapons states, United States, Russia, UK, France, and (informally) China, have all announced an end to fissile material production for weapons. India also is reprocessing the spent fuel from its nuclear power reactors, an option pursued currently only by Russia, France, and the UK. Japan is about to begin operating a large reprocessing plant. Other countries simply store their spent nuclear fuel.

Weapons Grade Plutonium.

India's weapons grade plutonium comes from the 40 megawatt thermal (MWt) CIRUS and 100 MWt Dhruva reactors. Assuming that the reactors operate at full power when they are available allows an upper-bound estimate of plutonium production. At full power and an availability factor of 70 percent, each year CIRUS would produce about 9.2 kg of weapons grade plutonium, and Dhruva would produce about 23 kg of weapons grade plutonium.[15] The estimated cumulative weapons grade plutonium produced by 2006 CIRUS is 234 kg and by Dhruva about 414 kg.[16]

Spent fuel from CIRUS and Dhruva is reprocessed at the Trombay reprocessing plant (with a capacity of about 50 tons of spent fuel per year). It is hard to know how much of the plutonium that has been recovered from spent fuel has been incorporated into weapons.

It is estimated that over the years a total of 131 kg of India's weapons grade plutonium has been consumed in nuclear weapons tests, as reactor fuel and in processing losses. This would leave India with a current stockpile of about 500 kg of weapons grade plutonium.[17] It is typically assumed that 5 kg of plutonium is sufficient for a simple nuclear weapon. (More advanced designs could use as little as 3 kg). Thus, India's current stockpile of weapons grade plutonium would be equivalent to about 100 nuclear weapons. It is not known how much of this has been fabricated into weapons components.

Civil Plutonium.

Power reactors produce plutonium in their fuel as a normal byproduct of energy generation. As of May 2006, India's unsafeguarded reactors had produced about 149 terrawatt hours (TWh) of electricity. Their accumulated spent fuel produced so far would contain about 11.5 tons of plutonium.[18] They are now producing about 1.45 tons of plutonium per year. The currently safeguarded power reactors have produced a total of 108 TWh of electricity, and 1266 tons of spent fuel, containing about 6.8 tons of plutonium.[19]

In India, the chosen way of dealing with the spent nuclear fuel from power reactors is through reprocessing. India has two large reprocessing plants at Tarapur (about 100 tons/year) and Kalpakkam (about 100 tons/year) to recover plutonium from spent power reactor fuel.[20] It plans to increase its annual reprocessing capacity to 850 tons by 2014 to meet the needs of its fast breeder reactor program and AHWR.[21]

The "reactor-grade" plutonium in the high burnup spent fuel being discharged by these reactors has a different mix of isotopes from weapons grade plutonium. However, reactor grade plutonium can be used to make a nuclear explosive and, as mentioned earlier, one of India's May 1998 nuclear tests is reported to have involved such material. In his history of the Indian nuclear weapons program, George Perkovich claims "knowledgeable Indian sources confirmed" use of nonweapons grade plutonium in one of the 1998 tests, while Raj Chengappa in a semi-official history of 1998 tests claims "one of the devices . . . used reactor grade or dirty plutonium."[22] An estimated 8 kg of such reactor grade plutonium would be required to make a simple nuclear weapon.[23]

Figure 2 summarizes these estimates for the different stockpiles of plutonium that India has accumulated so far. However, the exact amount of separated plutonium that India has produced so far is not known.

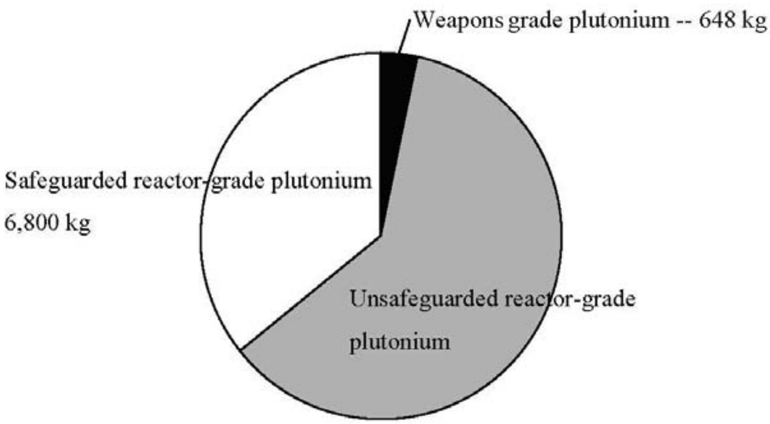

Figure 2. India's Total Plutonium Production.

The Uranium Constraint.

One important reason for the DAE's willingness to agree to have more of its nuclear facilities placed under safeguards is India's severe and growing shortage of domestic uranium. An Indian official told the BBC soon after the U.S.-India deal was announced, "The truth is, we were desperate. We have nuclear fuel to last only till the end of 2006. If this agreement had not come through we might have as well closed down our nuclear reactors and by extension our nuclear program."[24] The former head of the Atomic Energy Regulatory Board has reported that "uranium shortage" has been "a major problem . . . for some time."[25]

Nuclear Power Corporation of India Limited (NPCIL) data shows that most of its reactors have had lower capacity factors in the last few years.[26] Figure 3 shows the recent trend in operating capacity factors at India's nuclear power reactors as reported by NPCIL. It does not include data for Narora-1 and Rajasthan-1, both of which were shut-down for part of this period. The Indian Planning Commission noted that these reduced load factors were "primarily due to nonavailability of nuclear fuel because the development of domestic mines has not kept pace with addition of generating capacity."[27]

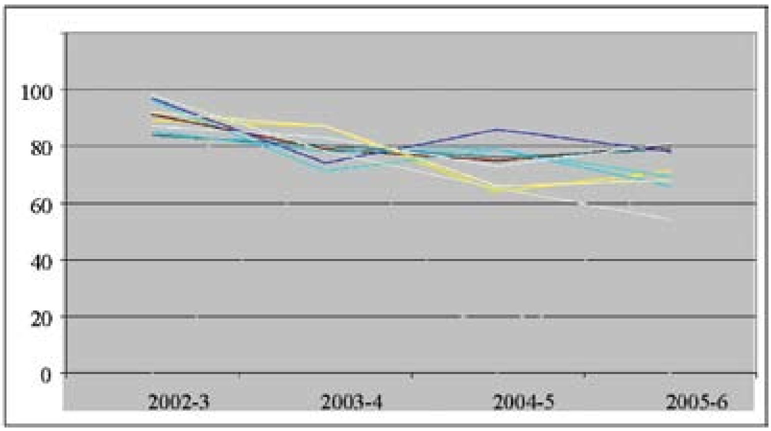

Figure 3. The Recent Decline in Indian Nuclear Power Plant Capacity Factors.

As of May 2006, the total electric capacity of India's power reactors that were domestically fuelled was 2,990 MWe—this includes the Rajasthan 1 and 2 reactors, which are under safeguards but have to be fuelled by domestic uranium. At 80 percent capacity, all these reactors would require about 430 tons of natural uranium fuel per year. The weapons grade plutonium production reactors, CIRUS and Dhruva, consume about another 35 tons of uranium annually. The uranium enrichment facility would require about 10 tons of natural uranium feed a year. Thus, it is estimated that the total current requirements are about 475 tons of domestic natural uranium per year. Nuclear Fuel Complex Chairman R. Kalidas has said that India's current annual uranium requirement is on the order of 400-500 tons of uranium oxide.[28]

Figure 4 shows the different demands for domestic uranium in India. At various times, India has been able to import limited amounts of low enriched fuel for its Tarapur reactors, from the United States (which provided the reactors), Russia, France, and China.

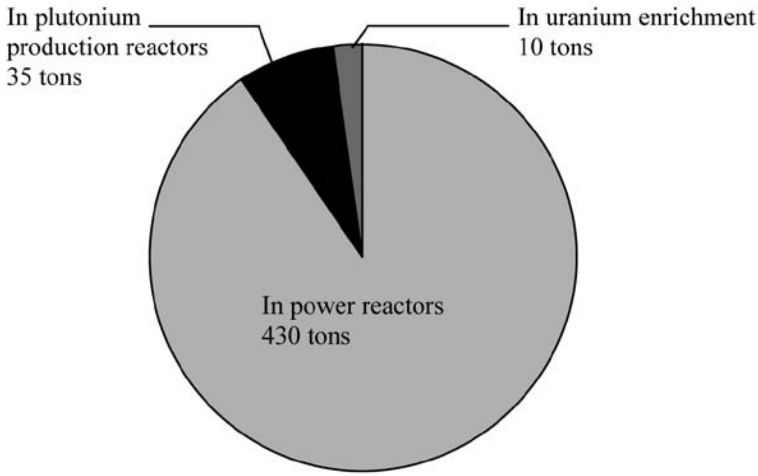

Figure 4. Annual Consumption of Domestic Uranium in India.

In comparison, it is estimated that current uranium production within India is less than 300 tons of uranium a year, well short of these requirements. It is assumed that India mines and mills 2000 tons of uranium ore per day, 300 days per year, at an average ore grade of 0.05 percent uranium. The actual ore grade being mined may be only 0.03 percent, since the better quality ore already has been used. The Jaduguda mill has a processing capacity of about 2,100 tons ore/day and may only have been producing 230 tons per year.[29] But efforts are being made to expand uranium production. An official report notes that one mill is under construction at Banduhurang, Jharkhand, and was expected to be completed in mid-2006, and that work is underway on another at Turamdih, which will have a capacity of 3,000 tons per day of ore (about 450 tons/year of uranium).[30]

DAE has been able to continue to operate its reactors by using uranium stockpiled from the period when India's nuclear generating capacity was much smaller. Estimates are that, in the absence of cut backs in India's nuclear power generation or uranium imports, this stockpile will be exhausted by 2007.

India is estimated to have total conventional uranium resources of about 95,500 tons of uranium, sufficient to supply about 10 GWe installed capacity of PHWRs for 40 years or so.[31] However, the DAE's efforts to open new uranium mines in the country have met with stiff resistance, primarily because of concerns in the communities around existing mines about the health impacts of uranium mining and milling.[32] State governments in Andhra Pradesh and Meghalaya, where DAE has found significant uranium deposits, have yet to approve new licenses for uranium mining and milling activities.[33]

It is possible, however, that DAE may be able to overcome this resistance. The most likely new sites are in the districts of Nalgonda and Kadapa, in Andhra Pradesh, with respective potential capacities of about 150-200 tons and 250 tons of uranium a year.[34] If these mines are developed, then India could meet its current domestic uranium needs for both its nuclear power reactors and weapons program. In the meantime, old mines are being reopened and existing mines expanded, including at Jaduguda.[35]

In the next few years, the domestic uranium demand for India's unsafeguarded reactors will increase further by about 140 tons/year, to 575 tons per year, as the 540 MWe Tarapur-3 and the 220 MWe Kaiga-3 and Kaiga-4 reactors are completed and begin operation in 2007. However, the total domestic uranium requirement will begin to decrease as some of the currently unsafeguarded reactors are opened for inspection in 2010, 2012, and 2014 and can thus be fueled with imported uranium along with the Rajasthan-1 and 2 reactors (see Figure 5). Consequently, if India is able to meet the additional demand for domestic uranium until 2010, the availability of uranium imports allowed by the U.S.-India deal thereafter will give it a growing excess uranium production capacity that could be used for weapons purpose.

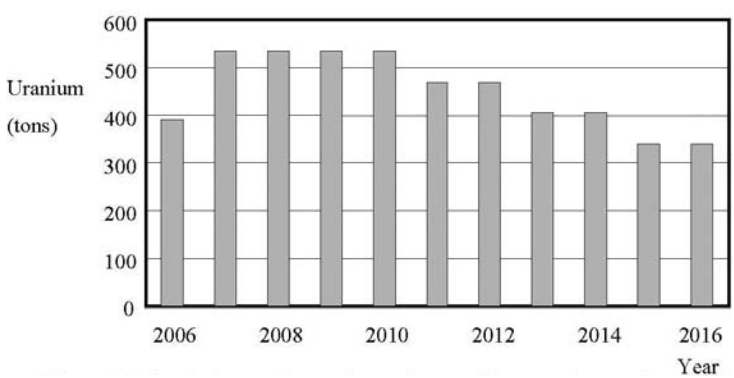

Figure 5. Estimated Annual Domestic Uranium Requirements for Unsafeguarded Heavy Water Power Reactors.[36]

India has offered to put 1,760 MWe of PHWRs under safeguards (including two reactors under construction) in addition to the two Rajasthan PHWRs with a combined capacity of 300 MWe that are already under safeguards. Without access to international uranium, all these reactors would have to be fueled using domestic uranium. At an 80 percent capacity factor, they would require about 300 tons of uranium annually.

If the deal goes through, the DAE will be able to purchase these 300 tons of uranium from the international market, in effect freeing up the equivalent of India's entire current uranium production for possible use in military facilities. With Nalgonda on line, the uranium available for the unsafeguarded power and weapons grade plutonium production reactors and the enrichment program increases to 450-500 tons/year. This would yield a uranium surplus of 75-125 tons a year after 2014.

There are several ways in which India could use its freed-up domestic uranium. In particular, concern has been raised about the possibility that it might be diverted to use in the weapons program. This option has been suggested by, among others, K. Subrahmanyam, former head of the National Security Advisory Board, who has argued that:

> Given India's uranium ore crunch and the need to build up our minimum credible nuclear deterrent arsenal as fast as possible, it is to India's advantage to categorize as many power reactors as possible as civilian ones to be refueled by imported uranium and conserve our native uranium fuel for weapons grade plutonium production.[37]

There are different ways in which this could be accomplished. One is that India could choose to build a third reactor dedicated to making plutonium for its nuclear weapons. There have been proposals for many years to build another large plutonium production reactor at the Bhabha Atomic Research Centre in Bombay.[38] The proposed reactor would be similar to the 100 MWt Dhruva that has been operating at BARC since 1985. A decision on whether to go ahead is expected early in 2007.[39] If a reactor of the same power rating as Dhruva is built, it could yield an additional 20-30 kg of plutonium, i.e., several bombs worth, each year.

India also could choose to use some of its domestic uranium to make weapons grade plutonium in one of its unsafeguarded PHWRs. This can be done by running the reactor in a "production" mode, i.e., by limiting the time the fuel is irradiated, through faster refueling.[40] This is beyond the normal design requirement of PHWR refueling machines but might be possible.

Assuming such high refueling rates are sustainable, then a typical 220 MWe pressurized heavy water reactor could produce between 150-200 kg/year of weapons grade plutonium when operated at 60-80 percent capacity.[41] Even one such reactor, if run on a production mode, could increase the existing rate of plutonium production by a factor of six to eight.[42] The net penalty for running one 220 MWe reactor in production mode is 190 tons of natural uranium.[43]

To offset this additional requirement of 190 tons/year of uranium if India were to operate a single 220 MWe PHWR in weapons grade plutonium production mode, it could recycle some of the depleted uranium recovered from the spent fuel from this reactor into the other seven unsafeguarded power reactors. This scheme involves fuelling 25 percent of the core with depleted uranium (containing 0.61 percent U-235) and ends up saving 20 percent of the normal natural uranium requirement, with the average burn up reduced to 5400 MWd/tHM.[44]

The resulting 20 percent savings on the roughly 306 tons/year of natural uranium the seven power reactors require is equivalent to 61 tons/year of natural uranium. The net penalty of running one reactor in production mode is reduced from 190 tons/year to about 130/tons per year. This implies that India could operate an unsafeguarded 220 MWe heavy water reactor in production mode, provided the Nalgonda and other mines can yield an additional 200 tons/year of uranium, and that India has sufficient reprocessing capacity to maintain the necessary flow of depleted uranium.

India already has fuelled some PHWRs using natural uranium and depleted uranium recovered as a byproduct of weapons grade plutonium production—including the Rajasthan-3 and 4, Kaiga-2 and Madras-2 reactors.[45] It has used depleted uranium recovered from low burn-up fuel from CIRUS and Dhruva.[46] These reactors generate only about 30 tons/year of spent fuel. However, there is a stock of about 750 tons of such spent fuel.[47] This would suffice for roughly 4 to 5 years if all the power reactors ran on a mixed natural and depleted uranium core.

Power Reactor Spent Fuel.

The nuclear deal does not constrain India's use of the 11.5 tons of plutonium from the spent fuel discharged by any of its currently unsafeguarded reactors. Each of the six currently operating reactors to be placed under safeguards, operating at 80 percent capacity, will add about 120 kg/year of plutonium during its remaining unsafeguarded operation. The total contribution from these six reactors will be about 4,300 kg before they are all finally under safeguards

India's total annual unsafeguarded plutonium production will increase from the current 1,450 kg/year as reactors under construction come into operation next year. It will decline in coming years as reactors are opened for inspection. Plutonium production will fall from about 2,000 kg/year in 2007 to about 1,250kg/year after 2014, when it will stabilize (see Figure 6) unless additional unsafeguarded reactors are built. Thus, the separation plan will serve to reduce India's annual production of unsafeguarded plutonium by about one-third.

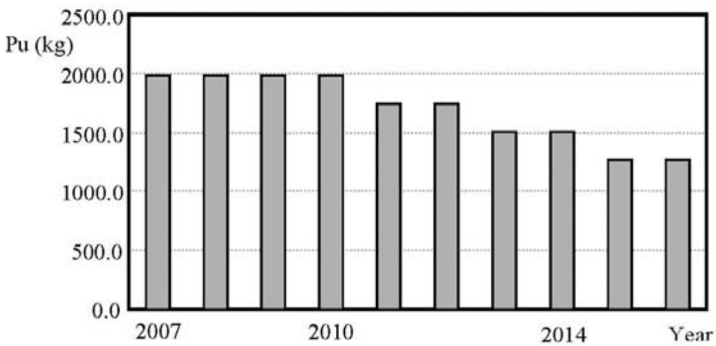

Figure 6. Annual Production of Unsafeguarded Plutonium from All Indian Power Reactors from 2007 until 2016, as Reactors Are Progressively Placed under Safeguards.

The Fast Breeder Reactor Program.

India's first large breeder reactor, the 500 MWe, Prototype Fast Breeder Reactor (PFBR) is under construction at Kalpakkam, near Madras. It is part of a larger complex that includes the Madras PHWR reactors and a reprocessing plant. This entire complex is being kept outside safeguards.[48] DAE chairman Anil Kakodkar has declared that "Both from the point of view of maintaining long term energy security and for maintaining the minimum credible deterrent the Fast Breeder Programme just cannot be put on the civilian list."[49] This suggests that the breeder may be used to produce weapons grade plutonium. The PFBR is expected to be completed in 2010.

Fueled initially by reactor grade plutonium separated from PHWR spent fuel, the PFBR would produce weapons grade plutonium in both its radial and axial blankets of depleted uranium while the plutonium recovered from the core could be recycled for use again as fuel (Figure 7). To recover the weapons grade plutonium, the core and blanket fuel assemblies would have to be reprocessed separately. There will be a dedicated reprocessing plant specially for the FBR.[50]

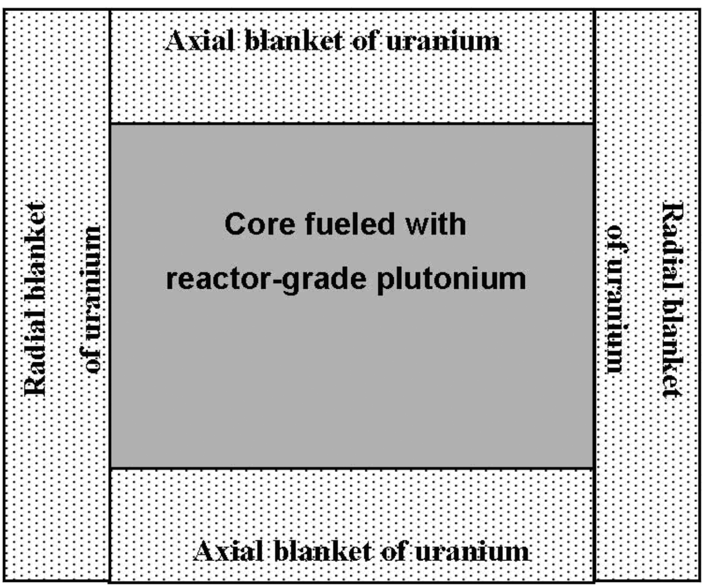

Figure 7. The Prototype Fast Breeder Reactor Burns Reactor-Grade Plutonium in Its Core and Produces Weapons-grade Plutonium in Its Radial and Axial Blankets.

The PFBR is designed to have a thermal power of 1,250 MW and an initial inventory of 1910 kg of plutonium in its core.[51] It is estimated that at 80 percent capacity the PFBR could produce on the order of 135 kg of weapons grade plutonium every year in its blanket.[52] This would amount to about 25-30 weapons worth of plutonium a year, a four- to five-fold increase over India's current weapons plutonium production capacity.

India plans to build four additional breeder reactors by 2020, and then move to larger 1,000 MWe breeders and eventually install 500 GWe of breeder capacity.[53] Each of the four planned 500 MWe breeder reactors would need two initial cores before they would be able to begin recycling their own plutonium, a total of about 16 tons.[54] India would appear to have more than sufficient unsafeguarded plutonium for placing all four of the planned breeders in the military sector. If these five breeders are built and all are kept military, then in about 15 years, India would be able to produce about 500-800 kg per year of weapons grade plutonium from them.

CONCLUSIONS

We have assessed plutonium production capabilities in India and how they might change as a result of the U.S.-India deal. India's current stockpile of weapons grade plutonium from its CIRUS and Dhruva reactors is found it to be about 500 kg. Assuming a typical figure of 5 kg of plutonium for each nuclear warhead, this stockpile would be sufficient for roughly 100 weapons. Under the deal, India will be able to produce another 45 kg of weapons grade plutonium from its CIRUS reactor before it is shut down in 2010. The Dhruva reactor will continue to operate and add about 20-25 kg/year. A second Dhruva sized reactor that is being considered would add a similar amount each year.

The most important potential increase in India's weapons grade plutonium production will come from its unsafeguarded fast breeder reactor, the PFBR, to be completed in 2010. We have estimated that it could produce about 130 kg of weapons grade plutonium each year, a four-fold increase in India's current production capability. However, the breeder would have remained unsafeguarded and produced the same amount of plutonium even in the absence of the U.S.-India deal.

India has a stockpile of about 11 tons of unsafeguarded reactor-grade plutonium. This stockpile is currently increasing at about two tons/year. We have estimated that the reactors India has offered to be safeguarded by 2014, in a phased manner as part of the deal, will contribute in total another four tons of unsafeguarded plutonium before they are opened for inspection. The eight reactors that are designated as military and will remain unsafeguarded will contribute 1,250 kg of reactor grade plutonium per year. All this reactor grade plutonium is also potentially weapons-useable.

We find that India's current domestic production of natural uranium of about 300 tons/year is insufficient to fuel its unsafeguarded reactors and sustain its current weapons grade plutonium and enriched uranium production, which altogether require about 475 tons a year. India has been able to escape this constraint so far by using stocks of previously mined and processed uranium.

Because of access to Uranium imports allowed by the deal, India may be able to produce 60-100 kg/year of weapons grade plutonium by partially running one of its unsafeguarded power reactors at low burn up. This will require operating the reactor refueling machines at much higher rates than normal and may limit the extent to which this is possible. A key constraint on this is the recycling of low-burn-up depleted uranium (containing about 0.6 percent Uranium-23 percent) as fuel. This in turn will depend on the operating capacity of India's reprocessing plants.

India already has achieved the fissile material requirements for a "minimal" arsenal, and it has been argued for some time that it should end production of fissile material for weapons.[55] It has been shown that half a dozen modest Hiroshima-yield weapons if dropped on major cities in South Asia could kill over a million people.[56] This suggests that several dozen weapons would more than suffice to meet any reasonable criteria for "minimum deterrence."[57] This number would permit a nuclear attack with a dozen warheads and provide for sufficient redundancy to deal with any concerns about survivability, reliability, and interception.[58]

Rather than pursue the option of a large expansion of its nuclear arsenal, India could choose to suspend all further production of fissile materials for weapons purposes pending the negotiation and entry into force of a Fissile Material Cutoff Treaty. This also is a necessary step in progress towards nuclear disarmament.

APPENDIX I

POWER REACTORS IN INDIA AND PAKISTAN

India (note: military reactors will not be open for safeguards)

Power reactor	Type	Power (MWe)	Start-up date	Safeguards (June 2006)	Open for Safeguards
Kaiga-1	HWR	220	16-Nov-00	Unsafeguarded	Military
Kaiga-2	HWR	220	16-Mar-00	Unsafeguarded	Military
Kakrapar-1	HWR	220	6-May-93	Unsafeguarded	2012
Kakrapar-2	HWR	220	1-Sep-95	Unsafeguarded	2012
Madras-1	HWR	170	27-Jan-84	Unsafeguarded	Military
Madras-2	HWR	220	21-Mar-86	Unsafeguarded	Military
Narora-1	HWR	220	1-Jan-91	Unsafeguarded	2014
Narora-2	HWR	220	1-Jul-92	Unsafeguarded	2014
Rajasthan-1	HWR	100	16-Dec-73	Safeguarded	Safeguarded
Rajasthan-2	HWR	200	1-Apr-81	Safeguarded	Safeguarded
Rajasthan-3	HWR	220	1-Jun-00	Unsafeguarded	2010
Rajasthan-4	HWR	220	23-Dec-00	Unsafeguarded	2010
Tarapur-1	BWR	160	28-Oct-69	Safeguarded	Safeguarded
Tarapur-2	BWR	160	28-Oct-69	Safeguarded	Safeguarded
Tarapur-4	HWR	540	12-Sep-05	Unsafeguarded	Military
Under Construction					
Kaiga-3	HWR	220	2007 (planned)	Unsafeguarded	Military
Kaiga-4	HWR	220	2007 (planned)	Unsafeguarded	Military
Kudankulam-1	VVER*	1000	2007 (planned)	Safeguarded	Safeguarded
Kudankulam-2	VVER	1000	2008 (planned)	Safeguarded	Safeguarded
Rajasthan-5	HWR	220	2007 (planned)	Unsafeguarded	2007
Rajasthan-6	HWR	220	2008 (planned)	Unsafeguarded	2008
Tarapur-3	HWR	540	2007 (planned)	Unsafeguarded	Military

*Russian: Pressurized Water Reactor.

ENDNOTES - CHAPTER 4

1. The U.S.-India nuclear agreement is at *www.whitehouse.gov/news/releases/2005/07/20050718-6.html*.

2. The politics and broader policy issues of the deal are discussed in Zia Mian and M. V. Ramana, "Wrong Ends, Means and Needs: Behind the U.S. Nuclear Deal with India," *Arms Control Today*, January/February 2006, *www.armscontrol.org/act/2006_01-02/JANFEB-IndiaFeature.asp*.

3. *Implementation of the India-United States Joint Statement of July 18, 2005: India's Separation Plan*, *mea.gov.in/treatiesagreement/2006/11ta1105200601.pdf*.

4. Fuel cycle facilities to be safeguarded are Uranium Oxide Plant (Block A), Ceramic Fuel Fabrication Plant (Palletizing) (Block A), Ceramic Fuel Fabrication Plant (Assembly) (Block A), Enriched Uranium Oxide Plant, Enriched Fuel Fabrication Plant, and Gadolinia Facility. There seem to be other fuel production facilities at the Nuclear Fuel Complex that will remain unsafeguarded, such as the New Uranium Oxide Fuel Plant; *www.aerb.gov.in/t/annrpt/anr99/srnp.htm*, and T. S. Subramanian, "Fuelling Power," *Frontline*, March 16-29, 2002, *www.frontlineonnet.com/fl1906/19060840.htm*.

5. *Implementation of the India-United States Joint Statement of July 18, 2005: India's Separation Plan*, *mea.gov.in/treatiesagreement/2006/11ta1105200601.pdf*.

6. The PREFRE reprocessing plant has had safeguards in place when running spent fuel from Rajasthan 1 and 2.

7. President Bush and Prime Minister Singh Press Conference, New Delhi, March 2, 2006, *www.whitehouse.gov/news/releases/2006/03/20060302-9.html*.

8. The Nuclear Suppliers Group member states are Argentina, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, China, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Kazakhstan, Latvia, Lithuania, Luxembourg, Malta, Holland, New Zealand, Norway, Poland, Portugal, South Korea, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and the United States, *www.nuclearsuppliersgroup.org*.

9. Some of these issues are also discussed in a recent report by Ashley Tellis, *Atoms for War*, Carnegie Endowment, 2006, *www.carnegieendowment.org/files/atomsforwarrevised1.pdf*.

10. R. Chidambaram and C. Ganguly, "Plutonium and Thorium in the Indian Nuclear Programme," *Current Science*, Vol. 70, No. 1, 1996.

11. K. V. Suresh Kumar, R. P. Kapoor, P. V. Ramalingam, B. Rajendran, G. Srinivasan, K. V. Kasiviswanathan, "Fast Breeder Test Reactor. 15 Years of Operating Experience," Paper presented at the Technical Meeting on Operational and Decommissioning Experience with Fast Reactors, IAEA-TM-25332, IAEA, 2002, pp. 15-27.

12. B. Battacherjee, "An Overview of RandD in Fuel Cycle Activities of AHWR," Paper presented at the 14th Indian Nuclear Society Conference, Kalpakkam, December 17-19, 2003, *www.indian-nuclear-society.org.in/conf/2003/1.pdf*.

13. George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation*, Berkeley, CA: University of California Press, 1999, p. 428.

14. Nuclear Notebook, "India's Nuclear Forces, 2005," *Bulletin of the Atomic Scientists*, September/October 2005. Indian Defense ministry sources have mentioned plans for 300-400 weapons. Vivek Raghuvanshi, "India to Stay the Course on Nuke Doctrine," *Defense News*, November 1, 2004.

15. This assumes a burn-up of 1,000 megawatt-days per ton of heavy metal (MWd/tHM) and a plutonium content of 0.9 kg/t in the spent fuel.

16. We assume that both CIRUS and Dhruva (since 1988) have had an average annual availability factor of 70 percent, except for CIRUS between 1991-97, when we assume a 60 percent availability factor because of reported problems with aging. R. C. Sharma and S. K. Agarwal, "Research Reactor: Its Refurbishment and Future Utilisation," *BARC Newsletter*, June 2004. We assume Khushab has been operating since 1998 with a 70 percent availability factor.

17. We emphasize that all of this plutonium may not have been separated. ISIS estimates India may have accumulated 575 kg of weapons grade plutonium as of the end of 2004; see ISIS, *India's Military Plutonium Inventory, End 2004, www.isis-online.org/global_stocks/end2003/india_military_plutonium.pdf*.

18. Assuming a 7,000 MWd/tHM burn-up, thermal efficiency of 0.29, Monte Carlo N-Particle (MCNP) code calculations by Alexander Glaser and Jungmin Kang show the fresh spent fuel contains about 3.8 kg of plutonium per ton of heavy metal (tHM). As the spent fuel cools, its Pu-241 decays with a 14-year half-life and the overall plutonium content therefore decreases by about 1 percent over 5 years to 3.75 kg per ton of spent fuel. Indian PHWRs now have an average burn-up of 7,000 MWd/tHM. K. C. Sahoo and S. A. Bhardwaj, "Fuel Performance In Water Cooled Nuclear Reactors," Paper presented at the 14th Indian Nuclear Society Annual Conference, Kalpakkam, December 17-19, 2003, *www.indian-nuclear-society.org.in/conf/2003/12.pdf*.

19. Currently safeguarded reactors are Tarapur 1 and 2 and Rajasthan 1 and 2. The Tarapur reactors have a thermal efficiency of 31.2 percent, an average fuel burn-up of 19,500 MWd/tHM, and produce 8 kg/tHM of plutonium.

20. Z. Mian and A.H. Nayyar, "An Initial Analysis of 85-Krypton Production and Dispersion from Reprocessing in India and Pakistan," *Science and Global Security*, Vol. 10, No. 3, 2002.

21. *Ibid*.

22. Perkovich, pp. 428-430; Chengappa, pp. 417-418.

23. J. Carson Mark, "Explosive Properties of Reactor-Grade Plutonium," *Science and Global Security,* Vol. 4, No. 1, 1993, pp. 111-124.

24. Sanjeev Srivastava, "Indian P.M. Feels Political Heat," BBC, July 26, 2005, available from *news.bbc.co.uk/go/pr/fr/-/2/hi/south_asia/4715797.stm*.

25. A. Gopalakrishnan, "Indo-US Nuclear Cooperation: A Nonstarter?" *Economic and Political Weekly,* July 2, 2005.

26. Nuclear Power Corporation of India, *www.npcil.nic.in/PlantsInOperation.asp*.

27. Planning Commission, Government of India, *Mid-Term Appraisal of the Tenth Five Year Plan (2002-2007), planningcommission.nic.in/midterm/cont_eng1.htm*. Chapter 10, pp. 229-230.

28. *RWE Nukem*, December 2004, p. 24.

29. *Ibid*.

30. *Project Implementation Status Report of Central Sector Projects Costing Rs. 20 Crore and Above*, October-December 2005, Infrastructure and Project Monitoring Division, Government of

India, April 2006, *mospi.nic.in/pi_status_report_oct_dec2005.pdf*. The Turamdih plant is expected to be commissioned by December, 2006, "UCIL exploring uranium ore in Chattisgarh, Rajasthan, Karnataka," *PTI*, June 5, 2006.

31. "Interview with R. Kalidas," *RWE Nukem*, December 2004.

32. Xavier Dias, "DAE's Gambit," *Economic and Political Weekly*, August 6, 2005.

33. T. S. Subramanian, "Uranium Crisis," *Frontline*, January 13, 2006.

34. At Nalgonda, the Uranium Corporation of India claims it expects to mine 1,250 tons of uranium ore per day. "Environmental Clearance for Uranium Mining," *Hindustan Times*, December 12, 2005. Assuming an average grade of 0.04-0.05 percent, this implies 150-187.5 tons/year of uranium. For Kadapa, see MECON Limited (Ranchi), EIA/EMP Report For Tummalapalle Uranium Project, Uranium Corporation of India Ltd, 2006. As noted above, India expects a large increase in ore processing capacity in 2006 that can more than handle this increased demand.

35. T.S. Subramanian and Suhrid Sankar Chattopadhyay, "Back To Singhbhum," *Frontline*, January 13, 2006.

36. This includes under construction HWRs as they come into operation and excludes HWRs once they come under safeguards and can be fuelled by imported uranium. It also excludes CIRUS and Dhruva and uranium demand from the enrichment program, which add up to about 45 tons per year.

37. K Subrahmanyam, "India and the Nuclear Deal," *Times of India*, December 12, 2005.

38. "BARC Planning New Dhruva-Type Reactor," *Hindustan Times*, April 28, 1999.

39. Mark Hibbs, "Replication of Dhruva Reactor Proposed for Next Indian Economic Plan," *Nuclear Fuel*, May 8, 2006.

40. This possibility is suggested by Albright, Berkhout, and Walker, p. 267. In normal operation, a 200 MWe PHWR refueling machine would need to change 8 fuel bundles a day. A typical refueling machine apparently requires 2-3 hours to change 4-8 fuel bundles, see, e.g., *CANDU Fundamentals*, *canteach.candu.org/library/20040700.pdf*, p. 179. For 1,000 MWd/tHM burnup, such refueling would have to be repeated seven times a day.

41. A. H. Nayyar, A. H. Toor, and Z. Mian, "Fissile Material Production in South Asia," *Science and Global Security*, Vol. 6, No. 2, 1997, pp. 189-203.

42. A 220 MWe power reactor operating at 1,000 MWd/tHM burn-up would require a seven times higher refueling rate than at its normal, 7,000 MWd/tHM, operation. This appears to be possible given the on-line refueling capabilities of these reactors.

43. Uranium consumption is about 222 tons/year in production mode versus 32 tons in power mode.

44. Baltej Singh, P. D. Krishnani and R. Srivenkatesan, "Use of Depleted Uranium in Equilibrium Core of Standard PHWRs: A Complete Study," (Paper presented at the 16th Annual Conference of the Indian Nuclear Society, 2005), *www.indian-nuclear-society.org.in/conf/2005/pdf_3/topic_1/T1_CP5_Baltej_Singh.pdf*. The depleted uranium requirement is twice that of the natural uranium it replaces, in order to maintain reactor performance.

45. Singh, Krishnani, and Srivenkatesan, "Use of Depleted Uranium in Equilibrium Core of Standard PHWRs: A Complete Study."

46. Depleted uranium fuel is manufactured at the Nuclear Fuel Complex using uranium recovered by the reprocessing plant which handles spent fuel from CIRUS and Dhruva. C. Ganguly, "Manufacturing Experience Of PHWR and LWR Fuels," Paper presented at the 14th Indian Nuclear Society Conference, Kalpakkam, December 17-19, 2003, *www.indian-nuclear-society.org.in/conf/2003/8.pdf*. In a PHWR at a burnup of 1,000 MWd/tHM, the 0.7 percent U-235 in natural uranium fuel is reduced to 0.6 percent U-235, while fuel with a burnup of 7,000 MWd/tHM contains 0.2 percent uranium-235.

47. As of 2003, the Nuclear Fuel Complex at Hyderabad had produced about 76 tons of depleted uranium fuel. *Ibid*.

48. The four reactors at Kaiga also have been designated as military and may imply this site is to host another reprocessing plant and unsafeguarded breeder reactor, similar to the arrangement at Madras.

49. *Ibid*.

50. India plans a series of "FBR parks," each of which will have two to four FBRs, a dedicated reprocessing plant and a fuel fabrication plant, including at Kalpakkam; T. S. Subramanian, "A Milestone at Kalpakkam," *Frontline*, November 6, 2004.

51. *Design of Prototype Fast Breeder Reactor*, Indira Gandhi Centre for Atomic Research, December 2003, *www.igcar.ernet.in/broucher/design.pdf*. The plutonium content of the fuel is reported to be 20.7 percent in the inner core and 27.7 percent in the outer core, with approximately 91 percent of the total power generated in the core; D. G. Roychowdhury, *et al*., "Thermal Hydraulic Design of PFBR Core," *LMFR Core Thermohydraulics: Status and Prospects,* IAEA-TECDOC-1157, June 2000, *www.iaea.org/inis/aws/fnss/fulltext/1157_3.pdf*.

52. We assume a core breeding ratio of 0.68 and an overall breeding ratio of 1.05. Note that Japan's Monju and the cancelled U.S. Clinch River fast breeder reactors had core breeding ratios of 0.6-0.75; S. Usami, *et al*., *Reaction Rate Distribution Measurement and the Core Performance Evaluation in the Prototype FBR Monju*, last updated July 5, 2005, *aec.jst.go.jp/jicst/NC/tyoki/sakutei2004/sakutei17/siryo41.pdf*. For this range of core breeding ratios, the PFBR would produce about 164-109 kg of weapons grade plutonium. Preliminary results from MCNP calculations on PFBR plutonium production support this range of plutonium production. Alexander Glaser, private communication.

53. T. S. Subramanian, "A Milestone at Kalpakkam," *Frontline*, November 6-19, 2004, *www.hinduonnet.com/fline/fl2123/stories/20041119003210200.htm*.

54. The spent fuel from the breeder would need to cool before it could be reprocessed and the plutonium recycled, and so an initial plutonium stock for two cores, about four tons in total, is required for each breeder.

55. Zia Mian and M. V. Ramana, "Beyond Lahore: From Transparency to Arms Control," *Economic and Political Weekly*, April 17-24, 1999; Zia Mian, A. H. Nayyar and M. V. Ramana, "Making Weapons, Talking Peace: Resolving The Dilemma of Nuclear Negotiations," *Economic and Political Weekly*, July 17, 2004; R. Rajaraman, "India-U.S. Deal and the Nuclear Ceiling," *The Hindu*, September 10, 2005; R. Rajaraman, "Nurturing the Indo-US Agreement" in *The Debate on the Indo–US Nuclear Cooperation*, Delhi Policy Group and Bibliophile South Asia, 2006.

56. Matthew McKinzie, *et al*., "The Risks and Consequences of Nuclear War in South Asia," in *Out of the Nuclear Shadow*, Smitu Kothari and Zia Mian, eds., Delhi: Lokayan and Rainbow Publishers and London: Zed Books, 2001.

57. R. Rajaraman, "Save the Indo-US Agreement," *Hindustan Times*, November 5, 2005.

58. R. Rajaraman, "Cap the Nuclear Arsenal Now," *The Hindu*, January 25, 2005, R. Rajaraman, "Towards De-Nuclearisation of South Asia," paper presented at the 2nd Pugwash Workshop on South Asian Security, Geneva, Switzerland, May 16-18, 2003.

TERRORISM, MISSILES, AND ARMS CONTROL

CHAPTER 5

ASSESSING THE VULNERABILITY OF THE INDIAN CIVILIAN NUCLEAR PROGRAM TO MILITARY AND TERRORIST ATTACK

Charles D. Ferguson

GROWING DANGERS

While the controversial U.S.-India nuclear deal has focused attention on the potential for sparking nuclear war or an arms race in East or South Asia, little or no attention has been paid to how the deal's implementation might increase the threats of terrorism and military attack against Indian nuclear facilities. These threats could grow in three ways. First, the deal could facilitate a substantial expansion of India's plutonium stockpile in the civilian and military sectors. Plutonium, a toxic and fissile material, could, in the hands of skilled terrorists, fuel improvised nuclear devices—crude but devastating nuclear bombs—or radiological dispersal devices—one type of which is popularly called a "dirty bomb."[1] Second, the deal could spur expansion of India's civilian nuclear facilities, thereby increasing the number of targets for terrorist or military attacks. Third, the deal brings India into much closer alignment with the United States. This alliance already has stirred animosity toward India from Osama bin Laden, the leader of al-Qa'ida. Moreover, closer Indo-American relations could also breed resentment in Pakistan and result in a more vulnerable India, especially in armed conflict involving India and Pakistan.

Al-Qa'ida-affiliated operatives may have launched or helped perpetrate the July 11, 2006, terrorist bombings in Mumbai. Soon after these attacks, the U.S. Embassy in New Delhi issued a warning about possible terrorist assaults against Indian government facilities, including nuclear sites. In response, New Delhi boosted security at its nuclear complex by early August.[2] Perhaps security requires further strengthening. For instance, in late August, villagers near the Kakrapar nuclear facility reported seeing two men armed with automatic weapons inside a prohibited area, but still outside the most sensitive area of the facility.[3]

India's extensive nuclear complex both in the civilian and military sectors already presents a target-rich environment. Moreover, India has ambitious plans for a major expansion of this complex. This expansion could increase the risk of accidents, attacks, or sabotage. Without adequate quality controls in training, the risk of accidents increases and, even with high quality of training, a rapid influx of workers into the nuclear program increases the probability of saboteurs entering the program.

Shaken by sectarian strife and terrorism for many decades, India resides in one of the most violence-prone regions of the world. Jihadist groups have caused much of this violence. Some of these groups have ties to al-Qa'ida, which has considered using nuclear and radiological terrorism. Pakistan has sponsored terrorist groups to further its aims in the separatist region of Jammu and Kashmir, and could consider using such groups as proxies in a military attack against other regions of India, including those containing nuclear facilities.

The focus here is on the military and terrorist threats to India's civilian nuclear facilities. But because Indian civilian and military nuclear programs are intertwined, the analysis will consider significant areas of overlap, notably the growing plutonium stockpiles that can fuel both programs. First, this chapter examines India's civilian nuclear infrastructure, assessing potential vulnerabilities to attack. Second, it discusses terrorism and sectarian violence involving India and whether this violence is likely to be directed against nuclear facilities. Finally, after reviewing efforts India has reportedly taken to protect these facilities, the chapter recommends further urgently-needed security measures.

In sum, the major recommendations are that India should:

- Ensure that the different modes of a terrorist or military attack are fully considered and continually evaluated in assessing the safety and security of its nuclear facilities;
- Separate more of its civilian nuclear facilities, including breeder reactors, from connections to the military program to reduce the target profile of these facilities and to help remove them from the shroud of secrecy surrounding the military program;
- Work with China and Pakistan toward a fissile material cap to limit the amount of plutonium potentially available to terrorists;
- Develop cooperative nuclear security by sharing and implementing best practices with the United States, the International Atomic Energy Agency (IAEA), and other partners;
- Apply to new facilities and retrofit to the extent possible in existing facilities sabotage-resistant safety systems as well as additional safety and

security measures such as extra diesel generators and relatively low-cost fortifications around spent fuel pools and vulnerable buildings, in addition to active and passive air defenses for critical nuclear sites; and,

- Create a more transparent and self-critical civilian nuclear infrastructure that would empower an independent regulatory agency and would be continually vigilant about insider threats.

INDIA'S CIVILIAN NUCLEAR INFRASTRUCTURE

Understanding the potential vulnerabilities of India's civilian nuclear program to military or terrorist attack first requires understanding the vision behind the program. For decades, India has envisioned a three-pronged approach to developing its civilian nuclear infrastructure. First, it would exploit its limited indigenous deposits of uranium to fuel thermal reactors. These reactors are called "thermal" because they rely on slowed down neutrons, or neutrons possessing thermal or relatively low energies, to power the nuclear reactions in these reactors' cores. Second, India would harvest the plutonium produced in the thermal reactors to make fuel for fast breeder reactors. The "harvesting" is called reprocessing, which uses chemical processes to extract plutonium from highly radioactive spent nuclear fuel. Fast reactors use high speed, or high-energy, neutrons to power the reactions. Breeder reactors can produce, or breed, more plutonium fuel. Third, India wants to create a fleet of thorium-reactors that would use the fertile element thorium to produce uranium-233, a fissile material that can power reactors.

India is estimated to possess one-third of the world's deposits of thorium.

Many aspects of this three-pronged plan can increase India's risk of militaries or terrorists targeting civilian nuclear assets. The sheer complexity of the enterprise could complicate management of ensuring adequate security throughout the program. The different reactor designs, for instance, would require detailed attention to differences in vulnerability to various modes of attack. For instance, one type of reactor might have adequate protection against attacks from the air because the reactor design might have a strong containment building around the reactor core. In contrast, a different design might have a weaker containment structure, but might present vulnerabilities to truck bombs. Protecting against these differing vulnerabilities demands a highly technically-trained guard force, as well as a regulatory agency that is vigilantly and continually conducting rigorous security tests, probing for and correcting any weaknesses.

The second prong involving bulk processing and handling of tons of separated plutonium can increase the risk of diversion of this bomb-usable material. In contrast, keeping plutonium embedded in spent nuclear fuel provides a highly radioactive and lethal barrier against theft. In the event of an accident or an attack that results in radioactivity release to the environment, reactors fueled with plutonium could cause greater harm to health than reactors fueled with uranium because plutonium is a much more toxic material.[4]

The third prong, if not managed properly, could raise the risk of uranium-233, a fissile material that can power the easiest to make nuclear bomb, a gun-type device, falling into the wrong hands. The thorium cycle produces uranium-232, which decays to highly radioactive daughter products. Even relatively small concentrations of uranium-232 and its daughters can emit lethal doses of gamma radiation.

Because U-232 and U-233 have essentially the same chemical properties, separating the one isotope from the other is very difficult. One method involves limiting the daughter products of U-232 by chemically removing thorium and other daughter products from the uranium mixture. However, within 2 years after this chemical separation, the buildup of highly radioactive daughter products can lead to a lethal dose in 20 minutes to a person within one meter of a critical mass of uranium-233. This assumes that uranium-232 is present at least to the level of 0.1 percent. Another method is to remove U-232 by using laser isotope separation (LIS) methods. Employing powerful lasers, LIS selectively excites and ionizes uranium-233 to separate it from uranium-232. India's Department of Atomic Energy (DAE) has stated that its long-term ambition is to use LIS to remove enough U-232 to reach a level of a few parts per million (ppm). At this level, workers could handle a mixture of U-233 and U-232 for 10s to 100s of hours without exceeding their annual occupational radiation exposure doses. But terrorists also could handle safely such a mixture.

A uranium-233 mixture can be denatured to make it less bomb-usable. To do that, sufficient U-238 can be added into the mixture to increase greatly the critical mass needed to make a bomb out of the mixture. This isotopic denaturing depends on the reactor design as well as the reprocessing method used with the U-233 mixture. Nuclear physicists Jungmin Kang and Frank von Hippel have concluded, "The proliferation resistance of thorium fuel cycles depends very much upon how they are implemented."[5] For instance, they found that pressurized light water reactors fueled with a mix of low enriched uranium and thorium fuel at high burnup produce high U-232 contamination levels. Thus, this type of usage is commensurate with proliferation resistance. In contrast, heavy water reactors operated in a low burnup mode can produce low concentrations of U-232.

India has plans to develop an advanced heavy water reactor using the thorium/uranium-233 cycle. Presently, India has been operating since 1996 the Kamini research reactor on uranium-233 fuel. This reactor has a modest power rating of 30 kilowatt thermal (kWth). Notably, the Kamini reactor is located at the Bhabha Atomic Research Center (BARC), which is part of the Indian nuclear weapons complex. Like the plutonium program, the thorium program blends into India's weapons program.

By design, the Indian civilian and military nuclear programs are intertwined. An attack on India's military program also would likely adversely affect India's civilian program and vice versa. The analysis turns to an examination of the different components of India's civilian nuclear program and the different potential modes of attack or sabotage against the program.

Indian Nuclear Facilities.

India has several types of nuclear facilities, including nuclear power plants, plutonium production reactors, research reactors, spent fuel storage areas, high-level radioactive waste storage facilities, and reprocessing plants.

Nuclear Power Plants. Despite the ambitious three-pronged plan, India has struggled to build even a small fraction of the nuclear power plants envisioned.[6] Once the 540-megawatt electric (MWe) Tarapur-3 reactor supplies power to the grid, expected to occur in mid-2006, India will have about 3,900 MWe of installed nuclear power capacity.[7] Under the optimistic planning scenario, New Delhi wants 11,000 MWe by 2010 and 29,000 MWe by 2020. Of the 29,000 MWe, 20,000 MWe are intended to come from indigenous development. It is uncertain whether India will follow through on acquiring 9,000 MWe of power from foreign sources. New Delhi apparently put forward that figure prior to the March meeting between Prime Minister Manmohan Singh and President George W. Bush to help sweeten the U.S.-India nuclear deal.[8] However, for many years, India has announced plans for 20,000 MWe of nuclear power by 2020, and with the soon-to-be-completed two Russian VVER-1000 reactors, imported reactors will produce at least 2,000 MWe of the planned increase in nuclear power capacity. India's Nuclear Power Corporation has sent dozens of engineers to be trained in Russia to operate the VVER-1000 reactors.[9] New Delhi has discussed buying additional reactors from Moscow.

Past performance or shortfalls do not dictate future success or failure. Still, India repeatedly has failed to reach its nuclear power production goals by substantial margins.[10] Within the next few years, India plans to complete construction of at least eight indigenously built nuclear power plants, with a cumulative capacity of 2,780 MWe. Adding this amount to the 2,000 MWe from the Russian reactors, India would more than double its current nuclear power capacity. Nonetheless, even if India does not increase its use of nuclear energy by almost nine times by 2020, a growth of one-half or even one-fourth would challenge significantly India's ability to train enough competent nuclear engineers, technicians, plant managers, and security guards within the next 14 years. According to India's top civilian nuclear management, the DAE has had a functioning nuclear engineering school since the late 1950s and is taking steps to ensure that India can train enough engineers adequately to meet the projected growth in nuclear energy development.[11] India's Nuclear Power Corporation reported in 2003 that it has more than 11,000 employees working at its nuclear power plants.[12] That number was for a total power capacity of about 3,000 MWe, implying the need for three to four employees per MWe. If this ratio holds roughly constant as the power increases, India would need 60,000 to 80,000 employees in 2020 for a goal power capacity of 20,000 MWe. The actual number of employees needed probably would be less than that amount because the newer plants would tend to have a higher power rating and, therefore, would need fewer employees at fewer higher-power rating plants. Still, the overall conclusion is that DAE will need to train several thousand to tens of thousands of new employees. Assuming DAE can train sufficient competent engineers, it also needs to take into account the increased risk of the insider threat if the nuclear workforce expands exponentially.

The next generation of Indian nuclear engineers and plant managers at least would have to receive training on three types of thermal reactors or additional reactor designs depending on what types of foreign reactors India would import, if those import deals are actualized. Presently, the predominant type of Indian commercial reactor is the pressurized heavy water reactor (PHWR), based on the Canadian Deuterium Uranium (CANDU) design. Fourteen of India's 16 thermal reactors are PHWRs. These PHWRs provide about 3,500 MWe, or more than 90 percent, of installed capacity. Boiling water reactors (BWRs) provide the remainder. The third type of thermal reactor that India will have in the coming years is the Russian-designed VVER-1000, which is a pressurized water reactor (PWR) design.

Reactor designs determine much of the inherent strengths and weaknesses of a reactor. Nonetheless, reactors of the same design can differ in their characteristics because of differences in construction. Engineers can vary the construction among reactors of the same design due to many considerations. One of the foremost considerations is site selection. Every reactor site is unique. Proximity to other reactors at the site or location of cooling sources such as bodies of water, for example, can affect the layout of a nuclear power plant significantly and lead to deviations from a standard design. Because detailed information on particular Indian nuclear power plant sites is not available openly, this chapter discusses the general characteristics that can affect the safety and security of India's commercial reactors.

Designers of nuclear power plants rely on the concept of defense-in-depth, which means using redundant systems to provide increased protection against accidents. Almost all systems inside a nuclear power plant have one or more backup systems to ensure that if the main system fails, a replacement or emergency system will provide protection quickly. For example, if the primary coolant system ruptures, an emergency cooling system is available to prevent the reactor core from melting and possibly leading to a release of radiation to the environment.

In general, there are two exceptions to the defense-in-depth practice. A reactor has only one pressure vessel surrounding the highly radioactive core. If the pressure vessel would rupture, a backup pressure vessel would not be available to contain the core. Nonetheless, the radioactivity in the core would not necessarily be released to the environment because most commercial reactors have a strong containment building surrounding the reactor. The containment is the last line of defense for a nuclear power plant preventing a release of radiation to the environment. But here is the second exception to defense-in-depth. A commercial reactor, if it has a containment structure, usually has only one. (As discussed later, the newer Indian PHWRs have a double-domed containment structure.) Thus, in assessing whether a nuclear power plant can withstand an attack, it is vitally important to know how strong its containment building is.

CANDU-type reactors, such as the Indian PHWRs, have certain safety features that make them more resistant to surviving attack or sabotage. CANDU cores typically are subdivided into two thermo-hydraulic loops. Each loop has hundreds of individual pressure tubes. This feature would help localize a loss-of-coolant incident caused by accident, attack, or sabotage. Moreover, the large-volume, low-pressure, and low-temperature heavy water moderator surrounding the coolant would provide a large heat sink to further protect the reactor fuel from melting down in a loss-of-coolant incident. Furthermore, because the steam generators are located above the core, natural thermo-siphoning would help carry away heat from the core and mitigate the effects of a loss of coolant incident.[13]

Containment buildings using a minimum of four-foot thick concrete walls typically enclose CANDU reactors. India's most recently built PHWRs have an added safety feature: double-domed containment structures.[14] These PHWRs are the Kaiga-1 and 2 reactors, the Rajasthan-3 and 4 reactors, and the Tarapur-3 and 4 reactors. But developing the double-domes did not occur without incident. In 1994, Kaiga-1 experienced a partial collapse of its inner dome during construction. In response, Indian engineers revised the design. These PHWRs use microsilica-based high performance concrete.[15] The newer PHWRs also have other safety features, including an automatic, quick acting poison injection system to shut down the reactor in an emergency and microprocessor-based systems for reactor protection and control.[16]

India's oldest commercial reactors are located at Tarapur, which is about 100 kilometers from Mumbai. India bought these U.S.-designed reactors from General Electric (GE), which manufactured boiling water reactors. Tarapur-1 and 2 began operation in 1969. After more than 30 years of operation, these reactors normally would be nearing their end of life. But Indian engineers have made more than 300 modifications to the Tarapur BWR plant to improve its safety. The DAE believes that these improvements will allow Tarapur-1 and 2 to run for another 30 years. Safety problems had plagued these plants in the past. In particular, the tubes in the secondary steam generators had developed cracks. Technicians could not plug the leaks without running a significant risk of receiving large doses of radiation. Consequently, these generators were shut off from the plant, and in 1985, the reactors were derated from 210 MWe each to 160 MWe.[17] The containment structures of these reactors are not as robust as more modern BWRs. The earliest generation GE BWR used the torus or inverted light-bulb-shaped containment design, which relies on a pressure suppression system. This system, in the event of a loss of coolant accident, is intended to absorb steam and prevent a buildup of pressure that could rupture the containment building. Thus, designers reasoned that the pressure suppression system would allow for a weaker containment building, saving on construction costs. As early as 1972, safety officials were recommending that this containment system be discontinued because of concerns about the failure of the system during an accident.[18] Even if the system would function properly during a loss of coolant accident, a weak containment building might not withstand the crash of a large airplane.

India has purchased two Russian light water reactors to supplement its indigenous reactor production. The older indigenous reactors typically are rated at about 220 MWe (with two notable exceptions, mentioned above). The newer indigenous reactors, such as Tarapur-3 and 4, that are coming online within the past are rated around 500 MWe. In contrast, the Russian PWRs being built at Kudankulam are 1,000 MWe each. Thus, the foreign supplied reactors would offer a significant boost to India's power capacity. The Russian VVER-1000 reactor has a relatively large coolant-to-power ratio; thus, like a CANDU reactor, it has some inherent protection in the event of a loss of coolant incident. However, the VVER-1000 has some inherent weaknesses. Vulnerabilities include steam lines and isolation valves too close together, which a single blast could knock out; the control room located at the lower level of the reactor building, potentially prompting quick evacuation if the containment is breached, thus minimizing the amount of time operators have to control the reactor; and relatively weak containment structures that an airplane might penetrate.[19] The VVER-1000s are being constructed in Tamil Nadu, where a number of terrorist groups are based.

Research Reactors. Compared to commercial nuclear power plants, research reactors at first glance do not appear to offer tempting targets. Research reactors typically contain much less radioactivity than commercial reactors. Also, the former facilities usually do not have the high symbolic or economic value of the latter facilities. However, an attacker might strike a research reactor because it tends to be weaker than a commercial reactor. While the vast majority of commercial reactors, including all Indian commercial power plants, employ strong containment structures, many research reactors do not use containment buildings, and if they do, the containments tend to be not as strong as those surrounding commercial reactors. Research reactors, especially those at universities, also tend to have less security forces than commercial power plants.

Indian research reactors, however, usually are located within institutions that perform both civilian and military work. If security at these dual-use institutions remains strong because of their role in India's military program, attackers would likely decide to target relatively weaker nuclear facilities unless they had assistance from workers inside the institutions. Conversely, because these institutions have a dual-use role, military or terrorist attackers might find striking against these facilities attractive. A successful attack would deal a blow against India's civilian and military nuclear infrastructure. At the Bhabha Atomic Research Center at Trombay, there are two operating research reactors (the Apsara LWR and the Purnima-3 LWR), three decommissioned reactors (the Purnima-1 critical assembly, the Purnima-2 LWR, and the Zerlina PHWR), and one planned to start operating in 2010 (the compact high temperature reactor). The decommissioned reactors, while not operating, still could present potential targets because of the possible presence of radioactive materials on-site. At the Indira Gandhi Center for Atomic Research (IGCAR) at Kalpakkam, there is the Kamini test reactor, which, as mentioned earlier, uses uranium-233.

Plutonium Production Reactors. Indian plutonium production reactors employ the technology in certain types of research reactors to make plutonium for nuclear weapons. While plutonium production reactors are part of the military program, these reactors are considered here because they also are intertwined with the civilian program. Currently, India uses the Cirus and Dhruva research reactors to produce plutonium. Both of these reactors are located at BARC in Trombay. Also, BARC contains a plutonium separation plant that can process 30 to 50 tons of spent fuel annually and a plutonium weapons component facility.[20] Even six kilograms of plutonium would be sufficient to make a nuclear bomb. This is a very small amount compared to the bulk of plutonium that India processes. Terrorists who have enlisted the help of insiders might be able to sneak out enough plutonium to build an improvised nuclear device or a radiological dispersal device.

Plutonium, however, poses significant technical challenges for terrorists wanting to make a relatively high-yield nuclear bomb with an explosive yield of roughly one to 20 kilotons. An implosion nuclear device, or the Nagasaki-type bomb, demands use of high-speed electronic switches and precisely shaped and specialized conventional explosives, for example.[21] Nonetheless, Pakistani nuclear scientists who are sympathetic to terrorist causes might help terrorists construct a bomb from Indian plutonium. This scenario is not farfetched. Osama bin Laden reportedly met with two Pakistani nuclear physicists in 2001 and asked about nuclear bomb making.[22]

If terrorists could not enlist expert assistance or would face insurmountable technical hurdles to making an implosion bomb, they could decide to build a much less powerful plutonium-fueled gun-type nuclear bomb. By using highly enriched uranium, the Hiroshima bomb, a gun-type device, achieved a nuclear yield of about 13 kilotons. The gun-type device is the easiest to build nuclear weapon. However, it would still pose technical challenges to terrorists, but technically skilled terrorists have a greater chance of making this type of nuclear weapon than an implosion-type weapon.

Because plutonium emits more spontaneous neutrons than highly enriched uranium, it cannot power a high-yield gun-type bomb. Nonetheless, a plutonium gun-type bomb can produce an explosive yield of two to 10 tons.[23] While such a bomb would be about 1,000 times less explosive than a plutonium implosion bomb, it would still be much more powerful than a typical conventional bomb. Thus, an expanding stockpile of bomb-usable plutonium can increase the risk of terrorists building an improvised nuclear explosive.

Breeder Reactors. Faced with limited supplies of indigenous uranium, as noted earlier, India envisions fueling a fleet of commercial reactors with plutonium. Consequently, India has researched breeder reactors, a technology that most of the world has abandoned. Presently, a fast breeder test reactor is operating at IGCAR in Kalpakkam and is helping India gain research experience with this technology. A much larger 500 MW breeder reactor is slated to begin operation in 2010 at Kalpakkam. New Delhi pointedly left its breeder reactor program outside of its list of designated civilian reactors to be under international safeguards. Although the breeder program would likely produce fuel for civilian reactors, the fact that this program remains on the military side of India's nuclear complex has raised concern that it could increase the stockpile of plutonium for nuclear weapons. As with the plutonium production reactors, a major problem with the breeder program is the possibility that terrorists could steal plutonium to make nuclear bombs or dirty bombs.

Spent Fuel Pools. Spent fuel pools are tanks full of water that store spent, or used, nuclear fuel that has been discharged from a reactor. These pools typically are located near the reactor at a power plant site. While commercial reactors usually contain millions of curies of highly radioactive materials that could cause significant harm if released to the environment, spent nuclear fuel pools can contain several times this amount of radioactivity because a spent fuel pool can store several reactor cores. The radioactivity build up can climb even higher. If spent fuel is not moved from the pool and transferred to dry storage casks, the pool can fill up beyond its original design capacity. For example, the pool at Tarapur-1 initially was designed to store at most 72 metric tons of spent fuel. But according to the International Nuclear Safety Center, this pool contains more than twice that amount. Storing more than the originally designed amount of spent fuel can increase the risk of the spent fuel catching fire in the event of a loss of coolant incident.

If an attack causes a propagating zirconium cladding fire, large amounts of radioactivity could be released. After assessing the two types of spent fuel pools at U.S. nuclear power plants, the U.S. National Research Council concluded, "successful terrorist attacks on spent fuel pools, though difficult, are possible."[24] That study recommended to reduce the risk of such attacks, the pools should be properly secured; effective means of cooling should be available under emergency conditions; as soon as permissible, spent fuel should be stored in dry storage casks; and the remaining spent fuel should be reconfigured in the pools to minimize the risk of a propagating fire.

India has the boiling water reactor type of U.S. power plant. The General Electric Mark I BWR plants, related to the Indian Tarapur BWR plant, were designed to have their spent fuel pools located inside of the containment structure. This configuration would provide a hardened protective layer for the pool. But the countervailing factor is that BWR spent fuel pools generally are well above ground level, and thus in the event of a rupture, a BWR pool could drain more easily than a pool that is partially or fully below ground level.[25]

The majority of Indian spent fuel pools at PHWRs most likely follow the CANDU design. The typical CANDU plant has its spent fuel pool outside of the containment building; thus it is more exposed to attack than a BWR pool. But the CANDU pools are generally partially or fully below ground level, making them harder to drain.[26]

Reprocessing Plants. Reprocessing plants extract plutonium from spent nuclear fuel. Presently, India uses the PUREX reprocessing method, which is considered by nonproliferation experts to be proliferation-prone because it completely separates plutonium from the self-protecting highly radioactive materials in spent fuel. Thieves or terrorists can carry separated plutonium without suffering near-term harm to health.

India presently has two bulk, or industrial-scale, reprocessing plants: the Power Reactor Fuel

Reprocessing Plant at Tarapur and the Kalpakkam Reprocessing Plant. Each plant can reprocess about 100 tons of spent fuel annually, which translates into nearly one ton of plutonium, assuming that about 1 percent of the spent fuel is plutonium.[27] This estimate also assumes that the reprocessing is very efficient. In reality, there will be some losses, but because India has had decades of experience in reprocessing, it likely can operate the reprocessing plants at high efficiency. But in any plant, there will be losses and material unaccounted for (MUF). MUF can add up to many kilograms of plutonium not properly tracked especially in a bulk handling facility. As India's rate of reprocessing and production of plutonium-based fuel increase, the likelihood for large amounts of MUF will increase. This situation will increase the potential for plutonium diversion. Even under strict International Atomic Energy Agency accounting, a 1 percent MUF could easily occur. This relatively rigorous accounting probably still would result in up to 20 kilograms of plutonium unaccounted for in India's two existing industrial-scale plants. This amount of plutonium could conceivably power two to three first-generation implosion nuclear explosives. Reducing the MUF to below bomb-usable amounts is next to impossible at bulk reprocessing facilities. Increasing the amount of reprocessed plutonium can also increase the chance of hazardous release of radioactivity and plutonium dispersal.

*High-level Radioactive Waste Storage Area*s. Reprocessing plants also pose another danger to an attack that can release massive amounts of radioactivity to the environment. The highly radioactive fission products removed from spent nuclear fuel during reprocessing are stored in large high-level liquid waste tanks. Rupturing these tanks could result in millions of curies of radioactivity released. In comparison, the Chernobyl accident released more than two million curies of radioactive cesium. Thus, a worst-case attack on a high-level waste storage facility could be comparable to the contamination from the Chernobyl accident. India has developed the capability to immobilize this liquid waste in glass. Such immobilization would create hard to disperse radioactive materials and would provide significant protection against radioactivity release from an attack on a high-level waste storage facility. To make effective use of this protection, India would have to operate the immobilization at a rate commensurate with the production of liquid waste.

Uranium Enrichment Facilities. Usually uranium enrichment facilities would not pose significant threats for attack because uranium, unlike plutonium, is not very radioactive and would not result in significant harm to public health if it were dispersed. Also, low enriched uranium used in commercial light water reactors and certain other types of reactors cannot fuel nuclear weapons. Although little is known openly about India's secretive uranium enrichment program, the Rare Materials Project (RMP) at Mysore has a gas centrifuge plant that apparently is devoted to enriching uranium for nuclear submarine fuel. India's nuclear submarine program has been stuck in low gear for decades and might not require weapons-grade uranium for fuel. However, some analysts have suggested that India might employ the RMP to make weapons-grade uranium for its weapons program.[28] The amount of highly enriched uranium, if any, produced at the RMP is unknown, but even as little as 40 kilograms in terrorists' hands could fuel a gun-type nuclear bomb.

Electricity Distribution Grid. A terrorist or military attack that disabled a nuclear power plant could have far-reaching effects on India's electrical power system. Although New Delhi has been striving to improve the stability and reliability of the national electrical grid, this distribution system has suffered from frequency and voltage fluctuations.[29] On an unstable grid, loss of a major generator such as a nuclear power plant could bring down much of the electrical distribution system. In addition to causing a major blackout, this event could jeopardize the safety of the affected nuclear plant because external sources of power typically provide reliable means of running safety equipment such as reactor coolant pumps. Knocking out the grid connected to the plant would decouple the plant from external sources of power.

Under that scenario, on-site diesel generators would have to provide backup power to operate safety equipment. According to the U.S. Nuclear Regulatory Commission (NRC), "The reliability of the diesel generator is strongly dependent on the interaction of the following factors: design, testing and operational requirements, operational history, inspections, maintenance, and the personnel qualifications of operators."[30] In 1977, the NRC cautioned, "The demonstrated reliability of standby diesel generator (DG) units in operating nuclear power plants has been less than anticipated."[31] Although in recent years, the NRC has cited a 97.5 percent reliability rate, independent analysts have estimated that the actual reliability rate is about 90 to 95 percent. While there are no openly available estimates of India's diesel generator reliability, even a 95 percent reliability rate means that a major grid failure that knocked out 10 or more reactors would translate into a more than 40 percent chance that one diesel generator would not operate at a nuclear reactor. A 90 percent reliability rate would translate into a 65 percent failure chance under that scenario. To provide additional reliability, a nuclear power plant could have additional diesel generators. However, even this added backup does not provide absolute protection because the diesel generators at a plant could experience common-mode failure.

Modes of Attack or Sabotage.

A military or terrorist strike against an Indian nuclear facility could make use of a variety of attack modes or sabotage, including airplane crashes or bombings, truck bombs, commando-type attacks, insider collusion, and cyber-terrorism.

Airplane Crashes or Bombings. In the immediate wake of September 11, 2001 (9/11), nuclear regulatory officials admitted that containment structures were not designed to withstand the impact of large commercial aircraft. But nuclear industry representatives have emphasized the strength of containment structures and have expressed confidence in the capability of containments to protect against airplane crashes. The nuclear industry in the United States has sponsored studies to assess whether containments would remain intact after an airplane crash. In perhaps the most prominent and widely reported of these studies, which was commissioned by the Nuclear Energy Institute, the Electric Power Research Institute (EPRI) in June 2002 determined that containment buildings "can safely protect the reactor against most commercial aircraft," including 757s (the type used in the 9/11 attack) and 777s.[32] Then in December 2002, EPRI reported the results of a related study in which it simulated the impact of a Boeing 767-400 into four types of structures: containment buildings, spent fuel storage pools, spent fuel dry cask storage facilities, and spent fuel transportation containers. Although the containment building experienced "some crushing and spalling (chipping of material at the impact point) of the concrete" and the spent fuel pools suffered "localized crushing and cracking of the concrete wall," all simulations showed that the aircraft was not able to breach the protection structures.[33] Industry officials also have scoffed at the notion that hijackers could direct large airplanes traveling at fast speeds into a containment structure, which is a relatively low profile target.

Outside the nuclear industry, critics made their own calculations of the effects of airplane crashes on nuclear facilities. Among the independent analysts, Edwin Lyman, a nuclear physicist, has assessed that the engines of large aircraft traveling at high speeds "would penetrate the containment, leading to a fuel spill within the building and most likely a severe jet fuel fire and/or explosion."[34] These fires or explosions could cause multiple system or common mode failures. Even if containment structures are strong enough to withstand the direct impact of a large aircraft, many other buildings at nuclear facilities are much softer targets. For example, auxiliary buildings at nuclear power plants are typically not hardened. Smashing airplanes into these targets could result in many lives killed and substantial property and financial damage.

Perhaps terrorists will never use airplanes to attack nuclear facilities. In contrast, some militaries have already crossed this threshold and attacked nuclear reactors. In 1981, for example, Israel launched a preemptive attack by bombing and destroying Iraq's Osirak research reactor, which was believed to become a plutonium production reactor. Later in the 1980s, Iraq bombed Iran's Bushehr nuclear power plant site during the Iran-Iraq War. Also, in the 1980s, Bennett Ramberg drew attention to nuclear power plants as Achilles heels, offering relatively weak structures, but valuable symbols, for an enemy to attack.[35]

Truck bombs. Over the past 3 decades, terrorists increasingly have used trucks to deliver devastating explosives to targets. Trucks are advantageous because they are hard to slow down once they gain momentum, allowing them to crash through unreinforced barriers, and can carry large amounts of explosives. India has suffered from many truck bomb attacks. Such attacks carried out by Islamic extremists in Kashmir have killed scores of people and damaged some hardened structures. Although terrorists probably would prefer trucks because of the large hauling capacity, they also have used car bombs on several occasions. For example, on August 25, 2003, Mumbai was rocked by two powerful car bombs. Also, many car bombs have detonated in Kashmir.

Commando-type Attacks. Most militaries, including the Pakistani military, have highly skilled special fighters or commandos who are trained to attack and penetrate well-protected facilities. One of the most daring and famous military commando attacks was the Allied effort during World War II to destroy the Norsk Hydro plant that was producing heavy water for the Nazis' nuclear program. British commandos at first tried to hang-glide to the Norwegian plant, but they failed because of the difficulties of landing on the rocky terrain. Finally, Norwegian commandos parachuted to a spot near the plant and then scaled steep, ice-covered cliff faces to place explosives at the plant.[36]

Commandos usually are trained in multiple means of attack. For instance, they could barrage nuclear facilities with rocket propelled grenades, mortars, or artillery. Also, they could conduct attacks by air, land, or water routes. In addition, highly skilled commandos could disable external power supplies to a nuclear plant just prior to launching a coordinated, multiple onslaught. Knocking out external power would reduce the capability of a nuclear plant to provide for adequate cooling to the reactor core.

While there have not been any reported commando attacks against Indian nuclear facilities, terrorists trained in commando techniques broke through tight security to attack the Indian parliament in New Delhi on December 13, 2001. Parliament was in session at that time. This attack brought India and Pakistan to the brink of war. A similar type of attack against a nuclear facility might spark an armed conflict between the two nuclear-armed countries.

Cyber-attacks. Nuclear power plants and other nuclear facilities rely on computer systems to operate. Consequently, military or terrorist attackers can attempt to use cyber-methods, such as hacking into computer systems or unleashing computer worms or viruses, to strike at India's nuclear infrastructure. According to a 2002 report in the *Indian Express*, major Indian nuclear research institutions such as the Indira Gandhi Centre for Atomic Research and BARC have experienced repeated attempts at cyber-attack. Notably, in 1988, cyber-attackers stole critical data from BARC.[37] Many Indian computer experts point to Pakistan as a sponsor of cyber-attackers. Al-Qai'da also is believed to support and encourage cyber-terrorism. Some of the cyber-groups that have targeted India include Anti India Crew, G-Force, World's Fantabulas Defacers, Pakistan Hackerz Club, Kill India, and Death to India.

Cyber-attacks can provide many advantages to an attacker. A cyber-attack is cheap compared to traditional methods. Tracking the attack can be very difficult. Attackers can mask their identities and locations and can launch an attack off-site. Cyber-attacks can cross borders easily because of the global nature of the Internet. For militaries, the Internet offers a virtual battlefield.[38] Increased frequency of computer attacks between India and Pakistan often has coincided with times when the two countries have prepared for possible physical attacks. The rapid growth of software engineering and other computer specialties has spurred an exponential growth in the number of Indians who have advanced computer skills. Even if only a tiny fraction of these specialists turns to cyber-terrorism, New Delhi would face an increased internal security threat. Even though the Indian Parliament passed the Information Technology Act of 2000, in part to address cyber-threats, Praveen Dalal, an Indian legal and computer expert, has called for the Indian legislature to amend this law because it does not protect against cyber-attacks adequately.[39]

Insider Collusion. Workers at nuclear facilities have knowledge about the detailed operations and vulnerabilities at these places that outsiders usually would not possess. Thus, insider collusion would serve as a multiplier effect for outside attackers. To boost the chances of causing devastating damage, terrorist or military attackers would devote significant effort to recruit insiders. Skilled and highly trained insiders, such as nuclear engineers, likely would know how to disable emergency cooling systems and emergency sources of power such as diesel generators. Such disablement would increase the likelihood of a reactor meltdown and radiation release. Insiders could sabotage other vital plant systems while outside attackers are placing guard forces under siege.

India has experienced the betrayal of insiders. One of the most high profile insider attacks was the assassination of Prime Minister Indira Gandhi by her own guards. A major theme of Indian legends and literature is the fear of betrayal. For example, the *Artha Shastra*, a classic Indian Machiavellian text which predated Machiavelli's *The Prince* by about 1,500 years, advises its prince to use an army of spies to keep watchful eyes on the loyalty of wives and officials. Also, according to Stanley Wolpert, a leading scholar of India, Chanakya's *Artha Shastra*,

> remained the standard text for several Indian Empires . . . almost a timeless tribute to human treachery, banality, and the corrosive pettiness of power. There was even an elaborate "Circle" (Mandala) theory of foreign policy that Chanakya developed, teaching every Indian monarch that the king ruling the circle of his immediate neighbor was his "Enemy," while just beyond lived his "Friend."[40]

To cite another prominent example from literature, the famous epic *Ramayana* pitted the virtuous Prince Rama against the villainous Ravana. Rama feared betrayal and forced his bride Sita, who had been abducted by Ravana, to prove her chastity in a trial by fire. After Rama became king, he continued to believe gossip that Sita was disloyal.

Even if a devastating event is not a clear act of insider sabotage, the public can be primed to view such events in that light, searching for scapegoats. Many have viewed the Bhopal chemical catastrophe, one of the worst industrial accidents in history, as an act of sabotage. On December 3, 1984, hazardous chemicals spilled out of the Union Carbide plant at Bhopal, killing thousands of mostly poor Indians. This event underscored the potential for complex technology to wreak havoc. These technological tragedies can lead to loss of faith in humanity's ability to control its inventions and can have profound socially disruptive effects as Paul Slovic observed in the journal, *Science*:

> An accident that takes many lives may produce relatively little social disturbance (beyond that experienced by the victims' families and friends) if it occurs as part of a familiar and well-understood system (such as a train wreck). However, a small accident in an unfamiliar system (or one perceived as poorly understood), such as a nuclear reactor or a recombinant DNA laboratory, may have immense social consequences if it is perceived as a harbinger of further and possibly catastrophic mishaps.[41]

Managerial and operator errors contributed to the Bhopal disaster and further eroded public confidence in corporate competence.[42] An accident at or sabotage of an Indian nuclear power plant could be perceived as a nuclear Bhopal, potentially damaging public acceptance of nuclear energy in India. The public or the government also might try to pin the blame of a nuclear Bhopal on Pakistan, possibly stimulating a war between India and Pakistan.

Indian officials have taken measures to guard against the insider threat at nuclear power plants. In particular, India's Nuclear Power Corporation has instituted a Vigilance Directorate to, in part, "strive towards achieving zero degree tolerance to corruption" and also "encouraging whistle blowing arrangements."[43] According to the corporation, it has maintained surveillance on employees who have access to sensitive parts of the plants and has done regular and surprise inspections to try to detect possible misconduct.

Although vitally important and necessary, personnel reliability programs such as the Vigilance Directorate are not foolproof. In the United States where the military has had decades-long practice with a personnel reliability program (PRP), between 2.5 and 5 percent of the PRP certified personnel are decertified and shut out from nuclear related duties.[44]

Regulation, Safety, Secrecy, and Security.

A safe nuclear facility is not necessarily a secure facility and vice versa. Nonetheless, common nodes for both safety and security are the regulatory agency and the culture of operations at the facilities. Concerning the culture of operations, key factors are whether management instills a safety and security culture and fosters trust among employees so that they feel that they can raise safety and security concerns without fear of reprimand or reprisal. An assessment of how safety incidents are handled by the regulator can indicate how security incidents are addressed.

The Atomic Energy Regulatory Board (AERB) is the regulatory agency for India's civilian nuclear facilities. But because many of the civilian facilities are embedded in the weapons program, BARC reviews the functioning of the military-related facilities. From the beginning of India's nuclear program, the Official Secrets Act has shrouded the program and blocked needed safety improvements, according to safety advocates. In 1999, T. S. Gopi Rethinaraj, a safety advocate, wrote, "India's nuclear establishment has grown into a monolithic and autocratic entity that sets the nuclear agenda of the country and yet remains virtually unaccountable for its actions."[45]

During the 1990s, then-AERB chairman Dr. A. Gopalakrishnan led the charge that safety had fallen short. Soon after raising questions about safety problems, the Indian government decided to not renew his contract.[46] In 1996, he cited, "there were 130 safety-related issues in various nuclear facilities, of which 95 belonged to the NPC [Nuclear Power Corporation] alone."[47] The Official Secrets Act prevented him from being fully open about the specific issues. The Chief Engineer of the NPC responded that Gopalakrishnan was an alarmist, and that his accusations have played into the hands "of vested interests internationally who are running down India's self-reliant achievements in nuclear energy and have been periodically using the international media to create fear psychosis."[48] But the Indian nuclear establishment was not carrying out an open investigation of Gopalkrishnan's safety concerns. A conflict of interest, for example, arose when Raja Ramanna was appointed to an inquiry committee even though he was chairman of the Atomic Energy Commission when many of the safety incidents took place.

In the 1990s, headlines about India's nuclear safety or lack thereof blazoned "Doomsday averted," "Headed for a meltdown," and "Sugarcoating nuclear power."[49] Some of the known incidents are: In 1991, the switch gear room in the first unit of the Kakrapar Atomic Power Station caught fire and caused a complete loss of the emergency power system and partial loss of the electrical power supply; also in 1991, for almost a month, the Dhruva plutonium production reactor operated without a functioning emergency core cooling system; on March 31, 1993, a major fire happened in the turbine room of the Narora Atomic Power Station; in September 1997, the workers union charged that there were high radiation levels at the Madras Atomic Power Station; and on March 26, 1999, large quantities of radioactive heavy water leaked out of the Madras Atomic Power Station. By the late 1990s, India had sunk to the lowest bracket of efficiency and performance in a *Nuclear Engineering International* survey of the world's nuclear programs.

A plethora of safety incidents can point to shortcomings in the defense-in-depth protective functions of nuclear plants. Weaker defense-in-depth safety systems would make these plants less able to withstand damage from a military or terrorist attack. Safety failures could be blamed on saboteurs supported by terrorists or by Pakistan.

Since the 1990s, there have been few reported safety incidents. The lack of reported incidents could either point to a secrecy clampdown or improvement in safety. A combination of the two factors might be the correct explanation. The Indian nuclear program, according to outside safety and regulatory experts, still is burdened with a regulatory agency that is not fully independent. Moreover, the Official Secrets Act probably still exerts a chilling effect. These barriers to self-critical appraisal of safety shortcomings also could lead officials to not take a hard examination of security culture.

However, safety appears to have improved in India's nuclear program in recent years. For instance, since the late 1990s, a number of India's nuclear power plants have received peer reviews by the World Association of Nuclear Operators (WANO). WANO grew out of the industry's goal of striving to prevent a repeat of the 1986 Chernobyl accident. In addition to peer reviews of particular plant operations, WANO also has conducted technical exchanges involving India to help instill better safety practices.[50]

In May 2005, Gopalakrishnan addressed safety concerns and responded to his past critics who had raised the issue of alleged undue influence of foreigners in India's nuclear activities:

> In fact, without any foreign technical assistance, the DAE engineers have rectified almost all the safety deficiencies which I had documented and submitted to the government . . . in 1995. Therefore, invoking the need for safety assistance from the U.S. is merely a ploy to indirectly plant doubts in the minds of the Indian public that DAE's capability to maintain safety in our reactors is inadequate in comparison to U.S. expertise.[51]

His article was published in the lead up to the unveiling of the controversial U.S.-India nuclear deal in July 2005. Gopalakrishnan believes firmly in India maintaining its self-reliance, especially in a world dominated by the United States. Other former and current Indian nuclear officials have expressed similar resistance to outside nuclear safety assistance. Such resistance also would tend to block India from receiving nuclear security assistance from outsiders.

Still, in the same article, Gopalakrishnan underscored some current safety issues. In particular, he warned against DAE's consideration of operating Tarapur reactors "with plutonium-based indigenous fuel" because this "is impractical and dangerous" and "world-wide studies have established that introducing more than 30-35 percent plutonium into boiling water reactors could bring adverse changes in their safety-related physics and kinetics parameters." Despite his reservations about relying on foreign assistance, he encouraged DAE "to initiate detailed technical discussions and consultations" with France and Russia "to further ensure public safety" about the breeder reactor program.[52] While those countries have breeder reactor programs, the French Superphenix breeder reactor had to be shut down soon after completion because of sodium coolant leaks. There has been an extensive history of safety problems in breeder reactor programs. Without rigorous attention to safety, India could experience numerous safety issues if it moves ambitiously with its breeder program as it has planned to do.

TERRORISM AND SECTARIAN VIOLENCE

Since independence in 1947, India repeatedly has suffered from terrorism and sectarian violence. While New Delhi has made great strides in creating the world's largest democracy and in officially ending the caste system, centuries of religious strife and caste discrimination lie just below the surface, ready to boil over.[53] In the past few decades, tens of thousands have died in India because of sectarian and terrorist violence.[54] Even though South Asia has experienced several wars in the past sixty years, terrorism has killed more people than all the wars in South Asia during that time period.[55] In recent years, the cycle of terror among disaffected groups continues and arguably has increased in its fury. Although the West has recently experienced high profile terrorist events, including the 9/11 attacks in the United States, the March 11, 2004 (3/11) attacks in Spain, and the July 7, 2005 (7/7), attacks in Britain, there have not been continual attacks in these countries. In contrast, as terrorism analyst Swati Parashar has underscored, "India on the other hand barely recovers from one attack when another is successfully launched. It is a never ending saga of terror that needs to be examined."[56]

Religious terrorism has caused the largest number of terrorist incidents and killings. Much of this terrorism has arisen from the Sikh separatist movement wanting to create an independent Khalistan, and from the strife in Jammu and Kashmir. While the former movement raged prior to 1995, the latter conflict continues to flourish. Pakistani-linked pan-Islamic groups operate in Jammu and Kashmir.

Four Pakistani pan-Islamic organizations, the Lashkar-e-Toiba (LET), the Harkut-ul-Mujahideen (HUM), the Harkat-ul-Jihad-al-Islami (HUJI), and the Jaish-e-Mohammad (JEM), which are active in India, have joined Osama bin Laden's International Islamic Front (IIF), which formed in 1998. Osama bin Laden also is the leader of al-Qai'da. All of these terrorist groups have safe havens in Pakistan, and two of them, LET and HUJI, also have found shelter in Bangladesh. While these groups had at first recruited their members from Pakistan, since 2003 they have drawn recruits from the Indian Muslim diaspora community in the Gulf region and from the Indian Muslim community within India. Muslims in India generally are opposed to al-Qai'da and the pan-Islamic terrorist groups.[57] However, with more than 140 million Muslims in India, which has the second largest Muslim community in the world, al-Qai'da affiliated groups need only recruit a tiny fraction to create a formidable force operating inside India.

The connection of these Pakistani pan-Islamic groups to al-Qai'da increases India's risk of nuclear and radiological terrorism. Bin Laden has proclaimed that al-Qai'da has a religious duty to acquire weapons of mass destruction (WMD).[58] He also has cited the American bombing of Hiroshima to rationalize al-Qai'da's drive for nuclear weapons.[59] Lending support to bin Laden's call to nuclear arms, in May 2003, Shaykh Nasir bin Hamid al-Fahd, a young Saudi cleric, wrote the religious paper "A Treatise on the Legal Status of Using Weapons of Mass Destruction" to try to justify Muslims' use of such weapons in the defense of the Umma, the Islamic community.[60] This rhetoric mirrors bin Laden's *modus operandi*. Like the Prophet Mohammed, bin Laden purposefully warns foes before they are subjected to attack. This behavior also tracks the Prophet Mohammed's conviction of trying to convince the enemy of the error of his ways and giving him an opportunity to surrender or make restitution. For example, bin Laden warned Spain and Britain before the 3/11 and 7/7 attacks. Both countries apparently were primary targets of al-Qai'da-affiliated groups because they were closely aligned with the United States, especially in the war in Iraq.

Until April 23, 2006, neither bin Laden nor his deputy, Ayman al-Zawahiri, had criticized India directly. On that date, bin Laden, in a video aired by the Al Jazeera TV channel, spoke about India's involvement in Kashmir and referred to an alleged Crusader-Zionist-Hindu war against the Muslims. A prominent South Asian terrorism analyst believes that the bin Laden message was provoked in part by President Bush's visits to India and Pakistan in early March 2006.[61]

Other Islamic extremists have warned Muslims about Hindus allegedly colluding with the United States and Israel. Notably, Professor Khurshid Ahmad, a leading ideologue for the Jamaat-e-Islami, has written about the Islamist "axis of evil," revolving around Christians, Jews, and Hindus.[62] Such rhetoric may have inspired al-Qai'da or an al-Qai'da-affiliated group to bomb commuter trains on July 11, 2006. These bombings killed about 200 people in Mumbai. Soon after the attack, a self-described al-Qai'da representative said that al-Qai'da had established a cell in Kashmir and that the bombings were "a reaction to what is happening to the minorities, especially Muslims in India."[63]

Early backlash against India allying with the United States occurred on October 29, 2005, when three precisely coordinated bombs detonated in Delhi, killing about 50 people. These bombings had the mark of al-Qai'da and the IIF because of the well-synchronized nature of the multiple attacks and the occurrence close to Al Quds Day, which is on the last Friday of the Ramadan fasting period. Many Muslims commemorate Al Quds Day by protesting against the Israeli occupation of East Jerusalem where the Al Quds mosque is located. The bombings also happened 2 days before Diwali, a major Hindu festival. Moreover, the blasts follow on the heels of a propaganda campaign against India launched by al-Qai'da, the Taliban, and the IIF. For example, on August 9, 2005, the Al Arabiya TV channel broadcast an alleged al-Qai'da video that showed interviews with jihadists in Afghanistan saying that they are avenging the killing of Muslims by the United States, Britain, Israel, and India.[64] The propaganda campaign ramped up soon after Prime Minister Singh's high profile visit to the United States in July 2005.[65] During that visit, Singh and Bush unveiled the U.S.-India nuclear deal.

So far, religious terrorists in India have not attacked nuclear facilities or used nuclear or radiological materials in their attacks. However, on September 12, 2001, Sheikh Jamil-ur-Rehman, the leader of the Tehrik-ul-Mujahideen, a terrorist group in Kashmir, promised to attack nuclear facilities in India.[66] Although some religious terrorist organizations, such as al-Qai'da, have expressed strong interest in nuclear terrorism, all of the religious terrorist groups have favored well-proven techniques of improvised explosive devices, suicide bombings and hostage taking, as well as hijacking and blowing up aircraft. South Asian terrorist groups which are influenced mainly by nonreligious motivations also have employed these non-nuclear methods and notably have introduced to the subcontinent one of the more radical methods: suicidal terrorism. In May 1991, suicidal terrorism first appeared in India with the assassination of Prime Minister Rajiv Gandhi by the Liberation Tigers of Tamil Eelam (LTTE), a national-separatist group in Sri Lanka. However, after the Pakistani pan-Islamic groups of LET, HUM, HUJI, and JEM teamed up with bin Laden's International Islamic Front (ISF) in 1998, they have embraced and expanded the use of this method. Terrorists' willingness to covet martyrdom may be required for them to penetrate a nuclear facility. Certainly, an airplane crash into a nuclear plant would call for suicidal terrorists. Also, a truck bomb would likely require a terrorist martyr to drive to the designated target at the nuclear facility and ensure the detonation of the explosive.

At least one terrorist who wanted to crash airplanes into nuclear power plants had lived in neighboring Pakistan. Khalid Shaikh Mohammed, a Pakistani and one of the chief planners of the 9/11 terrorist attacks, told interrogators that his ambitious original plan for 9/11 involved 10 airplanes instead of the four that were used. In addition to smashing airplanes into the World Trade Center and the Pentagon, he wanted to crash planes into the Central Intelligence Agency (CIA) and Federal Bureau of Investigation (FBI) headquarters, as well as nuclear power plants.[67] He was captured in Rawalpindi, Pakistan, in March 2003 and had connections to al-Qai'da-affiliated groups throughout South and Southeast Asia. Mohamed Atta, the leader of the 9/11 hijackers, also reportedly "considered targeting a nuclear facility he had seen during familiarization flights near New York . . . referred to as 'electrical engineering'."[68] But the 9/11 report notes:

> According to Binalshibh [one of the 9/11 planners], the other pilots did not like the idea. They thought a nuclear target would be difficult because the airspace around it was restricted, making reconnaissance flights impossible and increasing the likelihood that any plane would be shot down before impact. Moreover, unlike the approved targets, this alternative had not been discussed with senior al-Qai'da leaders and therefore did not have the requisite blessing.[69]

Some terrorist attacks in India have brought it close to war with Pakistan. In particular, the December 13, 2001, attack on the Indian parliament and the following January 2002 attack on the Kaluchak army camp spurred New Delhi to mobilize its military along the India-Pakistan border. Many Indian leaders believed that Islamabad was responsible for allowing the perpetrators of these attacks to operate within Pakistan. The military mobilization spurred U.S. intervention with Islamabad. In response, Pakistan temporarily stemmed the flow of militants into India. According to V. R. Raghavan, a retired general in the Indian army, this experience in part shifted Indian strategy "from defensive to proactive, offensive responses to terrorism."[70] As a consequence, in the future, India may use "punitive military actions such as air strikes against terrorist infrastructure and military forays to take out terrorist bases in Pakistani territory."[71] In light of this new more aggressive strategy, a terrorist attack on or sabotage of an Indian nuclear facility could spark a war between India and Pakistan, particularly if New Delhi suspects Islamabad's involvement in the initiating event.

Concerns about Pakistan attacking nuclear facilities have influenced decisions on where to build Indian nuclear power plants. For example, on June 23, 2006, the Indo-Asian News Service reported that New Delhi was forced to rethink its original plans to locate a new nuclear plant in Punjab after concerns were raised about the proposed site's close proximity to Pakistan. Instead, the new plant will be built in Haryana.[72]

Al-Qai'da or al-Qai'da-affiliated groups in South Asia could try to blackmail India to "liberate" Kashmir from India. Blackmail is most effective when it targets what someone cherishes. It would not have been lost on jihadi terrorists in South Asia that India believes dearly in its nuclear program. Moreover, a blow delivered to this program also would strike at the United States, which has invested much of its foreign policy clout in promoting India's civilian nuclear development. Jihadis seeking the liberation of Kashmir would not want to commit nuclear terrorism inside that region because of fear of harming their constituents. Instead, they would target Indian nuclear facilities outside that region of which there are many. The blackmail scenario could play out in a number of ways. Conceivably, a terrorist group could forewarn Indian authorities before the attack demanding surrender of Kashmir. Alternatively, the group might believe that a more effective method would be to prove its capability by launching an attack on a nuclear facility and then make its demand. The blackmail would take the form of threats against other facilities. New Delhi probably would suspect Islamabad's involvement, especially because Indian leaders likely would reason that successful terrorist strikes against nuclear facilities would require financial and technical assistance from a state sponsor. This scenario could then spiral into a war between India and Pakistan.

While nonreligious terrorist groups in India apparently are not motivated to acquire and use WMD, possible exceptions are Marxist and Maoist groups. These groups intend to right the wrongs of economic and social injustice experienced by hundreds of millions of India's poor people. Marxist groups in India have linked up with Maoist groups in Nepal, Sri Lanka, and Bangladesh.[73] This network could lend means of financial and technical support among these groups. Although Marxist and Maoist terrorist organizations in South Asia have not expressed interest openly in chemical, biological, radiological, or nuclear terrorism, one group has drawn attention recently to its targeting of India's economic infrastructure. During the past 4 years, the Naxalites, a Maoist-inspired group, have spread throughout parts of eastern and southern India. Their numbers have increased recently, and they are held responsible for attacks that killed about 900 people in 2005. The Naxalites and some Marxist groups recently have threatened to attack mining operations.[74] A major uranium mining and milling site in Jaduguda is located in the Indian region of Jharkhand, a stronghold of the Naxalites. The Naxalites already have attacked railways and could turn their sights on nuclear power plants because of these facilities' high-profile economic significance.

PROTECTIVE MEASURES

The Ministry of Home Affairs is the lead agency in managing internal Indian security. A major part of the Home Ministry, the Central Industrial Security Force (CISF) is responsible for defending nuclear installations and is independent of the DAE. But the CISF, a paramilitary force, has many additional responsibilities. It protects oil refineries, ports, airports, steel plants, and many other places that are vital for India's economy. The CISF currently consists of more than 95,000 personnel guarding more than 250 industrial locations. It has a specially trained fire wing that provides fire-fighting services to the government. With all of these duties, there are concerns that CISF is stretched too thin.[75] Even the Indian government's official Web site for the CISF acknowledges, "CISF is increasingly being called upon to perform important duties beyond its charter such as internal security, airport security, security of highway, election duties, etc." While not discussing the details of its training methods, the CISF Web site mentions that its seven training institutions are trying "to keep the force abreast of the latest trends in threat perception and its management vis-à-vis the technological advancements in the field."[76] It is not reported openly as to what types and frequency of testing the CISF undergo at nuclear facilities.

In 2004, India's Border Security Force (BSF) announced that it is forming a battalion with special skills in countering nuclear, biological, and chemical threats. The special battalion will receive training from nuclear experts at BARC. At that time, the BSF also pointed to increased concerns about militant camps in Bangladesh. While the battalion has established its main base of operations near Bangladesh, BSF reported that the battalion could deploy in any part of India if and when needed.[77]

In April 2002, the Chairman of India's Nuclear Power Corporation announced that he was cognizant of the terrorist threat and mentioned that the DAE and CISF have performed security drills at nuclear facilities.[78] Within a month after 9/11, New Delhi promulgated no-fly zones around nuclear power plants.[79] However, it is uncertain whether these facilities are adequately protected by anti-aircraft defenses.

The Indo-U.S. Working Group on Counterterrorism has discussed a variety of issues including nuclear terrorism. The United States reportedly has brought up the issue of assistance to secure Indian nuclear facilities.[80] But such assistance faces the hurdle of appearing to place India in a subservient position. Indian officials pride themselves on trying to become self-reliant. To have a greater chance of being accepted, U.S. help with nuclear plant security at least would have to be perceived as a cooperative venture.

Crises often have spurred India and Pakistan to enhance cooperative efforts to address mutual security concerns. In the 1980s, for instance, Indian fears about Pakistan's nuclear weapons program were rising. During the early 1980s, New Delhi considered preemptive strikes against Pakistan's nuclear facilities, especially the Kahuta plant. Rumors were circulating that Israel would carry out the attack if India so requested.[81] As noted earlier, Israel had bombed the Osirak reactor in Iraq in 1981. During this time period, New Delhi had yet to recognize Israel diplomatically because of not wanting to rile India's large Muslim population. A possible buildup to a preemptive attack heightened already growing tensions on the Subcontinent.

A partial defusing of the crisis atmosphere came about with the 1988 agreement between the two adversaries to refrain from attacking each other's nuclear facilities in the event of war. The agreement entered into force in 1991. Since January 1, 1992, the two sides annually have exchanged a list of their nuclear facilities. Although this agreement has served as a confidence-building measure, it has its shortcomings. It does not define "nuclear facility," and it does not specify when a facility should be included on the list, that is, when construction has started or been completed. The lists have never been published openly. Outside observers suspect that the lists are incomplete and most likely do not include many military facilities. If possible, it would be interesting to compare the list India has sent Pakistan to the list of civilian facilities India has sent to its parliament and the United States with respect to the U.S.-India nuclear deal.[82]

Although India is not a signatory of the Nuclear Non-Proliferation Treaty, it is a member of the IAEA. The IAEA has provided some security training using seminars for Indian officials. Also, both Indian and Pakistani experts have participated in the IAEA-sponsored International Training Course on the Physical Protection of Nuclear Facilities and Materials operated by the Sandia National Laboratories.[83] But India and Pakistan could make more effective use of the IAEA by requesting International Physical Protection Advisory Service missions in which an international team makes confidential vulnerability assessments that result in specific recommendations to improve physical security. But Indian and Pakistani concerns about the leakage of sensitive information from civilian facilities embedded in the military complex are likely creating resistance to fully opening up to the IAEA.[84]

The two countries are also parties to the Convention on the Physical Protection of Nuclear Material (CPPNM). A major shortcoming of the CPPNM was that for many years, it only applied to protection of nuclear material during international transit. But amendments to the CPPNM in 2005, once ratified, would require parties to protect nuclear material at their domestic facilities. Still, independent security experts have expressed concern that security requirements, associated with the CPPNM and related IAEA guidance, are not rigorous enough.[85]

Guarding against Unintended Consequences.

While increasing the number of guards might appear always to increase security, certain countervailing human behaviors actually might weaken security if guard forces are increased. Scott Sagan, a Stanford University professor, has challenged the conventional thinking on guard forces. In a 2003 paper that won Columbia University's Institute for War and Peace Studies best paper award, he identified three ways in which more security forces could result in less security.

First, more guards could increase the threat from insiders. If recently hired guards are not screened thoroughly, saboteurs could infiltrate the nuclear facility. Even if the new guards are well-screened, screening procedures are not foolproof, and a rapid increase in new hires increases the probability of some malicious people being admitted. India's ambitious plan to increase rapidly the number of its nuclear plants could allow penetration by saboteurs unintentionally. While India likely would insist that it is only recruiting loyal employees for its nuclear facilities, Sagan cautions, "Unfortunately, organizations that pride themselves on high degrees of personnel loyalty can be biased against accurately assessing and even discussing the risk of insider threats and unauthorized acts." After an employee clears a background check, he could become the target of coercion by terrorists.

Second, Sagan observes that guard redundancy can diffuse responsibility through the phenomenon of social shirking. Citing examples from even elite military units, he points out that it is a common human tendency to assume that others will "take up the slack." Third, Sagan cautions that increasing security forces at a nuclear plant could lead to overconfidence that the security system is stronger that it really is. This unintended consequence can lead to the risky behavior of building and running more nuclear facilities than the security system can manage. Sagan concludes, "Predicted increases in nuclear security forces should not be used as a justification of maintaining inherently insecure facilities or increasing the number of nuclear power plants, storage sites, or weapons facilities." Still, he does not mean that "redundancy never works in efforts to improve reliability and security." He advises that greater awareness of the potential pitfalls in simply adding more security forces would likely increase vigilance. [86]

RECOMMENDATIONS

Over many decades, India has developed a widespread and multifaceted nuclear infrastructure. While New Delhi has instituted security practices, including a paramilitary guard force and a personnel reliability program, it continually must reevaluate the rigorousness of its security system as it forges ahead with an ambitious expansion of its nuclear enterprise. It is not clear whether India has reexamined its design basis threat (DBT) in light of al-Qai'da's growing influence on terrorist activity in India. The DBT is the particular level of threat from outside attackers and inside saboteurs.

Another complicating factor for Indian nuclear security is the tight interconnection between India's civilian and military nuclear programs. A commercial reactor would likely pose more of a target for military attack if it were associated with the military nuclear sector. Moreover, this blurring between the programs shrouds the civilian nuclear activities in more secrecy than a purely civilian program would experience. Although secrecy can keep sensitive information from the enemy, too much secrecy can silence questioning that leads to improvements in security.

Separate Civilian and Military Nuclear Programs.

India should move more of its civilian nuclear facilities into a separate civilian program. While New Delhi, under the U.S.-India nuclear deal, has designated an additional handful of its commercial reactors as subject to IAEA safeguards, many more of its reactors remain in the military sector. The United States should use what influence it has to urge India to place more of its commercial reactors, as well as its breeder reactors, under the civilian program. Other nuclear-armed countries such as France and Russia have designated their breeder programs as civilian. New Delhi has objected to designating its breeder program as purely civilian because it foresees this program as potentially providing a huge source of plutonium for weapons. Such potential plans should provide further incentive for the United States and other nuclear-armed countries to bring India and Pakistan into serious negotiations for a fissile material cutoff. Such negotiations also would have to involve China, which is believed to have stopped making fissile material for nuclear weapons but has never formally announced it has.

Develop Cooperative Nuclear Security.

India prides itself on having developed a largely indigenous nuclear program. Many Indian leaders bristle at the suggestion that their country needs security assistance. The United States, the IAEA, and other relevant entities should work cooperatively with India to improve its nuclear security. Perhaps the United States could leverage the U.S.-India nuclear deal to encourage New Delhi to engage in this issue.[87] U.S. security experts could brief Indian officials about security practices in the United States. In the spirit of true cooperation, India would be encouraged to discuss its practices. While the non-nuclear part of the U.S.-India deal mentions greater cooperation on fighting terrorism in South Asia, the United States and India should strive to ensure that more work is done in this area as the region confronts severe threats from numerous terrorist groups.

New Delhi likely would have to be convinced to accept a cooperative security program. A relevant precedent is the opening up of India's civilian nuclear program to outside peer review of the safety systems and operational practices at its nuclear power plants. WANO has conducted several such confidential reviews in India. A WANO-like security peer review could identify shortcomings in India's security system confidentially. The peer reviewers could involve IAEA security experts, as well as experts from other countries' nuclear programs. Indian experts could take part in serving as peer reviewers of other nuclear programs. Thus, the peer review program would not single out a particular country but would serve as a global network to exchange best security practices.[88] At a minimum, India should request more security reviews and seminars from the IAEA, especially through the IAEA's International Physical Protection Advisory Service (IPPAS) program.

Implement Best Safety and Security Practices.

While IAEA and WANO-type peer reviews are important in identifying safety and security shortcomings, safety and security will not improve without implementation of the recommended enhancements. Indian nuclear power plants should incorporate safety systems resistant to insider sabotage.[89] India should apply this sabotage-resistance to future plants and, to the extent possible, retrofit current plants. In general, vital safety equipment could require a two-person rule in order to allow access to the equipment. For example, make sure that emergency core cooling systems cannot be turned off unless at least two nuclear operators agree.

Inherent safety systems can be expensive. But there are inexpensive measures that can improve safety and security. For instance, passive air defenses such as barrage balloons or steel beams secured in concrete foundations could provide cost effective protection against airplane crashes.[90] Placing a berm around vulnerable nuclear plant structures, fortifying spent nuclear fuel pools, transferring spent fuel to dry storage casks, and supplying extra diesel generators for reliable emergency power can be other relatively easy ways to improve security. The extra diesel generators should be configured and maintained in a manner that minimizes the probability of common mode failure.

Create a More Open Civilian Nuclear Infrastructure.

While cooperative ventures can help enhance security, for this cooperation to be effective, openness to change is essential. In addition, openness to self-criticism is equally as important. A self-critical nuclear system requires a truly independent regulator. Although India's AERB appears independent on paper, New Delhi should ensure that the AERB is independent in practice. New Delhi also should make sure, by amendment as appropriate, that the Official Secrets Act does not have the chilling effect of silencing concerns about safety and security. As India continues to build up its nuclear program, it should continually assess whether its DBT is adequate to counter military and terrorist threats. Also as the Indian nuclear complex scales up, New Delhi should prepare to counter potentially hazardous unintended consequences, including increases in the insider threat and the dangers of a growing stockpile of weapons-usable plutonium.

ENDNOTES - CHAPTER 5

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CHAPTER 6

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

Richard Speier

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

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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.

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14. Milhollin.

15. *Ibid*.

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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.

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28. Madhuprasad.

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CHAPTER 7

A REALIST'S CASE FOR CONDITIONING U.S NUCLEAR COOPERATION

George Perkovich

The debate over the nuclear deal negotiated by the Bush administration and the government of India is too narrow. This is ironic inasmuch as the best argument for the deal is that it advances big strategic goals. Some administration officials admit privately that the purported nonproliferation benefits of the deal are thinner than the paper it is not yet written on, and they hope to convince Congress that, even if there are no nonproliferation gains, the grand strategic benefits still make the deal worth supporting. Strangely, nevertheless, the debate focuses on the nonproliferation aspects of the deal and leaves larger strategic questions relatively unexamined.

I will not rehearse the various arguments made by nonproliferation specialists who criticize the deal. By and large, these criticisms are correct. If the proposed deal would not undermine other countries' continued willingness to strengthen and enforce nonproliferation rules, the administration could prove this by allowing the 45 countries in the Nuclear Suppliers Group to debate the deal fully and offer ways of improving it *before* urging Congress to vote on the administration's proposal. If the U.S.-India deal is so harmless, then the Nuclear Suppliers Group (NSG) should not have major problems with it. If NSG members have major problems with it, the deal is not so harmless.

To put it another way, proponents of the deal say it will achieve nonproliferation benefits or, at least, will not cause a weakening of the rules and enforcement of the nonproliferation regime. Rather than accept this claim on faith, is it not prudent to test it in the marketplace of states that are vital to the regime's maintenance and enforcement, the NSG? What sound argument can be made to proceed without such a test? Concern that the NSG could adopt new rules ahead of U.S. congressional action and thereby give French, Russian, or other actors a commercial advantage, overlooks the fact that the NSG acts by consensus, and the United States can block proposed changes that disadvantage it, or delay the proposed changes until U.S. legislation can be adapted to conform with them.

Instead of dealing seriously with concerns raised by nonproliferation specialists within and outside the U.S. Government—and many other countries—the President's key advisors tend to dismiss them as pedantic and small-minded. Nonproliferation details are seen as getting in the way of grand historical change, or of a long-delayed honeymoon in relations between the United States and India.

Rather than argue that the nonproliferationists are right (or wrong), I want to question whether the story being created by the grand history makers is such a good one after all. I believe that the authors—current and former advisors to Secretary of State Condoleezza Rice and President George W. Bush—are careless in their assumptions about the virtues of nuclear power in both its forms, civilian and military.

In Realist terms, champions of the deal are inflating the value of nuclear weapons at a time when U.S. interests are best served by deflating it. By doing nothing to constrain India's capacity and will to expand its nuclear arsenal and by hinting that a more robust Indian arsenal can help balance China's power, the United States sends an inflationary signal to the global marketplace. Indeed, the signal is stronger to the degree that Washington is rewarding India by removing all long-standing policies that penalize states acquiring nuclear weapons. These penalties were meant precisely to devalue this currency. A strong case can be made that rules need to be changed to bring India (and Pakistan and Israel) into the broad nonproliferation regime, recognizing that these states possess nuclear weapons and have not violated the Non-Proliferation Treaty (NPT). But changing the rules is not the same as abolishing them. Hasty, wholesale abandonment of rules that distinguish between the benefits that non-nuclear weapon states under the NPT enjoy, and those that nuclear India (Pakistan and Israel) might gain, devalues the restraint that countries such as Argentina, Brazil, Germany, Japan, South Africa, South Korea, Sweden, and others have exercised in forsaking nuclear weapons. More graduated benefits should have been considered.

As a consequence of the intervention in the Indian nuclear currency market, many Iranians speculate that, in short order, the United States will subordinate nonproliferation objectives vis-à-vis Iran, as it has with India. American officials (and analysts like me) can list correctly the vital differences between Iran and India, and insist that what is being done for India would not be done for Iran or any other non-nuclear weapons state under the NPT. Still, Iranians and many other observers calculate that Iran is greater civilizationally than Pakistan and on par with India. Iran has greater energy resources than both and occupies a vital geostrategic position. Therefore, some Iranians assume, the Indian model can be adapted to their country.

We should imagine that if Iran succeeds, Turks and Egyptians, and perhaps South Koreans and Japanese, may revise their own calculations. To the extent that these countries are friendly toward the United States, they will believe, with some reason, that Realist interests in America ultimately would accommodate their acquisition of nuclear weapons.

This currency intervention, as it were, contravenes Realist interests whether one favors an international model with the United States as an unrivaled, unipolar power, or a model with the United States as a liberal institution-builder. Either way, the United States is best served by diminishing the attractiveness of nuclear weapons both as military instruments and as symbols of power. In military terms, the spread of nuclear weapons to additional actors—states or terrorists—reduces the freedom with which the United States can project its military power or exercise its will in crises. Nuclear weapons can be equalizers; the United States is likely to be the equalizee, as former chairman of the House Armed Services Committee Les Aspin once put it.

Certainly the United States will try to deprive Iran and other hostile countries from acquiring this technology precisely to prevent limitations on American power projection. Yet Washington's capacity to rally the international coalition necessary to achieve this objective is vitiated by the specific strategy and tactics it is employing against Iran and the broader climate created by the India deal.

To the extent that states capable of producing nuclear weapons conclude from the India deal that they can begin to develop hedging capabilities, and bet that the United States or others gradually will accommodate them as it is accommodating India, it is prudent to anticipate that Japan, South Korea, Indonesia, and perhaps Turkey and Egypt might move to achieve nascent fissile material production facilities. Other factors more immediate than the U.S.-India deal would be more important in driving such decisions, particularly the future of the North Korean and Iranian nuclear programs. Still, the accommodation being offered to India will increase, rather than decrease, the probabilities of such hedging by governments that know the United States will not see them as enemies.

If states in Northeast, Southeast, and Southwest Asia move to acquire overt or recessed nuclear weapons capabilities, the United States, as the world's greatest power, will face an overwhelming challenge. As Henry Kissinger recently wrote,

> The management of a nuclear-armed world would be infinitely more complex than maintaining the deterrent balance of two Cold War superpowers. The various nuclear countries would not only have to maintain deterrent balances with their own adversaries, a process that would not necessarily follow the principles and practices that have evolved over decades among the existing nuclear states. They would have the ability and incentives to declare themselves as interested parties in general confrontations.[1]

It is reasonable to assume that the United States would have interests in all such confrontations, and therefore would face greater nuclear risks and challenges than any it has known thus far.

Beyond increasing the potential of more difficult balance-of-power challenges, the proposed deal undermines international institutions and rules that are vital to a cooperative security model, and is not useful to a model with the United States as the unipolar power. A unipolar power needs rules to help identify the bad guys and rally support for its efforts to corral them. Indeed, even a unipolar power in today's world cannot solve alone most of the problems that really threaten it, so it needs to strengthen good rules and convince other actors to buy into them.

The NSG was created by the United States in the aftermath of the first Indian nuclear test in 1974, and each episode of its strengthening has been driven by the United States. Now the United States, perhaps with congressional blessing, is preparing to act as if the NSG is insignificant. It is difficult to see how this approach would strengthen the NSG or even be neutral.

And if the United States unilaterally removes all rules limiting nuclear cooperation with India before the International Atomic Energy Agency (IAEA) and India have established the terms of safeguards that India is willing to adopt, the United States would be undermining the IAEA. The IAEA is far from perfect. It needs improvements, many of which require action by the states comprising its board of governors. But it has in recent years taken steps to enhance significantly its capacity to detect efforts by states to hedge on their nonproliferation commitments. As my colleague, former deputy director of the IAEA Pierre Goldschmidt, explains, since 1998 the Agency has used improved detection technologies and new analytical approaches to strengthen the likelihood of gaining warning that a state's nuclear activities are not exclusively peaceful. The Agency's limitations pale in comparison to the lack of political will by China and Russia, as veto-wielding members of the United Nations (UN) Security Council, to act decisively to enforce compliance with rules. Nothing in the U.S. approach to the nuclear deal with India increases respect for the IAEA or the willingness of China and Russia to take more seriously their responsibility to enforce compliance with nuclear nonproliferation rules. Rather than treating the IAEA as an afterthought and thereby weakening its salience, the United States should signal that it will not open nuclear commerce with India without knowing whether India will agree to safeguards that the IAEA deems sufficient.

Without explosive testing, it is difficult for a state newly acquiring nuclear weapons to be confident that it actually has a weapon that will work. Explosive testing also greatly improves a state's capacity to impress its own population (for political gain) and its neighbors (for power and deterrent purposes). These are major reasons why the Comprehensive Test Ban Treaty for decades has been a top nonproliferation objective. The United States has weakened the no-test constraint and its own legitimacy, by refusing to ratify the treaty, even as it has maintained since 1992 a moratorium on nuclear testing. Recognizing the importance of preventing the ripple effects that nuclear testing by any country would cause, the United States and India, in the July 2005 announcement of the proposed nuclear deal, emphasized that India would maintain its own moratorium. Yet, in subsequent negotiations and statements, the impression has grown that, in the event of renewed testing by India, the United States would seek to help India maintain supplies of fuel and other technology necessary to maintain nuclear reactors to be built as a result of the international cooperation opened because of the deal. This signal, too, alarms countries that are vital to strengthening and enforcing the nonproliferation regime.

Narrowing in on India, are the Realist implications of the proposed deal as positive as the deal's champions assert? Realism, like all statecraft, aims to increase one's power so that one can affect others more than they affect oneself. But power has many components. The Soviet Union was a superpower militarily, but it collapsed because it lacked the economic productivity and innovation required to meet the needs of its people and compete in an international system. It threatened many of its neighbors and disposed them to balance against its power and compete in an enervating arms race. It lacked the political harmony and justice necessary to mobilize its human resources.

India is a stunningly diverse democracy of one billion people, hundreds of millions of whom are extremely poor. It is afflicted by secession movements, lawlessness in some places, a violent rivalry with Pakistan, unsettled borders with Pakistan and China, inadequate infrastructure, and other challenges. How is the need for more fissile materials for nuclear weapons among the top 10 Indian requirements to be prosperous, strong, stable global power? What is the scenario for military conflict with China? What circumstances today, or in the foreseeable future, would make it imperative for India to need more nuclear weapons to preserve peace with China, and what strategies should be pursued now to redress such circumstances? Are there alternatives, or greater priorities, than building more nuclear weapons?

To the extent that American officials and supporters of the proposed deal address this question, they seek to have it both ways. On one hand, they argue that India will not use international nuclear cooperation to build a significantly larger nuclear arsenal. On the other, they argue that India will not accept limitations on a potential build up of its fissile material stockpile for weapons, and the United States should not press India on this.

India's history, and the perspectives and priorities of its current leadership, indicate that the country recognizes the extremely limited utility of nuclear weapons and will eschew a major build-up. Given this perspective, why not devote more creative diplomatic energy to exploring with India, China, and Pakistan how to limit the potential for further nuclear weapons building?

Turning to the nuclear industry for civilian purposes, in small-"c"-conservative terms, proponents of the nuclear deal fail to appreciate that the scale of nuclear electricity generation in the world today derives from cultural, institutional, political, and economic patterns that cannot be changed radically without dangerous consequences.

Engineers sit at computer monitors and design miraculous new reactors and spent-fuel reprocessing and waste management techniques and pronounce that the world can and therefore must build thousands of new power reactors to save the planet, but people who walk around in places like Nevada or New York (to pick "N" states) or India or Iran or Indonesia (to pick three "I" countries) know a core conservative truth: that the people who must manage and live with this technology are not ready to do so with the enthusiasm and care necessary to turn engineers' dreams into real-world realities.

Markets are imperfect. They often do not internalize real social costs and therefore send erroneous signals. They often are distorted by subsidies and other forms of manipulation. But even imperfect markets indicate whether societies are politically, economically, and culturally "ready" to adopt major new technologies on a massive scale. This is one reason why markets reflect conservative wisdom: Markets may be more rooted in the social reality of a place at any given time than centralized planning and investment are. The nuclear industry has never done well in market-dominated societies; it has done best in France, the Soviet Union, Japan, South Korea, and now perhaps China and India.

The nuclear project in India always has been dominated by a nuclear establishment that has formed a state within the state. This establishment has failed to deliver on its promises and now reluctantly seeks a bailout through the proposed U.S.-India deal. Prime Minister Singh, an enlightened economist, may hope that opening the Indian sector to international participation will engender some competitive discipline, but a market is hardly envisioned. The Indian state will be required to invest major subsidies, and the hope is that Russian, French, and perhaps American suppliers will do the same. This may turn out to be enlightened insofar as more market-oriented energy supplies, particularly fossil fuels, fail to internalize the social costs of climate change and health effects of coal emissions.

Yet conservative suspicion is warranted. We should ask whether societies are prepared to make the investment and site-choosing decisions necessary to add thousands of new nuclear power plants and the waste management technologies that would be required to reverse the growth of carbon dioxide emissions. We should ask whether other strategies can achieve more realistically and cheaply the desired public good.

These conservative Realist considerations suggest that if other alternatives to the proposed U.S.-India nuclear deal are not explored, there is a risk that Asia will experience a dangerous and costly build-up of nuclear arsenals—a nuclear bubble much more dangerous than housing or stock-market bubbles.

These considerations suggest the following: Why hasn't the United States vigorously and thoroughly pursued means to limit further fissile material production for nuclear weapons in southern Asia, including China? If China were to forego a major increase in its nuclear arsenal, then India would not feel the need to produce more plutonium or highly enriched uranium for bombs. Pakistan would likely follow along with such constraints if China and India were to do so, with U.S. encouragement. India could then put almost all of its nuclear facilities under safeguards, which would buttress, rather than erode, the global nonproliferation regime. International partners could sell India nuclear fuel without thereby augmenting India's nuclear weapons arsenal.

Pursuing this objective would earn the U.S. global credibility it badly needs to lead the struggle against proliferation in Iran and elsewhere. If the President could announce to the world that, "As of today, no country is making additional nuclear weapons, none is adding to the global glut of weapons plutonium and highly-enriched uranium," it would be much easier to rally all countries to prevent Iran, North Korea, or other challengers from producing materials that could be used in nuclear weapons.

To make this objective a reality, China, India and Pakistan are key. (Israel most likely would go along, strengthening prospects of nonproliferation in the Middle East). But China will not cut short the expansion of its nuclear arsenal if the United States does not reassure Beijing. U.S. plans to develop the capability to preemptively destroy China's nuclear forces and command-and-control infrastructure intensify China's nuclear requirements. Faced with such a scenario, China will not limit the expansion and modernization of its nuclear arsenal, which means that India will not agree to limit its potential nuclear bomb production.

U.S. officials have never even tried to discuss with Beijing, New Delhi, and Islamabad whether a nuclear arms build-up can be avoided. Instead, they have endorsed a bilateral deal with India that pushes in the opposite direction, knowing that China will then seek to reciprocate by offering nuclear cooperation with Pakistan to keep up. Perhaps an Asian nuclear arms competition cannot be avoided, but Congress should not allow the United States to fuel one before the administration has tried. The administration should be required to report to Congress on the conditions under which China, Pakistan, and India would agree to join the United States, Russia, France, and the United Kingdom—nuclear weapons states that have already publicly undertaken moratoria on producing fissile materials for nuclear weapons.

To make such an assessment, the United States will have to talk with these countries about the issue. Because Congress would dismiss the interests of any country making far-fetched demands, each would have an incentive to take the issue of a global moratorium seriously. India might discount Chinese willingness to declare a moratorium, by saying that China would still retain a stockpile of fissile material that can be converted to new weapons. Pakistan might say the same of India. From this could emerge the first serious discussion of the pros and cons of three-way regional nuclear constraints. In any case, Congress and the world would gain a clearer picture of the potential consequences of the proposed nuclear deal with India.

In parallel with a U.S. exploration of this issue with China, India, and Pakistan, Pakistan itself might consider whether to declare a voluntary cessation of fissile material production through the end of the year, and offer to extend it indefinitely if all countries with unsafeguarded fissile material production facilities join it. (Pakistan would not do so without the blessing of China.)

Beyond the fissile material issue, there are two important initiatives related to the NSG that should be considered. If we cannot wait for the NSG to deliberate and test the proposition that the deal as proposed will not cause other leading members of the international community to weaken their support of the rule-based nonproliferation regime, the United States at least should propose a process for strengthening international rules in light of the India deal. One example would be to work within the NSG to clarify the terms under which a "safety exemption" should be allowed for nuclear cooperation. Russia's recent use of such an exemption to provide fuel to the Tarapur reactor invites a further weakening, rather than a strengthening, of NSG rules.

Returning to the nuclear testing issue, the United States should reconsider its resistance to ratifying the Comprehensive Test Ban Treaty. If, as is likely, the necessary two-thirds majority cannot be mustered in the Senate to this end, the United States should clarify at a minimum that it will not abet an Indian decision to test by promoting work-around nuclear supply arrangements.

It is possible that the U.S.-India deal is too far advanced to improve it significantly. In that case, the United States has a greatly increased responsibility going forward to exert concentrated, sustained leadership to minimize the undesired effects of the deal. The natural temptation after completing the arduous process of passing the deal will be to move on to less demanding issues. This could gravely undermine the Realist interests of the United States and the international system.

ENDNOTE - CHAPTER 7

1. Henry Kissinger, "A Nuclear Test for Diplomacy," *Washington Post*, May 16, 2006, p. A17.

STRATEGIC MATTERS

CHAPTER 8

WHAT SHOULD WE EXPECT FROM INDIA AS A STRATEGIC PARTNER?

Ashley J. Tellis

It is probable that when the history of the George W. Bush administration is finally written, the transformation of the U.S.-Indian relationship will be judged as the President's greatest foreign policy achievement. This success, if sustained through wise policies and skillful diplomacy by future administrations, will portend enormous consequences for the future balance of power in Asia and globally to the advantage of the United States. The rapid transformation of the relationship between the world's oldest and the world's largest democracies, which began in the final years of the Clinton administration and which received dramatic substantive impetus in the Bush presidency, has had the effect of obscuring the fact that the bilateral relationship between the United States and India historically represented an engagement marked by dramatic alterations.[1]

U.S-Indian Relations Historically: A Giant Sine Wave.

During the dark years of World War II, the United States was perhaps the most important country to press Great Britain to end its colonial empire in India. Shaped by America's own ideals of liberty, the Roosevelt and later the Truman administrations became strong advocates of Indian independence. The post-Independence Indian leadership led by Jawaharlal Nehru was eager to reciprocate American overtures of friendship and, despite their formal invocation of nonalignment in the face of the emerging Cold War, sought to develop a close strategic relationship with the United States that would provide India with arms, economic assistance, and diplomatic support. Although this effort was only partly successful, in some measure because the United States still deferred to Great Britain on issues relating to security in the Indian subcontinent and more significantly because the emerging U.S. vision of containment left little room for informal allies like India, U.S.-Indian relations nonetheless remained very cordial from 1947-62. The United States during this period soon became the largest aid donor to India, and Washington viewed India as an important theater in the struggle against global communism despite New Delhi's reluctance to become formally allied with Washington in its anti-communist crusade. The year 1962 in fact marked the zenith of U.S.-Indian relations during the Cold War, when the United States strongly supported India politically, diplomatically, and militarily during the Sino-Indian war.

America's growing involvement in Vietnam thereafter, coupled with India's own inward turn in the aftermath of its defeat in 1962, resulted in the 1965-71 period marking the nadir in U.S.-Indian relations. The growing U.S. disenchantment with Indian neutralism in the face of years of American assistance, the distractions of the Vietnam war, and the increasingly manifest failures of Indian socialism, all together set the stage for repeated confrontations: The 1965 Indo-Pakistani war witnessed the first formal U.S. arms embargo on New Delhi—a dramatic reversal of the earlier U.S. policy of assisting India militarily and one that was viewed in India as unjustified, given that India was a victim of deliberate Pakistani aggression during this conflict. The aftermath of the war also brought new humiliations in the form of coercive American efforts at conditioning food aid during the most serious agricultural failure faced by India in the post-Independence period, an episode that led to the forced devaluation of the Indian rupee and a minor economic crisis. Finally, the most serious confrontation in U.S.-Indian relations was during the 1971 Indo-Pakistani war, when the Nixon administration, because of its reliance on Pakistan as the intermediary in its opening to China, supported Islamabad against New Delhi despite the Pakistani junta's brutalization of its eastern provinces, which resulted in an armed revolt against Islamabad that eventually precipitated a generalized Indo-Pakistani war that locked India and the United States on opposite sides.

The years 1971-82 were a frosty period in the bilateral relationship as the United States attempted to come to terms with its own defeat in Vietnam and its gradual loss of influence in South Asia caused both by the defeat of its ally, Pakistan, in the 1971 war and the sharp increase in Soviet influence as a result of the Indo-Soviet Treaty that was concluded just prior to the 1971 war. Just as the United States and India began to grow comfortable in the mutual distance that had set in as a result of the recriminations of 1971, another great Republican president, Ronald Reagan, made a concerted effort to heal the breach between the two democracies. Although Reagan's intentions were shaped greatly by his desire to avoid ceding India to the Soviet sphere of influence permanently, his overtures of friendship were welcomed gladly by then Indian Prime Minister Indira Gandhi because of her own desire to maintain a durable breathing space between India and the Soviet Union. Thus, the 1982-91 period witnessed a delicate and gradual warming of U.S.-Indian relations: The warming was symbolized by new American efforts to accommodate Indian desires for dual-use high technologies in an effort to wean New Delhi away from excessive dependence on Moscow, while the delicacy was repeatedly displayed as India sought to avoid becoming engulfed by the new Reagan strategy of confronting the Soviet Union in what would eventually become the death knell for Washington's Communist rival.

The year 1991 brought the Cold War to a dramatic close with the dissolution of the Soviet Union. To all intents and purposes, India appeared like the loser in South Asia, and Pakistan the improbable winner.[2] India's principal patron, the Soviet Union, had lost the Cold War and had disappeared from the political landscape. Pakistan's principal patron, the United States, had won the Cold War, and its lesser patron, China, stood to gain from the Soviet demise. While that might have seemed like an initial advantage as far as Pakistan was concerned, the real consequence turned out to be that the collapse of superpower competition afforded the United States the opportunity to cut Pakistan loose as an ally and reengage India in order to construct that bilateral partnership that both sides desired since India's independence but which eluded them throughout the Cold War. The years 1991-98, therefore, saw renewed efforts on both sides to build a new relationship unconstrained by the pressures that were dominant during the Cold War. The absence of bipolarity meant that the United States and India could judge each other on their own terms and seek a relationship based on the strength of their direct mutual interests rather than the derivative pressures arising from their relations with others. The maturing of the Indian economy, which was an underperformer for much of the Cold War period, provided added impetus for seeking a new bilateral relationship on both sides. For the United States, India held the promise of becoming a big emerging new market for American goods and services, whereas the United States remained for New Delhi a critical source of trade and investments, high technology, and above all political reassurance and diplomatic support.[3] Although U.S.-Indian relations throughout this decade were shadowed by new U.S. pressures on nonproliferation—arising entirely out of the U.S. conviction that capping, rolling back, and eventually eliminating India's nuclear weapons program was critical to its larger global strategy of controlling the spread of nuclear weapons—both sides attempted as best they could to prevent their disagreements on this issue from impeding the rapprochement in bilateral relations.

The strategy adopted for this purpose by the Clinton administration was that of a "carve out," meaning that the United States would segregate its disagreement with India on nuclear weapons, while proceeding to improve bilateral relations in all other issue areas. Unfortunately, this strategy quickly reached the limits of its success, in part because India's economic development had by now reached a point where its further growth required expanded access to a range of dual-use high technologies, all of which, being controlled by various global nonproliferation regimes managed by the United States, would stay perpetually beyond New Delhi's reach so long as the "carve out" approach pursued by the United States dominated Washington's efforts to rebuild relations with India. In these circumstances, the Clinton administration's efforts—while no doubt well-intentioned and arguably even justified at that point in time—became an enormous source of frustration to India. Even worse, the administration's nonproliferation successes in the global arena, such as the indefinite extension of the Non-Proliferation Treaty and the conclusion of the Comprehensive Test Ban Treaty (CTBT), were seen as fundamentally undermining Indian efforts at maintaining its "nuclear option" and thereby put New Delhi on a collision course with Washington. Ironically therefore, the 1991-98 period, which witnessed strong efforts on both sides to construct a new bilateral relationship unhampered by historic Cold War pressures, quickly ended with a bang—literally—as New Delhi tested a series of nuclear weapons in May 1998 and in a deliberate challenge to the United states promptly declared itself to be a "nuclear weapons state."[4]

The testing of nuclear weapons by India—followed quickly by tests in Pakistan—resulted, once again, in a meltdown in U.S.-Indian relations as the Clinton administration imposed a series of nuclear-related sanctions on India. These sanctions, which came during a period of highly-charged atmospherics and shrill diplomacy, proved to be more a psychological than a material blow to India's strategic programs, but they had the effect of resuscitating past Indian memories of U.S. opposition. This discomfiting moment in bilateral relations might have lasted longer than it finally did if it were not for Pakistan's aggression in Kargil, a region that lies along the northern frontiers of the disputed state of Jammu and Kashmir. This ill-advised adventure, once again, brought the United States and India together in an intense bout of collaborative diplomacy that had the beneficial result of removing much, though not all, of the mutual discord that had set in after the nuclear tests. It also strengthened the commitment of both sides to work out the disagreement on nuclear issues in a constructive way leading first to an intensely useful 14-round dialogue between U.S. Deputy Secretary of State Strobe Talbott and India's Foreign Minister Jaswant Singh and finally to a wildly successful March 2000 visit by President Bill Clinton to New Delhi.[5] By the time the Bush administration arrived in office, therefore, U.S.-Indian relations were once more on the path to improvement, but still lacked a decisive resolution of the one issue that bedeviled mutual ties since 1974: India's nuclear weapons program and its status as an outlier in the Non-Proliferation Treaty.

When viewed in retrospect, however, the dispute over India's nuclear program was merely the third impediment to the strong bilateral relationship that President Truman and Prime Minister Nehru had envisaged at the time of India's independence in 1947. The first and most significant impediment throughout the Cold War was simply India's quest for strategic autonomy. This desire for freedom to choose one's own ideology, policies, and friends sat uncomfortably with U.S preferences at a time when Washington was engaged in a global confrontation with Soviet communism. In that Manichean struggle, the Indian desire for nonalignment was viewed occasionally in the United States as a form of moral indifference in the struggle between good and evil. Even when moral considerations were not at issue, the pursuit of U.S. global interests, which resulted initially in formal or tacit alliances first with Pakistan and later with China—both Indian rivals—resulted in strained relations with New Delhi. These strained relations were to engender a deepening of Indo-Soviet ties, as New Delhi sought to acquire a superpower patron of its own to deal with the threat to its security first posed by an American-supported Pakistan and later by an American-supported China. The end of the Cold War, however, decisively removed this first impediment to closer U.S.-Indian relations and, while it does not assure perfect amity between the two countries by itself, it at least removes a key structural impediment that historically impeded the development of close collaboration.

The second impediment to close bilateral ties arose from factors specific to India: New Delhi's relative weakness during much of the Cold War. The traditional Indian strategy of relying on a centrally planned economy that emphasized self-reliance (at least in the industrial sector) failed to advance both political and development goals and instead institutionalized poor management, pervasive inefficiency, a rentier bureaucracy, the stifling of initiative, low rates of return, the absence of internal and foreign competition, and depressed rates of economic growth. The net effect was that India not only failed to develop into the great power that it sought to become at the time of its independence, it actually lost out in relative terms to the Asian tigers which were its economic peers as late as the early 1960s. India's pervasive economic underperformance and its lack of connectivity to the Western economic system (or the global economy) arising from its autarkic policies virtually guaranteed its strategic irrelevance during the Cold War.[6] Whatever relevance India had derived was mostly because it was viewed as a battleground during the early phase of U.S-Soviet competition. Once a more mature understanding of the global balance of power set in (as was the case during the latter half of the Cold War), India, with its relatively poor economic performance, provided the United States with few stakes in its success. As a result, Washington made some efforts to wean New Delhi away from Soviet enticements after 1982, but India's marginality in the global economic system guaranteed that these efforts would never be robust or long-lasting. The steady shift in Indian economic fortunes after about 1980, and the relatively high growth rates sustained since 1991, ensures however that the future of U.S.-Indian relations is likely to replicate the past. Today, India is widely viewed as a rising economic power and virtually all studies suggest that its economy will find a place within the world's top three or four largest concentrations of economic power sometime during the first half of this century.[7] This reality by itself ensures that the second structural impediment that prevented the growth of close U.S-Indian relations—New Delhi's economic underperformance and, by implication, its strategic irrelevance—is on the cusp of disappearing forever.

By the time the Bush administration took office in 2001, therefore, there remained only one last structural impediment to closer U.S-Indian ties and that was New Delhi's anomalous nuclear status in the post-1974 period: a state with nuclear weapons, but not a nuclear weapons state. It is this reality that President Bush has gone to great lengths to correct, first through the Next Steps in Strategic Partnership (NSSP) concluded during his first term, and then through the July 18, 2005, Joint Statement with Prime Minister Singh, wherein he proposed the renewal of international nuclear cooperation with New Delhi, which is tantamount to accepting India as a de facto nuclear weapons state.[8]

Although it is unclear at the time of this writing what the legal future of this proposal will be, the fact remains that Bush's bold initiative is colored greatly by his judgment that avoiding the sine wave oscillations characterizing the bilateral relationship in previous decades will be critical if the United States is to master the geopolitical challenges that are likely to confront it, especially in Asia, in the 21st century. In this context, setting aright the U.S-Indian relationship in a way that assists the growth of Indian power is judged to be essential to U.S. interests because it permits Washington to "pursue a balance-of-power strategy among those major rising powers and key regional states in Asia which are not part of the existing U.S. alliance structure—including China, India, and a currently weakened Russia," a strategy that "seeks to prevent any one of these [countries] from effectively threatening the security of another [or that of the United States] while simultaneously preventing any combination of these [entities] from 'bandwagoning' to undercut critical U.S. strategic interests in Asia."[9]

The Value of a Transformed U.S.-Indian Relationship.

The principal value in transforming the U.S.-Indian relationship is that it provides hope for reaching the *summum bonum* that eluded both sides during the Cold War. The possibility of decent U.S.-Indian relations during that period survived at the end of the day only because of the shared values that derived from a common democratic heritage. As the historical record of this epoch in the previous section indicated, these values sufficed to prevent both countries from becoming real antagonists, but they could not prevent the political estrangement that arose regularly as a result of divergence in critical interests. With the passing of the bipolar international order and with India's own shift towards market economics at home, the traditional commonality of values is now complemented by an increasingly robust set of intersocietal ties based on growing U.S.-Indian economic and trade linkages, the new presence of Americans of Indian origin in U.S. political life, and the vibrant exchange of American and Indian ideas and culture through movies, literature, food, and travel.

These links are only reinforced by the new and dramatic convergence of national interests between the United States and India in a manner never witnessed during the Cold War. Today and for the foreseeable future, both Washington and New Delhi will be bound by a common interest in:

- Preventing Asia from being dominated by any single power that has the capacity to crowd out others and which may use aggressive assertion of national self-interest to threaten American presence, American alliances, and American ties with the regional states;
- Eliminating the threats posed by state sponsors of terrorism who may seek to use violence against innocents to attain various political objectives, and more generally neutralizing the dangers posed by terrorism and religious extremism to free societies;
- Arresting the further spread of weapons of mass destruction (WMD) and related technologies to other countries and subnational entities, including substate actors operating independently or in collusion with states;

- Promoting the spread of democracy not only as an end in itself but also as a strategic means of preventing illiberal polities from exporting their internal struggles over power abroad;
- Advancing the diffusion of economic development with the intent of spreading peace through prosperity through the expansion of a liberal international economic order that increases trade in goods, services, and technology worldwide;
- Protecting the global commons, especially the sea lanes of communications, through which flow not only goods and services critical to the global economy but also undesirable commerce such as drug trading, human smuggling, and WMD technologies;
- Preserving energy security by enabling stable access to existing energy sources through efficient and transparent market mechanisms (both internationally and domestically), while collaborating to develop new sources of energy through innovative approaches that exploit science and technology; and,
- Safeguarding the global environment by promoting the creation and use of innovative technology to achieve sustainable development; devising permanent, self-sustaining, market-based institutions and systems that improve environmental protection; developing coordinated strategies for managing climate change; and assisting in the event of natural disasters.

It would not be an exaggeration to say that for the first time in recent memory Indian and American interests in each of these eight issue-areas are strongly convergent.[10] It is equally true to assert that India's contribution ranges from important to indispensable as far as achieving U.S. objectives in each of these issue-areas is concerned. That does not mean, however, that the United States and India will *automatically* collaborate on every problem that comes before the two countries. The differentials in raw power between the United States and India are still too great and could produce differences in operational objectives, even when the overarching interests are preeminently compatible. Beyond the differentials in raw power, bilateral collaboration could still be stymied by competing national preferences over the strategies used to realize certain objectives. And, finally, even when disagreement over strategies is not at issue, differences in negotiating styles and tactics may sometimes divide the two sides.

What does it mean, then, to say that U.S.-Indian interests are strongly convergent, if bilateral collaboration cannot always be assumed to ensue automatically? It means three things. First, that there is a grand *summum bonum* that the two sides can secure only collaboratively, even though each party is likely to emphasize different aspects of this quest. For the United States, the ultimate value of the U.S.-Indian relationship is that it helps preserve American primacy and the exercise thereof by constructing a partnership that aids in the preservation of the balance of power in Asia, enhances American competitiveness through deepened linkages with a growing Indian economy, and strengthens the American vision of a concert of democratic states by incorporating a major non-Western exemplar of successful democracy such as India. For India, the ultimate value of the U.S.-Indian relationship is that it helps New Delhi to expand its national power. Although this growth in capabilities leads India inexorably to demand formally a "multipolar" world—a claim that, strictly speaking, implies the demise of American hegemony—the leadership in New Delhi is realistic enough to understand that American primacy is unlikely to be dethroned any time soon and certainly not as a result of the growth in Indian power. Rather, because Indian power and national ambitions will find assertion in geographic and issue areas that are more likely to be contested immediately by China rather than by the United States, Indian policymakers astutely recognize that only protective benefits accrue to New Delhi from American primacy, despite their own formal—but not substantive—discomfort with such a concept.

Second is that the United and India share a common vision of which end-states are desirable and what outcomes ought to be pursued—however this is done—by both sides. Irrespective of the tensions that inhere in the competing visions of hegemony and multipolarity at the level of theory and in the grand strategies formally pursued by the two countries, both Washington and New Delhi are united by a common understanding of which strategic end-states are in the interests of both sides. Thus, both countries, for example, agree that a powerful authoritarian China that has the capacity to dominate the Asian landmass serves neither American nor Indian interests. Both sides similarly understand that a radicalized Islam at war with itself and the world outside it threatens the security of both countries even if only in different ways. Further, neither country believes that despite their own possession of nuclear weapons and their reluctance to surrender these capabilities either permanently or to some global authority, other states or nonstate actors—even if friendly—ought to be encouraged to acquire such capabilities. Such a list can be developed further, only proving that the ambiguities that lie in each country's conception of the *summum bonum* at the grand strategic level does not in any way translate into fundamental differences at the practical level where certain critical political goals are concerned. As a result, not only is a close U.S.-Indian bilateral relationship eminently possible, it is fundamentally necessary since both countries will be increasingly critical to the achievement of those goals valued by each side.

Third, that there are no differences in vital interests, despite the tensions in the competing grand strategies, which would cause either party to levy mortal threats against the other or would cause either country to undercut the other's core objectives on any issue of strategic importance.

These two realities—informed by the convergence in interests, values, and intersocietal ties—provide a basis for strong practical cooperation between the United States and India. They are realities that do not define U.S. bilateral relations with any other major, continental-sized, state in Asia. The fact that the United States and India would never threaten each other's security through the force of arms—and have never done so historically despite moments of deep disagreement—provides an enormous cushion of comfort in the bilateral relationship because it insulates policymakers on both sides from having to confront the prospect of how to manage the most lethal threats that may otherwise be imagined. U.S. relations with neither Russia nor China enjoy any comparable protection. Therefore, even when U.S.-Indian relations may be confronted by profound disagreement, these altercations would be no better and no worse that those arising with other friends and allies. This reality in effect, then, bounds the lowest limits of the relationship: While disagreements between friends and allies are never desirable, they at least hold out the reassurance that these disputes will not end up in violent conflict and that by itself provides an opportunity for exploring some reasonable "positive sum" solutions.

Given these three judgments, President Bush's decision to accelerate the transformation in U.S.-Indian relations (through multiple avenues now being contemplated by the administration) represents an investment not only in bettering relations with a new rising power in what will become the new center of gravity in global politics—Asia—but also, and more fundamentally, an investment in the long-term security and relative power position of the United States.

The Practical Consequences of Transforming the U.S.-Indian Relationship.

Several practical implications flow from the three realities that define the U.S.-Indian relationship. To begin with, the strengthening U.S.-Indian bond does not imply that New Delhi will become a formal alliance partner of Washington at some point in the future. It also does not imply that India will invariably be an uncritical partner of the United States in its global endeavors. India's large size, its proud history, and its great ambitions, ensure that it will likely march to the beat of its own drummer, at least most of the time. When the value of the U.S.-Indian relationship is at issue, the first question for the United States, therefore, ought not to be, “What will India do for us?”—as critics of the Bush administration’s civilian nuclear agreement with New Delhi have often asserted in recent memory.[11] Rather, the real question ought to be, “Is a strong, democratic (even if perpetually independent) India in American national interest?” If this is the fundamental question and if the answer to this question is “Yes”—as it ought to be, given the convergence in U.S. and Indian national security goals—then the real discussion about the evolution of the U.S.-Indian relationship ought to focus on how the United States can assist the growth of Indian power, and how it can do so at minimal cost (if that is relevant) to any other competing national security objectives.[12]

Advancing the growth of Indian power consistent with this intention, as the Bush administration currently seeks, is not directed, as many critics have alleged, at “containing” China. A policy of containing China is neither feasible nor necessary for the United States at this point in time. India, too, currently has no interest in becoming part of any coalition aimed at containing China. This is not because New Delhi is by any means indifferent to the growth of Chinese capabilities but because Indian policymakers believe that the best antidote to the persistently competitive and even threatening dimensions of Chinese power lies, at least in the first instance, in *the complete and permanent revitalization of Indian national strength*—an objective in which the United States has a special role.[13] The United States, in turn, has a complementary perspective. Rather than merely “containing” China, the administration’s strategy of assisting India to become a major world power in the 21st century is directed, first and foremost, towards constructing a stable geopolitical order in Asia that is conducive to peace and prosperity. There is little doubt today that the Asian continent is poised to become the new locus of capabilities in international politics. Although lower growth in the labor force, reduced export performance, diminishing returns to capital, changes in demographic structure, and the maturation of the economy all suggest that national growth rates in several key Asian states—in particular Japan, South Korea, and possibly China—are likely to decline in comparison to the latter half of the Cold War period, the spurt in Indian growth rates, coupled with the relatively high though still marginally declining growth rates in China, will propel Asia's share of the global economy to some 43 percent by 2025, thus making the continent the largest single center of economic power worldwide.

An Asia that hosts economic power of such magnitude, along with its strong and growing connectivity to the American economy, will become an arena vital to the United States—in much the same way that Europe was the grand prize during the Cold War. In such circumstances, the administration's policy of developing a new global partnership with India represents a considered effort at "shaping" the emerging Asian environment to suit American interests in the 21st century. Even as the United States focuses on developing good relations with *all* the major Asian states, it is eminently reasonable for Washington not only to invest additional resources in strengthening the continent's democratic powers but also to deepen the bilateral relationship enjoyed with each of these countries—on the assumption that the proliferation of strong democratic states in Asia represents the best insurance against intracontinental instability as well as against threats that may emerge against the United States and its regional presence. Strengthening New

Delhi and transforming U.S-Indian ties, therefore, has everything to do with American confidence in Indian democracy and the conviction that its growing strength, tempered by its liberal values, brings only benefits for Asian stability and American security. As Undersecretary of State Nicholas Burns succinctly stated in his testimony before the House International Relations Committee on September 8, 2005, "By cooperating with India now, we accelerate the arrival of the benefits that India's rise brings to the region and the world."[14]

Once the fundamental argument is understood—that India's growth in power is valuable to the United States principally not because of what it does for us, but because of what it enables New Delhi to become in the context of an emerging Asia—the second-order consideration of whether (and how) India will collaborate in endeavors critical to the United States can be appreciated in proper perspective. Only when the importance of strengthening India in America's own self-interest is affirmed, however, does the question of whether and how New Delhi would partner with the United States become a useful one. It is not necessary to have a Realist obsession with great power politics in order to defend the validity of such an approach. As George Perkovich, arguing from what is unabashedly a Liberal-Humanist perspective, has concluded, deepened U.S.-Indian relations that have the effect of strengthening India make strategic sense whether or not New Delhi supports Washington on a range of political issues because:

> . . . India is too big and too important in the overall global community to measure in terms of its alignment with any particular U.S. interest at any given time. It matters to the entire world whether India is at war or peace with its neighbors, is producing increasing prosperity or poverty

> for its citizens, stemming or incubating the spread of infectious diseases, or mimicking or leapfrogging climate-warming technologies. Democratically managing a society as big, populous, diverse, and culturally dynamic as India is a world historical challenge. If India can democratically lift all of its citizens to a decent quality of life without trampling on basic liberties and harming its neighbors, the Indian people will have accomplished perhaps the greatest success in human history.
>
> India will struggle to do this largely on its own, disabused of notions that the United States or others might help without asking anything in return. This capacity to do things on one's own is autonomy, a form of power that India has achieved to its great credit. To go further and make others do what one wants them to do through payment, coercion, or persuasion is a more demanding measure of power. Iraq raises questions whether even the United States has this power. India, to be great, has more urgent things to do.[15]

Although Perkovich's argument may not satisfy a hard-nosed Realist concerned about protecting U.S. national security interests conventionally understood, there is nonetheless good news even from a narrowly self-interested perspective of American national interests. The good news about India's obsession with its national autonomy is that while it does not a priori guarantee New Delhi's support for Washington in regards to any specific operational objective, implementation strategy, or political tactic (even when the larger interests are otherwise identical), *it does not preclude such assistance either*. In fact, during the last 5 years, India has built up an impressive record of backing the United States in a wide variety of issue-areas, despite its formal and continuing commitment to "nonalignment" as a foreign policy doctrine. The list of Indian initiatives in support of the United States is a lengthy one—many specific activities are in fact still classified—but the following iteration highlights the reality and the possibilities of U.S.-Indian strategic collaboration.

Since 2001, India:

- Enthusiastically endorsed President Bush's new strategic framework, despite decades of objections to U.S. nuclear policies, at a time when even formal American allies withheld their support;
- Offered unqualified support for the U.S. anti-terrorism campaign in Afghanistan to include the use of numerous Indian military bases, an offer that was never made even to the Soviet Union which functioned as New Delhi's patron during the last decades of the Cold War;
- Expressed no opposition whatsoever to President Bush's decision to withdraw from the ABM Treaty, despite the widespread international and domestic condemnation of the U.S. action;
- Endorsed the U.S. position on environmental protection and global climate change in the face of strident global opposition;
- Assisted the U.S. initiative to remove Jose Mauricio Bustani, the Director-General of the Organization for the Prohibition of Chemical Weapons despite strong third-world opposition in the United Nations (UN);
- Protected high-value U.S. cargoes transiting the Straits of Malacca during the critical early phase of the global war on terror, despite the absence of New Delhi's traditional requirement of a covering UN mandate;

- Eschewed leading or joining the international chorus of opposition to the U.S.-led coalition campaign against Iraq, despite repeated entreaties from other major powers and third-world states to that effect;
- Considered seriously—and came close to providing—an Indian Army division for postwar stabilization operations in Iraq despite widespread national opposition to the U.S.-led war;
- Signed a 10-year defense cooperation framework agreement with the United States that identifies common strategic goals and the means for achieving them despite strong domestic opposition to, and regional suspicion about, such forms of collaboration with Washington;
- Collaborated—and continues to partner—with the United States by becoming one of the largest donors to the reconstruction effort in Afghanistan despite strong—and continuing—U.S. efforts to limit Indian assistance in certain programs because of sensitivities involving Pakistan; and,
- Voted with the United States at the September 2005 IAEA Board of Governors meeting to declare Iran in "non-compliance" with the Non-Proliferation Treaty, despite strong domestic opposition and international surprise.

These examples, viewed in their totality, illustrate several important aspects of U.S-Indian strategic collaboration. First, despite the absence of preexisting guarantees, bilateral cooperation between Washington and New Delhi is eminently possible on many issues vital to the United States. Second, from the perspective of American interests, what New Delhi does in some instances may be just as important as what it refrains from doing. Third, in every instance where the United States and India have been able to collaborate during the last 5 years, the most important ingredients that contributed to achieving a fruitful outcome were the boldness of leadership, the astuteness of policy, and the quality of diplomacy—both American and Indian.

As we look at the three most pressing challenges likely to dominate the common attention of the United States and India in the first half of the 21st century—the rise of China amidst Asian resurgence in general, the threat of the continuing spread of WMD, and the dangers posed by terrorism and religious extremism to liberal societies—two assertions become almost self-evidently true: Not only are the United States and India more intensely affected by these three challenges in comparison to many other states in Europe and Asia, but effective diplomacy, wise policy, and bold leadership also will make the greatest difference in achieving the desired "strategic coordination" between Washington and New Delhi that serves American interests just as well as any recognized alliance.[16]

Since the character of U.S. policy, leadership, and diplomacy—whether tacit or explicit—will be critical to making such U.S.-Indian collaboration possible, both the administration and the Congress will have to partner in this regard. The most important contribution that the legislative branch can make here is by helping to change India's entitative status from that of a target under U.S. nonproliferation laws to that of a full partner. The administration's civilian nuclear agreement with India is directed fundamentally towards this objective. To be sure, it will produce important and tangible nonproliferation gains for the United States, just as it will bestow energy and environmental benefits on India.[17] But, at a grand strategic level, it is intended to do much more: Given the lessons learned from over 50 years of alternating engagement and opposition, the civil nuclear cooperation agreement is intended to convey in one fell swoop the abiding American interest in crafting a full and productive partnership with India to advance our common goals in this new century. As Undersecretary of State Burns phrased it in his recent testimony, "our ongoing diplomatic efforts to conclude a civilian nuclear cooperation agreement are not simply exercises in bargaining and tough-minded negotiation; they represent a broad confidence-building effort grounded in a political commitment from the highest levels of our two governments."[18]

Many administrations before that of George W. Bush also sought this same objective, but they invariably were hobbled by the constraints of U.S. nonproliferation laws that treated India as a problem to be contained rather than as a partner to be engaged. Not surprisingly, these efforts, though admirable, always came to naught for the simple reason that it was impossible to craft a policy that simultaneously transformed New Delhi into a strategic partner on the one hand, even as it was permanently anchored as the principal nonproliferation target on the other. These prior American efforts, however, served an important purpose: They confirmed that trying to transform the bilateral relationship with India always would be frustrated if it was not accompanied by a willingness to reexamine the fundamentals on which this relationship was based.

To its credit, the Bush administration learned the right lessons in this regard. Recognizing that a new global partnership would require engaging New Delhi not only on issues important to the United States, the administration has moved rapidly to expand bilateral collaboration on a wide range of subjects, including those of greatest importance to India. The agreement relating to civilian nuclear cooperation, thus, is part of a larger set of initiatives involving space, dual-use high technology, advanced military equipment, and missile defense. Irrespective of the technologies involved in each of these realms, the administration has approached the issues implicated in their potential release to New Delhi through an entirely new prism. In contrast to the past, the President views India as part of the solution to proliferation rather than as part of the problem. He views the growth of Indian power as beneficial to the United States and its geopolitical interests in Asia and, hence, worthy of strong American support. And he is convinced that the success of Indian democracy, the common interests shared with the United States, and the human ties that bind our two societies together, offer a sufficiently lasting assurance of New Delhi's responsible behavior as to justify the burdens of requesting Congress to amend the relevant U.S. laws (and the international community, the relevant regimes).

In reaching this conclusion, the administration has—admirably—resisted the temptation of "pocketing" India's good nonproliferation record and its recent history of cooperation with the United States, much to the chagrin of many commentators who have argued that New Delhi ought not to be rewarded for doing what it would do anyway in its own national interest. On this question, too, the President's inclinations are correct: Given India's importance to the United States in regard to each of the issue-areas identified earlier in this chapter, reaching out to New Delhi with the promise of a full partnership is a much better strategy for transforming U.S.-India relations than the niggardly calculation of treating Indian good behavior as a freebie that deserves no compensation because New Delhi presumably would not have conducted itself differently in any case. On all these issues, President Bush has made the right judgment—after a hiatus of many decades—with respect to India and its importance to the United States. In that judgment lies the best hope for avoiding yet another unproductive sine wave in bilateral relations in this new century.

ENDNOTES - CHAPTER 8

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CHAPTER 9

INDIA-IRAN SECURITY TIES: THICKER THAN OIL

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This article examines the nature and extent of the Indo-Iranian relationship. Interest in this bilateral relationship piqued in the United States due to the policy debate surrounding the United States-India civilian nuclear agreement and the ever-deepening Iranian nuclear crisis. While it has become de rigueur to suggest that this relationship is centered on hydrocarbon politics, this article contends that the Indo-Iranian relationship has much more to do with India's great power aspirations and concomitant expansive agenda for Central Asia. This article concludes with some reflections on the limits of this relationship and the importance of India to international efforts to contain Iran.

Since the 1990s, Delhi and Tehran have sought to forge a robust and comprehensive relationship inclusive of energy and other forms of commercial cooperation, infrastructure development in Iran and beyond, as well as military and intelligence ties. These bilateral developments have enjoyed widespread support among Iranian and Indian polities. Despite extensive regional press coverage, Indo-Iranian rapprochement has drawn the attention of the United States only episodically and never as intensely as in 2006. Arguably, increased scrutiny of the Indo-Iranian relationship arose due to the temporal convergence of two unrelated developments: the ever-deepening Iranian nuclear crisis and the efforts of President George Bush to persuade the U.S. Congress to adopt legislation enabling a civilian nuclear deal for India. This deal was seen by many policymakers in India and the United States as an integral part of an overall suite of engagements to help India become a global power and a strategic U.S. ally.

Underscoring the interplay between these two developments, critics of the nuclear deal argued that it would weaken the nonproliferation regime at a time when it must be adequately robust to counter Iranian intransigence towards its nuclear program. Both opponents of the administration's proposed Indo-U.S. civilian nuclear deal and proponents of some variant of such a civilian nuclear deal questioned the "strategic and military" ties that New Delhi and Tehran have trumpeted to their domestic audiences.

India's votes at the International Atomic Energy Agency (IAEA) "against Iran" in September 2005 and February 2006 were important tests for those policymakers who were dubious about India's intentions. While India did vote for the resolutions finding Iran to be in non-compliance in September 2005 and later to refer Iran to the United Nations Security Council (UNSC) in February 2006, there were earlier signs that India would either abstain or even oppose the United States on these issues. Notably, India's foreign minister, Natwar Singh, declared in October

2005 that India would not support U.S. efforts to refer Iran to the UNSC, which outraged key members of the U.S. Congress.

Some policymakers and analysts questioned the wisdom of promoting India as the newly designated strategic ally of the United States while it has what both New Delhi and Tehran call a strategic alliance. (India—like many countries—maintains several bilateral relations that are "strategic" in name only.) Detractors of the nuclear deal voiced concerns about two Indian nuclear scientists (Y.S.R. Prasad and C. Surendar) who provided assistance to Iran's nuclear program. Both were eventually sanctioned by the United States under the Iran Nonproliferation Act of 2000, although sanctions on Surendar were eventually dropped. Some congresspersons were disconcerted by the second Indian-Iranian naval exercise that took place in March 2006—coincident with President Bush's visit to South Asia. While the U.S.-Indian civilian nuclear deal was finally signed into law by President Bush on December 18, 2006, the House and Senate tried—but failed—to require India to halt its fissile material production and/or end its military relations with Iran as preconditions for nuclear cooperation.

Throughout Congress' deliberation on the civilian nuclear deal, administration officials consistently downplayed Delhi's ties with Iran by reducing them to India's growing energy needs. Officials argued that the civilian nuclear engagement would diminish India's reliance upon Iran, or at least provide the opportunity for the United States to shape India's relationship with Iran.[1] Given the various apprehensions about the Indo-Iranian relationship in the context of the nuclear deal, the Congressional Research Service authored a report examining the extent of the relationship, ostensibly to put to rest some of these concerns. While acknowledging that some differences in preferred policy towards

Iran could emerge, that report too concluded that India's motivations to pursue relations with Iran were primarily rooted in India's growing energy needs and therefore are relatively benign to U.S. interests.[2]

This essay seeks to challenge the view that India's ties to Iran are primarily tied to hydrocarbon politics. Rather, this paper argues that the Indo-Iranian relationship has much more to do with India's great power aspirations and concomitant agenda to expand its presence in Afghanistan and Central Asia. This paper concludes with a discussion of the constraints that may limit the extent of Indo-Iranian engagement.

BACKGROUND ON THE INDO-IRANIAN RAPPORT

On March 15, 1950, New Delhi and Tehran signed a friendship treaty which called for "perpetual peace and friendship" between the two states. In principle, this document committed the two to amicable relations; however, in practice, both states were mired—albeit to differing extents at different times—in opposing Cold War alliances that precluded the development of robust bilateral ties. Iran, under the leadership of Muhammad Reza Shah, had close ties to the United States and Pakistan through Iran's participation in the Baghdad Pact (later renamed the Central Treaty Organization, CENTO). During the 1965 and 1971 wars between India and Pakistan, Iran provided military assistance to Pakistan. (Iran was part of Pakistan's purported "strategic depth.") Nehru derided such alliances as a "wrong approach, a dangerous approach, and a harmful approach"[3] and championed instead the Non-Aligned Movement. Despite this aversion to superpower alliances, India forged close ties to the Soviet Union, which became India's primary defense supplier.

Although India largely welcomed Iran's 1979 Revolution as an expression of national self-assertion, and although the post-revolutionary Iranian leadership was generally well disposed towards India, significant differences persisted between New Delhi and Tehran. Iran was more critical of the Soviet invasion of Afghanistan than was India. India, under Prime Minister Indira Gandhi, avoided public condemnation even though privately she was deeply vexed that Moscow brought superpower confrontation into India's extended strategic environment. During the Iran-Iraq War, India remained ambivalent as it tried to simultaneously protect its oil interests in both states. India, with its large Muslim minority, was chary of Iran's exporting its revolution and was discomfited by the fact that Iran, with clerical rule, had moved far away from democracy and espoused support for Kashmiri self-determination.[4] While the decades of the 1970s and 1980s witnessed tensions between the two, there were episodic but notable periods of positive engagement, and the two sustained economic ties during this period, particularly on energy issues.

Significant improvements in relations did not materialize until the end of the Cold War. One of the most consequential events in their shared recent history was Indian Prime Minister Narasimha Rao's 1993 state visit to Iran. Rao became the first Indian Prime Minister to visit Iran since the revolution, and his state visit was declared a "turning point" in bilateral relations by Iran's then-President Ali Akbar Hashemi Rafsanjani. In 1995, Rafsanjani made a reciprocal visit to India. While high-level visits continued after 1995—which did much to solidify in some measure their mutual economic interests in key technological sectors—the next state visit did not occur until 2001, when Prime Minister Atal Bihar Vajpayee visited Tehran. This visit culminated in the 2001 Tehran Declaration, signed by Prime Minister

Vajpayee and Iran's President Muhammad Khatami. The Tehran Declaration laid the foundation for Indian and Iranian cooperation on a wide array of strategic issues, including defense cooperation.[5]

Two years later, in January 2003, President Khatami traveled to Delhi, where he was welcomed as the "Chief Guest" at India's 2003 Republic Day celebrations—an honor generally reserved for the most important of personages. Both leaders signed the New Delhi Agreement, which was important both in its timing and substance. India's feting of Khatami, contemporaneously with both the U.S. military buildup in the Persian Gulf in preparation for the second U.S. war in Iraq and with an unprecedented qualitative and quantitative expansion in U.S.-Indian military ties, declared the importance that New Delhi attaches to its relationship with Iran. The New Delhi Declaration was also important in its substance. Expanding off of the Tehran Declaration, this accord further committed the two states to deeper levels of engagement, including military cooperation.[6]

INDIA'S STRATEGIC ENVIRONMENT

Indian analysts and defense managers often describe India's strategic environment in terms of the entire Indian Ocean basin. The westernmost frontier of this strategic area stretches to the Straight of Hormuz and the Persian Gulf. Occasionally, Indian analysts claim the eastern coast of Africa as the westernmost border of this strategic space. To the east, it encompasses the Strait of Malacca and abuts the South China Sea. To the north it is comprised of Central Asia, and to the south, it extends to Antarctica.

Within this extended strategic neighborhood, India first and foremost seeks to be recognized as the preeminent power within the Indian Ocean basin. New Delhi already considers itself to be the preeminent power of South Asia. India also seeks to be—and to be seen as—a global power in due course.[7] New Delhi believes that it has a natural role in shaping regional security arrangements to foster stability throughout the Indian Ocean basin and beyond. India's Ministry of Defence Annual Report 2005-2006, for example, notes the "slow but steady" progress made in achieving "a truly multipolar world, with India as one of the poles . . . ."[8] India is also willing to be proactive to prevent developments that are fundamentally inimical to its interests by relying upon two instruments of India's "soft" power: its economic and political sources of influence.[9]

Consonant with New Delhi's expansive set of interests within the entire Indian Ocean basin, India has pursued actively a "Look East" policy and has maintained a very sophisticated greater Middle East policy that includes Israel, Iran, and several Central Asian and Arab states. Of particular import for this discussion is India's continuous effort to consolidate its strategic footing in Afghanistan and other parts of Central Asia, including two airbases in Tajikistan. Iran is critical to these efforts in many ways, because it provides India much-needed geographical access to these theatres.[10] In addition, since 2001, India has secured an unprecedented expansion in ties with the United States and has advanced its relations with the European Union and China. Regarding its varied dealings with countries that have outstanding conflicts with each other, India has consistently signaled its intentions to maintain its "strategic independence" by pursuing bilateral relations consistent with Delhi's regional requirements—irrespective of discord that these states may have with each other.

In recent years, India has sought to demonstrate that its security calculus is more inclusive than Pakistan both to counter the once-prevalent view that India is shackled to Pakistan and to establish India as an important power beyond the perimeters of South Asia. In short, India wants to be a supra-regional power, and it wants to be seen as one in other capitals. Central Asia, which includes Afghanistan along with Iran, comprises an important theater for this power projection, and only some of India's interests in Central Asia are Pakistan-focused. India sees enormous energy potential in the region. India is currently the world's sixth largest energy consumer, with more than half of its electricity production based upon coal.[11] In 2003, India produced 33 million tons (mt) of crude oil; it imported 90 mt—or 73 percent of its total requirement of 123 mt.[12] Some analysts believe that by 2020, India may become the fourth largest consumer, following only the United States, China, and Japan.[13] India hopes that it can diversify its energy sources and Central Asia, with 2.7 percent of the world's confirmed oil deposits and seven percent of the world's natural gas deposits, has long figured imminently in these plans.[14] India also sees Central Asia and Iran as enormous potential consumer markets for Indian products as well as its human capital and manpower. Militarily and strategically, Central Asia is an important area for Indian presence, at least in part to deny Pakistan the "strategic depth" it craves.

Iran Matters.

India needs Iran to achieve its varied objectives in Central Asia. Iran, for its part, sees a tremendous complementarity of interest with India. Both states seek to undermine unipolarity, and both states are uncomfortable with the role that the United States has played and will likely continue to play in the Middle East—despite the fact that both states have very different relations with the United States.

Both Iran and India share concerns about the domestic security situation in the Central Asian states, fear a recrudescence of [Sunni] Islamist power in Afghanistan and elsewhere, and are wary of the multitude of security threats that Pakistan poses to the region and beyond. Iran and India are both optimistic about the commercial benefits of Central Asian markets and hope to share the spoils of the North-South Transit Corridor. Iran will require massive infrastructure investments to extract maximum benefits from this corridor, and India is lined up to provide cost-effective intellectual and material assistance in the development of information technology networks, ports, roads, and rail projects. Both India and Iran see tremendous value in military cooperation, even if to date, few large-scale military interactions have taken place.

Finally, Tehran and Delhi derive benefits from their relationship domestically and internationally. India continues to confront communal conflict between its varied Muslim and Hindu communities. Close ties with Iran and a diverse array of other Muslim states (including states with important Muslim minorities) help diminish some Muslims' fears at home and abroad that India has become Islamophobic. These perceptions have been galvanized by, inter alia, India's recent efforts to promote a tripartite relationship with the United States and Israel to combat Islamist terrorism, the rise of Hindu nationalism, and the episodic but sanguineous incidents of anti-Muslim violence (such as the Gujarat massacres of Muslims in 2003 and the anti-Muslim riots following the destruction of the Babri Masjid in late 1992 and early 1993).[15] Such ties also help circumvent Pakistan's efforts in multilateral fora (such as the Organization of Islamic Countries) to raise the issue of Kashmir.

Iran, for its part, needs a partner like India with a sophisticated and complex set of international relations. This is at least in part because of Iran's increasing isolation as a result of the 2005 election of the hardliner president Mahmoud Ahmadinejad and Iran's unrelenting intransigence on the nuclear issue. While the U.S. position towards Iran began to harden in 2002, members of the European Union were at odds with the United States. This has changed, with members of the European Union increasingly espousing similar positions to that of the United States. After months of negotiations, the UNSC voted unanimously to impose sanctions in December 2006 for Iran's refusal to halt uranium enrichment.

While Indo-Iranian relations were strained by India's votes at the IAEA in September 2005 and February 2006, ultimately India's actions demonstrated Delhi's ability to finely balance its need for Tehran with its interest in securing its ties to the United States and the international community. At a time when Iran's regime has many vociferous detractors, India has remained an equally vocal defender of both Iran and its relationship with Iran. Notable in this regard was the February 2007 visit to Iran by India's Foreign Minister Pranab Mukherjee, amid heightened U.S.-Iranian discord and increasing evidence of Iranian involvement in Iraq.[16]

While many non-Indian observers focused on the simple fact that India voted "against Iran," Indian officials consistently explained its actions at the IAEA to domestic and Iranian audiences alike that India went to great lengths to help Iran during the various IAEA standoffs. Indian officials dilated upon the fact that India worked assiduously to ensure that the United States, France, Germany, and Britain did not "ride roughshod over Iranian interests" and lobbied the Europeans to amend their 2005 resolution, which called for an immediate referral to the UNSC. Following the February 2006 vote to refer Iran to the UNSC, Indian Prime Minister Manmohan Singh explained this decision in terms of helping to provide diplomatic solutions to the impasse and encouraging all parties to eschew confrontation and inflexibility.[17] While it is likely that Indian interlocutors are correct to suggest that Iran's situation could have been direr without Indian intervention, it is unclear that Iran sees the Indian role in this way. India's involvement in the Iran nuclear impasse also afforded it an interesting opportunity to demonstrate leadership on an issue on which it has a unique perspective.

INDO-IRANIAN RELATIONSHIP

In Structure.

The first institutional mechanisms established to guide Indo-Iranian relations is the "The Indo-Iran Joint Commission," which was established in 1983. This commission convenes at the foreign ministerial level to discuss and review progress made on economic issues. A second major milestone in the institutionalizing of the relationship was the signing of the Tehran Declaration. Signed by Iran's President Khatami and India's Prime Minister Vajpayee during the latter's April 2001 visit to Tehran, this accord focused heavily upon energy and commercial concerns, including a commitment to accelerate the development of a gas pipeline and the finalizing of an agreement by which Iran would provide India with liquefied natural gas (LNG). This agreement also reaffirmed their commitment to develop the North-South Corridor and to encourage their commercial sectors to utilize this corridor. They also agreed to promote scientific and technical cooperation.[18]

One of the important mechanisms that emerged from the 2001 meeting was the India-Iran Strategic Dialogue. The first such meeting was held in October 2001 and was convened by India's then-foreign secretary, Chokila Iyer, and by Iran's deputy foreign minister for Asia and the Pacific, Mohsen Aminzadeh. That first meeting focused on three major areas of mutual concern: first, regional and international security perspectives; second, the security and defense policies of India and Iran; and third, issues related to the international disarmament agenda. This body subsequently met four times, the last time being in May 2005. That meeting, convened by Aminzadeh and Undersecretary of Indian Ministry of External Affairs Rajiv Sigri, focused heavily on gas pipelines and upon a bilateral agreement for LNG.[19]

The most recent and arguably most substantial set of frameworks guiding Indo-Iranian relations is the January 2003 New Delhi Declaration, penned during President Khatami's visit to New Delhi, along with seven additional Memoranda of Understanding.[20] This document built and expanded on the 2001 accord. It focused upon international terrorism and the shared position that the Iraq situation should be resolved through the United Nations. Both states expressed an interest that they should pursue enhanced cooperation in the areas of science and technology, including: information technology, food technology, and pharmaceutical development and production. Some reports also suggest that space advancements (for instance, satellite launch) were discussed, although there is no such mention of them in the actual accord.[21] The enduring mainstays of the engagement—hydrocarbon and water issues—and mutual interests in exploring education and training opportunities also figured prominently. Both concurred that there should be close cooperation on efforts to reconstruct and rehabilitate Afghanistan.[22]

One of the key instruments signed during Khatami's 2003 visit was the "Road Map to Strategic Cooperation." This document follows the New Delhi Declaration closely and establishes a targeted framework for fulfilling the objectives set forth by the Declaration. The key areas mapped out include concrete steps on oil and gas issues (such as the ever-challenging pipeline project), the commitment to expand non-hydrocarbon bilateral trade and other forms of significant economic cooperation, and the joint effort to further develop the Chahbahar port complex, the Chahbahar-Fahranj-Bam railway link, and the Marine Oil Tanking Terminal. Perhaps the most controversial commitment spelled out included more robust defense cooperation between the two.[23] The document committed both sides to exploring political dialogue and modalities of cooperation on issues of strategic significance through the mechanisms of the Indo-Iran Strategic Dialogue, foreign office consultations, and the institutional interaction of both national security councils.

In Substance.

Energy and Commercial Interests

As reflected in the 2001 Tehran Declaration and the 2003 New Delhi Declaration, India and Iran want to move ahead on commercial and energy issues. Iran has the third largest reserve of oil, with proven reserves of nearly 132 billion barrels.[24] Iran also has the second largest proven reserve of gas with 971 trillion cubic feet.[25] Iran is anxious to get its hydrocarbons out of the ground and into new markets, and energy-hungry India wants to be such a market. India is not alone in seeking Iran's oil and gas. China, India's long-term strategic peer with exacting energy demands, seeks Iranian and Central Asia resources, and this need for energy resources will become yet another theater of competition for these two Asian giants.

However, progress on the energy relationship has been slow in developing. Currently, Indian crude oil imports from Iran range between 100,000 and 150,000 barrels per day (bpd), accounting for about 7.5 percent of India's total crude oil imports (around two million bpd).[26] India also seeks to obtain natural gas from Iran via the much-disputed "pipeline" by transporting gas from Iran to India via Pakistan. India and Iran also have ostensibly "finalized" a $22 billion deal whereby Iran will supply five million tons of LNG to India each year. The deal was signed by India's GAIL (Gas Authority of India Limited) and Iran's NIGEC (National Iranian Gas Export Company), a subsidiary of the National Iranian Oil Company (NIOC). According to this agreement, LNG will be supplied over a 25-year period, commencing from 2009, at a price of U.S. $3.21 per Million British Thermal Units (MMBTU).[27]

Due to the fact that Iran lacks the capability to produce LNG, India's GAIL has committed to help construct an LNG plant in Iran. However, industry analysts are doubtful that Iran will obtain such a capability any time soon. First and foremost, American components are generally necessary for such plants, and the United States will not provide Iran such components. To date, no LNG terminal has ever been built without any American-made components, and most LNG plants use processes developed by U.S. companies. Needless to say, should GAIL proceed with these plans, it could run afoul of the Iran-Libya Sanctions Act (ILSA), which requires sanctions on yearly investments in excess of $20 million in Iran's energy sector.[28]

India and Iran continue to make progress on their commitment to build a North-South Corridor with Russia. Russia, Iran, and India signed this agreement (called the Inter-Governmental Agreement on International "North-South Transport Corridor") in September 2000 in St. Petersburg. Since this corridor is a part of an Indo-Iranian initiative to facilitate the movement of goods across Central Asia as well as Russia, both India and Iran entered into an earlier trilateral agreement with Turkmenistan in 1997. This North-South Corridor permits the transit of goods from Indian ports to Iran's port of Bandar Abbas, or hopefully Chahbahar. Goods transit Iran via rail to Iran's Caspian Sea ports of Bandar Anzali and Bandar Amirabad. They are then transferred to ports in Russia's sector in the Caspian. From there, the route extends along the Volga River via Moscow and onward to northern Europe. This is intended to serve as an alternative cargo route, linking Indian products with Russia through the Baltic ports of St. Petersburg and Kotka in Rotterdam or through the Ukrainian Black Sea ports of Illychevsk and Odessa to connect to the Mediterranean. With a length of only 6,245 km, it is an enormous improvement over the 16,129 km route through the Suez Canal and the Mediterranean. Indian officials are very enthusiastic about this route, because it will reduce the logistics of moving goods and diminish travel time and transport costs. Trial runs began in early 2001, with some 1,800 freight containers moving through it; officials expected those figures to rise by the end of 2002. According to early reports in 2002, officials expected the corridor to handle 15 to 20 million tons of freight at $10 billion per year.[29]

As a part of this agreement, India agreed to help expand the Iranian port of Chahbahar and lay railway tracks that would connect Chahbahar to the Afghan city of Zaranj. Iran hopes that expanding Chahbahar will relieve some of the congestion of Bandar Abbas. Part of the concern that emanates from this activity is the ambiguity about what kind of facility or facilities will materialize at Chahbahar. Currently, India claims that this will be a commercial port. However, others in the region—such as Pakistan and China—fear that once it is complete, Indian naval vessels will have a presence there. These apprehensions are important and may affect the Chinese and Pakistani planning at Pakistan's Gwador port. The Gwador port lies along Pakistan's Makran coast, only a few hundred kilometers from Chahbahar. Gwador is being modernized and expanded with Chinese capital, and it is hoped that this port will diminish Pakistan's vulnerability to a naval blockade of its major port in Karachi. It has added importance in light of purported Indian and Iranian activities at Chahbahar.

India has also committed to upgrading the 215-kilometer road that links Zaranj and Delaran as part of a circular road network that will connect Herat and Kabul via Mazar-e-Sharif in the north and Kandahar in the south. This would permit Indian goods to move into Afghanistan via Delaran and beyond. This initiative to expand trade into Afghanistan is part of a trilateral agreement that was signed with Afghanistan in January 2003. This agreement permits Afghan exporters to use Chahbahar with a 90 percent reduction on port fees and a 50 percent saving on warehousing charges. Afghan vehicles are also given full transit rights on the Iranian road system.[30]

Business delegations have played an important role in consolidating business ties between the two countries. Khatami's 2003 delegation to New Delhi included a 65-member business group, and they weighed some $800 million in joint ventures that would involve 400 Indian and Iranian companies. India's Ministry of External Affairs contends that Indian investment was sought in Iran's automobile, information technology (IT), and textile sectors, and it was agreed that India could provide Iran with commodities such as sugar, rice, pharmaceuticals, food oils, and engineering goods. Both sides made a concerted effort to push non-oil trade. One of the means by which this is going forward is the Joint Business Council set up by the Indian Chambers of Commerce and Industry and the Iran Chamber of Commerce, Industries, and Mines.[31] Overall, the trade picture appears to be positive: The total value of all trade for the fiscal year ending March 2005 was $1.6 billion, compared to $1.18 for 2003-2004 and $913 million in 2002-2003. While this represents a growth trajectory, the total trade between the United States and India in 2005 was about $27 billion.[32]

Defense and Intelligence Ties?

While these two states have been talking about "strategic relations" for some time with few concrete results, the last few years have witnessed ostensibly substantive advances. India and Iran also established a joint working group on counterterrorism and counter-narcotics, reflecting their mutual security concerns in these functional areas. Moreover, as noted, they have instituted a strategic dialogue that has met four times between October 2001 and early 2007. This dialogue is the forum designed to explore opportunities for cooperation in defense in agreed areas, including training and exchange visits consonant with the commitments articulated in the 2003 New Delhi Declaration. Some analysts claimed that the agreement would boost Indian armament exports to Iran, a view that is shared by Iranian analysts as well.[33] Notwithstanding those assertions, such exports have not occurred, and they are not likely in the near future.

According to some analysts, Iran hopes that India will provide expertise in electronics and telecommunications as well as upgrades for many of its legacy Russian weapons systems.[34] While little in this regard has materialized, there have been various and consistent reports of specific military deals between India and Iran. In 2001, Indian Defense Secretary Yogendra Narain met with his Iranian counterpart Ali Shamkani to explore arm sales to Iran.

According to the Indian press, India has trained Iranian naval engineers in Mumbai and at Visakhapatnam. Reportedly, Iran is also seeking combat training for missile boat crews and hopes to purchase simulators for ships and subs from India. Iran also anticipates that India can provide midlife service and upgrades for its MiG-29 fighters and retrofit its warships and subs in Indian dockyards. India helped Iran develop batteries for its submarines, which are more suitable for the warm-weather gulf waters than those supplied by the Russian manufacturer. Some analysts claimed that Iran wanted Indian technicians to refit and maintain Iran's T-27 tanks as well as its BMP infantry fighting vehicles and the towed 105 mm and 130 mm artillery guns. India is also planning to sell Iran the Konkurs anti-tank missile.[35] There were several reports of a bilateral accord that would permit India to access Iranian military bases in the event of war with Pakistan. This accord allegedly would also permit India to rapidly deploy troops and surveillance platforms as well as military equipment in Iran during times of crisis with Pakistan. If true, this is a turning point in regional relations and one that will, in principal, put Iran in opposition to Pakistan. These same reports claim that Indian and Iranian troops will conduct combat training, and naval forces will conduct "operational and combat training on warships and missile boats."[36]

There has been some activity in the naval sphere; the two navies carried out their first joint naval maneuvers in the Arabian Sea in March 2003. This exercise was likely motivated at one level by the mutual concern about the security of sea-lanes of control and at another level by their discomfort with the increasing presence of the United States in the Persian Gulf in preparation for the invasion of Iraq. This 2003 naval exercise was notable because it both coincided with the mounting U.S. military presence in the Persian Gulf and Arabian Sea, and because among the burgeoning U.S.-Indian defense ties, the U.S.-Indian naval relationship has been the most dramatic in its depth and breadth.[37]

India and Iran conducted their second naval exercise on March 3-8, 2006, overlapping with President Bush's trip to Afghanistan, India, and Pakistan. There has been considerable acrimony over the precise nature of this engagement. According to a March 27, 2006 article published in *Defense News*, this naval engagement took place in Kochi and involved the IRIS Bandar Abbas (a fleet-supply-turned training vessel) and the IRIS Lavan, an amphibious ship. A spokesman for the Indian Navy's Southern Command reportedly explained that Indian naval instructors briefed nearly 220 sailors. The exercise, coming at a time when Congress was being asked to consider a civilian nuclear deal with India, antagonized critics of the deal. Indian and U.S. government officials have been busy, first denying the visit took place and next dismissing the characterization of the visit as exaggerated. Both U.S. and Indian officials deny that any "training" took place and that this was a standard port call.[38]

To focus merely on the substance (or lack thereof) of that particular exercise is to miss the larger picture of Indo-Iranian naval ties as described by Indian analysts. Recently, a senior fellow with India's Observer Research

Foundation described Indo-Iranian maritime relations in the following way:

> India and Iran have enjoyed good maritime relations that include high-level political and military visits, joint-naval exercises, naval technology cooperation, and maritime infrastructure developments symbolized by port development in Chahbahar. Naval cooperation between the two sides dates back to the mid-1990s when the Indian Navy helped the Iranian Navy to adapt four Russian-built Kilo-class submarines for warm water conditions in the Persian Gulf.[39]

Another important aspect of that naval visit was its timing and symbolism. As noted, it was concurrent with President Bush's visit to South Asia, during which President Bush agreed to deliver to India a path-breaking civilian nuclear deal that required legislative action by Congress and concomitant review of the deal and its implications. Indian officials correctly noted that the naval exercise was months in the planning. While this is surely true, it is equally true that the Bush visit was also months in the planning. The naval exercise—particularly one as unimportant as officials indicate—could have been postponed. Given the symbolic importance of such an exercise, the conduct of the exercise signaled to Tehran that India's foreign policies would not be dictated by Washington.[40]

Numerous analysts of South Asia infer that there are close security ties between Delhi and Tehran because of the Indian consulate in Zahedan with a likely intelligence presence there. India also established a consulate in Iran's port city of Bandar Abbas in 2001, which will permit India to monitor ship movements in the Persian Gulf and the Strait of Hormuz.[41] From a regional security point of view, the volume of defense trade, measured in dollars, may be less relevant than the kind of activities that appear to be ongoing, many of which may be more qualitative in nature. The presence of Indian engineers at Chahbahar and of Indian military advisors and intelligence officials in Iran confers to India a significant access to Iran. This access has tremendous import for India's ability to project power vis-à-vis Pakistan and Central Asia. It clearly provides India an enhanced ability to monitor Pakistan and even launch sub-conventional operations against Pakistan from Iran. Of late, numerous Pakistani officials opine that India is supporting the insurgency in Pakistan's troubled Baluchistan province and is exploiting its position in Afghanistan to enhance its intelligence activities against Pakistan. Pakistani observers also note that the presence of Indian engineers (and perhaps naval personnel in the future) at Chahbahar has particular utility for monitoring what is happening at Pakistan's Gwador port.

Technical Areas of Cooperation

It is clear that India has cooperated with Iran on civilian nuclear programs in the past. India sought to sell Iran a ten-megawatt research reactor to be installed at Moallem Kalyaeh in 1991, and may have also considered selling Iran a 220-megawatt nuclear power reactor. While both were to be placed under IAEA safeguards, the United States pressured India not to go through with the sales, fearing that Iran would use these facilities to make weapons-grade fissile materials.[42]

The issue of nuclear cooperation again emerged in October 2004, during a discussion between then President Khatami and India's late national security advisor, J.N. Dixit, in Tehran. Topics of discussion included regional security as well as economic and energy cooperation. Iran reiterated its commitment to cooperate with the IAEA and the Indian side confirmed, "New Delhi would always support Tehran's peaceful use of nuclear technology."[43] Controversy arose over reports of two Indian nuclear scientists, Y.S.R. Prasad and C. Surendar, who took assignments to provide technical assistance to Iran's nuclear program. Both served as chairman and as managing director of the Nuclear Power Corporation of India Limited (NPCIL). The United States imposed sanctions upon them in September of 2004 under Sections 2 and 3 of the Iran Proliferation Act (INA) of 2000. India objected to such sanctions and countered that Surendar had never visited Iran while in service or after his retirement, and Prasad's visits and consultancy services were provided under the aegis of the IAEA. Ultimately, sanctions remained against Prasad, while those against Surendar were dropped.[44]

Reports of Indo-Iranian space cooperation also galvanized small pockets of opposition to the "other Indo-U.S. deal" on space cooperation, presumably out of concern that U.S. technologies could find their way into the hands of Iranian scientists. Such critics note that Iran is interested in expanding its nascent space and satellite program, and this will require a variety of dual-use items that could assist Iran's missile development program and improve satellite capabilities.[45] Late in February 2003, the *Times of India* reported "India and Iran have an ongoing co-operation in space research," and quoted remarks of the managing director of Iran's ComKar System Communications, who claimed that his organization "already cooperates with ISRO (Indian Space Research Organization)." Unfortunately, little information is available about the nature of the cooperation or even if the cooperation really was "space cooperation" rather than more mundane communications-related projects.[46]

CONCLUDING THOUGHTS ON CONSTRAINTS AND IMPLICATIONS

Constraints.

While Iran is important to India, there are constraints that restrict India's reach into Iran—even if they are fewer than in the recent past. Until circa 2004, both the United States and Israel counseled India to minimize defense, energy, and strategic relations with Iran.[47] However, by 2005, officials from the Bush Administration expressed confidence that the relationship does not adversely affect major U.S. interests.[48] Whether this attitude will persist within the newly elected and Democrat-led U.S. Congress remains to be seen. Many in Congress will be watching India closely as the confrontation with Iran continues to intensify.[49]

As for Israel, Ariel Sharon expressed apprehension about India's ties with Iran during his 2003 visit to India, even though he eventually said he was satisfied with India's explanation of its relations with Iran. However, Israel again raised the issue during the Indo-Israeli Joint Working Group on Counterterrorism in November 2004.[50] Whether or not Israel currently shares the U.S. insouciance is difficult to assess, but Israel's concerns will remain salient for New Delhi, because Israel is India's largest arms supplier. Defense cooperation between India and Israel has expanded since official normalizations of relations in 1992 and includes sales of large weapons systems and extensive military training.[51]

Both India and Israel have considerable expertise in providing maintenance and upgrades for legacy Russian weapons platforms. As such there is an explicit symmetry between the kinds of defense-related services that Israel has furnished to India and the kinds of services that India seeks to provide to Iran and other Central Asian states. Israel has helped India with avionics upgrades with its MiGs, and in turn, India hopes to provide similar services to countries throughout the region. Thus Israel has good cause for unease, and India is not insensitive to this discomfiture. Consequently, Israeli equities will remain a part of New Delhi's decision calculus vis-à-vis Iran for the policy-relevant future and will serve as an important impediment to India's efforts to engage Iran.

As the Iran standoff continues and as the global consensus coalesces around sanctioning Iran, India's cooperation in maintaining that isolation will become increasingly important. Some of India's planned investment to help Iran acquire an LNG capability will likely run afoul of U.S. law and will undermine U.S.-led efforts to constrain and even punish Iran. While no one doubts that India prefers an Iran without nuclear weapons, India has signaled little intention to sacrifice all that hinges upon Iran. Now that India has secured a civilian nuclear deal with the United States, it remains to be seen whether Delhi will contribute to these important efforts. Some lawmakers such as the new Chairman of the House Foreign Affairs Committee, Tom Lantos, have already expressed such doubts in the wake of Mukherjee's 2007 visit to Tehran.[52]

Despite the Bush Administration's explicit forbearance on the Iran factor, Indian strategists and policymakers ultimately understand that U.S. patronage is likely necessary for it to achieve all that it aspires. In the past, India reasonably had few hopes to believe that the United States could or would support India's bid for great power aspirations and instead saw the United States as niggardly seeking to restrain India from assuming its rightful global role. Under such perceived conditions, it behooved India to hope for the best with respect to the United States while diversifying its options and cultivating ties with other important countries. India now has much greater expectations from its relationship with the United States and will tread carefully to preserve it.

ENDNOTES - CHAPTER 9

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Detail&id=884&&prog=zgp&proj=znpp,zsa,zusr.

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40. Tom Lantos in particular was disturbed by the exercise and opined that ". . . in order to become a strategic ally of the United States . . . India must recognise some basic facts, specifically some facts with respect to Iran: It is a terrorist state whose current

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CHAPTER 10

WILL INDIA BE A BETTER STRATEGIC PARTNER THAN CHINA?

Dan Blumenthal

The Joint Declaration signed on July 18, 2005, by President George W. Bush and Indian Prime Minister Manmohan Singh has been heralded in some quarters as the equivalent of President Richard Nixon's opening to China. America agreed to recognize India as a "responsible state with advanced nuclear technology" and pledged to support its civilian nuclear program and urge others to do the same. This agreement caught observers in the strategic community and Congress by surprise. Even supporters of closer relations with India had a difficult time understanding why the United States made a seemingly large concession on nonproliferation rules in exchange for a vague exchange of Indian support to help the United States combat HIV/AIDS, support those countries that seek a "U.S.-India Global Democracy Initiative," and otherwise support India's economic development in a number of areas—there simply seemed to be too little Indian *quid* for the American *quo*.

The opening to China under President Nixon and National Security Advisor Henry Kissinger provides some illumination on the current attempts to negotiate a "strategic partnership" with India. In both cases, expectations ran high as to what the two countries might accomplish in a new partnership. Both "openings" also were informed by an underlying strategic logic.

In the case of China, Nixon and Kissinger hoped to accomplish a strategic triangulation—an improvement of relations with both the Soviets and the Chinese at a time when the two were at the height of hostility. In so doing, the American government would create more options for itself in its great power game with Moscow. In addition, Nixon and Kissinger strongly believed that China could help ease America's exit from the Vietnam War, and even enlisted Beijing's help in brokering a political deal in Vietnam.

But the relationship did not turn out as planned by its creators. China is prospering and no longer a Maoist state that is a declared enemy of the United States. However, American policymakers increasingly are concerned that a rich, strong, yet still authoritarian China increasingly will pose security challenges to Washington. Indeed, though it always uses diplomatic and coded language, Washington now views China as a long-term strategic competitor. The U.S. *National Security Strategy* talks of "hedging" against China, the 2006 *Quadrennial Defense Review* names China as the only country that competes militarily with the United States and points at ways that Washington will try to maintain its strategic supremacy.[1] America's China policy since the end of the Cold War has been to help Beijing become richer and stronger, hoping that it would become democratic, and its rise would be peaceful. Washington premised its economic and technology policy on this belief. Now, uncertain about China's strategic intentions, America fears it may have helped create a strategic competitor.

Today, as Washington changes its India policy, it finds itself confronting a host of geopolitical challenges. On the one hand, it is engaged in a long global counterinsurgency against radical Islamic terrorists. On the other, a rising China will pose a long-term challenge so long as it defines its core interests as incompatible with those of America. In both cases, America must enlist allies to secure its interests and sustain the U.S.-led world order that has been the basis of global economic development and relative peace for over 60 years. And in both cases, American strategists believe that the ultimate solution lies in the eventual democratization of the regions and countries that pose these overriding threats.

India may prove a partner in confronting both of these challenges. First, as a liberal democratic country, Delhi accepts the notion that the more democracy spreads, the safer Indians will be. Second, India has been one of the foremost targets of jihadi terrorist attacks and shares an interest with Washington in bringing them to an end. Third, China has been a historic rival to India, and China's growing power is viewed in Delhi with much apprehension. India shares an interest with Washington in maintaining a balance of power in Asia that ensures that China will not predominate.

However, India is a rising power with its own aspirations. Though it likely will not challenge U.S. hegemony in Asia in the short term, neither will it necessarily accept a hegemonic America in perpetuity. The fact that India is a liberal democracy will help the two countries develop necessary accommodations with less suspicion and tension than characterize the Sino-American relationship. But India's path to power will be a long and bumpy one as it works out its place in the region and the world. The legacy of a "nonaligned" foreign policy and fiercely independent strategic culture will make the prospects for strategic partnership more difficult.

India's desire to maintain good relations with problematic countries along its periphery, including

Iran, should worry American policymakers. Though the Indo-American relationship has more potential than the Sino-American one, Beijing and Washington had an agreed-upon threat to focus their efforts. In contrast, Washington's biggest threat today is jihadi terrorism and the proliferation of weapons of mass destruction (WMD); Iran plays a big part in both. But India does not view Tehran as a threat. In addition, Delhi sees much of its strategic environment through the lense of its tension with Pakistan, while Islamabad is a necessary American partner in the war on terror. India will continue to modulate its nuclear policy in accordance with its competition with Pakistan and Pakistan's primary nuclear backer in Beijing. This, too, is cause for caution, as the nuclear equation in Asia is changing fast and is difficult to control.

The most persuasive argument for a new kind of relationship with India is not that today the two countries can cooperate as full partners the way Washington does with Australia, the United Kingdom, and increasingly with Japan. Rather, it is that India's power is rising, and that rise will change the geopolitical landscape profoundly. Because of India's *potential* to play a productive role internationally, America has a strong interest in assisting and influencing that rise.

It is with this strategic logic in mind that this chapter turns to the comparison between America's two big "openings" and tries to distill lessons for how to proceed with India in a fashion that will not end up harming Washington's interests. This chapter assumes that the way countries enter into negotiations governs long-term relations—expectations can be made too high or too low; governments can oversell to their publics; and decisions made on seemingly trivial matters can take on lives of their own as bureaucratic constituencies form to perpetuate narrow polices that conflict with larger, evolving goals. This chapter finds that America risks misperceiving Delhi's long-term intentions, and has not sufficiently hedged against a series of risks in its new relationship with Delhi, namely, India's ongoing partnership with Iran and its approach to strategic weaponry.

U.S. AND CHINA: LESSONS LEARNED?

1972: The Opening.

Before his historic trip to China, President Nixon jotted down notes that would guide his negotiation posture. In one category, he listed what America wants: "1. Indochina? 2. Communists—to restrain Chicom . . . expansion in Asia; and 3. In Future--reduce threats of confrontation with Chinese superpower." He then listed China's goals: "1. Build up their world credentials; 2. Taiwan; and 3. Get the United States out of Asia." A third list contained "What we both want: 1) Reduce danger of confrontation; 2) A more stable Asia; 3) A restraint on the Union of Soviet Socialist Republics (USSR)."[2]

Nixon and Kissinger believed that America had much to gain from working toward a normalization of relations with China and hoped that an American thaw in relations with both the Soviets and the People's Republic of China (PRC) would allow Washington to play one off the other and improve its strategic position relative to both. Nixon and Kissinger's original formulation was an equal and simultaneous thaw—only later did the relationship with China take on an overt anti-Soviet cast. The United States was in an intense strategic competition with both the Soviets and the Chinese at the same time, and many strategists viewed China as the more intense rival.[3]

Nixon also thought that improving relations with the Chinese could defuse the Sino-American rivalry, particularly with respect to Chinese support of Communist insurgencies in Southeast Asia. And Nixon and Kissinger thought Washington could secure Beijing's assistance in brokering a peace deal in Vietnam and thus allow the United States to exit the war "with honor."

It was clear to both men that the price for a diplomatic breakthrough would be major concessions on Taiwan, with which America had a treaty alliance and a long-standing partnership. Besides retaking Taiwan, Beijing also wanted to enhance its international status, and by 1978, as President Jimmy Carter and National Security Advisor Zbignew Brzezinski negotiated the terms of normalization, to grow its economy, modernize, and become a great power.

Nixon and Kissinger pursued the China opening against the backdrop of domestic political competition. Democratic Senator Edward Kennedy, the politician most feared by Nixon as a presidential contender, called for recognition of China at the United Nations (UN) and the drawdown of U.S. troops from Taiwan. Beijing played American politics skillfully, advantaging their diplomatic jockeying by sounding out Kennedy as well as other presidential contenders such as Ed Muskie and George McGovern about traveling to China.[4]

Kissinger went to China in 1972 in a climate of domestic political pressure, and highly desirous of a diplomatic coup. He thus prepared to makes concessions on Taiwan beyond what had been planned originally. At the outset of discussions, he told Premier Zhou Enlai that America would not support: 1. two Chinas, one

Taiwan and one China; or 2. an independent Taiwan. Pocketing those concessions, Zhou indicated that the talks could proceed.[5]

Kissinger made another rather extraordinary concession: He told Zhou Enlai that the United States would tell China about any Soviet-American understanding that would affect Chinese interests, and share sensitive intelligence on Soviet troop deployments.[6] Beijing obviously was receptive, as Soviet troops had amassed on China's borders, the two had engaged in intense border clashes throughout the late 1960s, and the Soviets were threatening to destroy China's nuclear facilities.

During Nixon's follow-up trip, he reiterated Kissinger's assurances on Taiwan, confirmed Kissinger's assurances on the Soviet Union, promised to help restrain Japan's influence over Taiwan, and agreed to collaborate with China on India—a signal that the United States and China thereafter would be two poles in the Asian power structure. Moreover, the President and his National Security Advisor established a pattern of relations with China that their successors would continue: Nixon and Kissinger made more concessions than they had intended during meetings with Chinese leaders and conducted much of their work in secrecy, fearful that a skeptical public would not support the private concessions that they were making. And, as the talks progressed, the Americans felt the need to provide the Chinese with carrots—mostly in the form of important technology—to ensure that the "the process would not be derailed."[7]

While the opening to China was governed by a power strategic logic—especially more maneuverability for the United States in its relations with the Soviets and an end to a "two front" Cold War—the bureaucratic and political pressures felt by the chief American protagonists resulted in less than optimal outcomes. The United States gave much more on Taiwan than they had wanted or arguably needed, changing from a promise of a drawdown of troops to a private acceptance of the Chinese position. And the Chinese, who had more to fear immediately from the Soviets than the United States, received a powerful assist against that threat. The power gap between the two was tremendous—China was still an impoverished country with a gross domestic product (GDP) per capita of $129 and the bulk of its citizens living in poverty.[8] The United States was one of two superpowers with a GDP per capita of $19,371. The reality of this power differential meant that the United States would carry China along, and Washington had to exaggerate China's importance to sell the relationship as a partnership.

1979: The Normalization.

Under President Carter and Brzezinski, the new China policy took a more overtly anti-Soviet cast. Brzezinski arranged for the Chinese to purchase advanced weaponry from Western Europe and for detailed policy and intelligence briefings for the Chinese on Soviet capabilities and intentions by defense officials. Carter allowed his Department of Defense (DoD) to lay the groundwork for direct military sales and the easing of export controls on "dual use" items that would benefit the Chinese military.

During his May 1978 trip to China, Carter also accepted China's terms on Taiwan to set normalization talks in motion. There would be no official U.S. Government presence on the island. This was a far cry from Nixon's earlier formulation that the United States simply would drawdown its forces on the island.[9] At Beijing's urging, Brzezinski also secured Carter's agreement to hold off on normalizing relations with Vietnam and to announce the normalization before the Strategic Arms Limitations Talks (SALT II) with the Soviets, much to the consternation of Secretary of State Cyrus Vance. Vietnam promptly signed a treaty with the Soviets, and diplomatic normalization with the United States would have to wait some 17 years.

This was a significant victory for Beijing, given that the People's Liberation Army (PLA) was planning on striking Vietnam to "teach them a lesson" for Hanoi's expulsion of ethnic Chinese and Hanoi's attack against the Chinese-backed Khmer Rouge in Cambodia. President Carter signaled that he would not disapprove of such an attack by China. Brzezinski went a step further—meeting nightly with Chinese Ambassador Chai Zemin and turning over valuable intelligence information.[10]

Beijing gained much from the process of normalization: concessions on Taiwan, a de facto green light to strike at historic rival Vietnam, and an up-staging of the Soviet Union before the arms limitations talks. America also opened the floodgates on technology transfers to the impoverished, technologically backward Chinese military-industrial complex. Carter offered Most Favored Nation trade status to China, but not to the Soviets. This was a departure from the Nixon-Kissinger idea that both Russia and China would receive trade benefits, the former as part of a broader détente policy. Moreover, though President Carter made human rights a centerpiece of his foreign policy, he pointedly neglected to include China in his criticism of how despotic regimes treat their people.

The Reagan Era: Haig and His Critics.

The Ronald Reagan administration continued along the path set forth by its predecessors. Secretary of State Alexander Haig, who had been a key Kissinger deputy during the 1972 opening, particularly was enthusiastic about advancing what he saw as a strategic partnership between the two countries. He pushed for direct military sales to China and an end to arms sales with Taiwan, winning administration approval for the former. The Reagan administration loosened high-technology restrictions to allow U.S companies to treat China the same for export purposes as friendly but not allied countries in Africa, Europe, and Asia. By 1985, "dual use" licensed exports to China were valued at $5 billion. High level military exchanges also picked up as in 1985 Chairman of the Joint Chiefs of Staff General John Vessey became the highest ranking military officer to set foot in Mainland China since 1949.

President Reagan also authorized direct Foreign Military Sales to China which eased the way for direct commercial transactions. China bought S-70C helicopters, artillery locating radar, torpedoes and, most notably entered into an agreement with the Americans to upgrade its F-8 fighter jet, known as the Peace Pearl program. The Reagan administration also negotiated a civilian nuclear cooperation agreement and authorized the sale and transfer of U.S.-designed satellites for launch on Chinese rockets which indirectly bolstered China's missile and military nuclear propulsion programs. In both the military and commercial arenas, Beijing was like a starving kid finally at his first meal, purchasing the most sophisticated technology that it could get its hands on. A modulated diplomatic relationship had morphed into a strategic and military partnership.

There were some dissenters concerning the "strategic partnership" approach to China both in and out of government. Strategists like Edward Luttwak, China specialists such as Doak Barnett, and Defense technocrats such as William Perry all sounded a note of caution. Luttwak asked: "Is it our true purpose to promote the rise of the People's Republic to Superpower status? Should we become the artificers of a great power which our grandchildren may have to contend with?"[11]

The Reagan adminstration had some powerful dissenters as well in Secretary of State George Shultz and his Assistant Secretary of State for East Asian Affairs Paul Wolfowitz. Shultz agreed with Wolfowitz's assessment that China's importance had been exaggerated to the detriment of U.S. strategy. China, he wrote, thus far constantly had created obstacles—Taiwan, technology transfer—which America had to overcome just to maintain a good relationship.[12] Shultz rebalanced America's Asia policy, emphasizing Japan as the key to the U.S. position.

The Bush-Clinton Years: From Accommodation to Accommodation.

While the Chinese may have contributed to the downfall of the Soviet Union,[13] once the common enemy was gone, the relationship lost its *raison d'etre*. Problems that had been plastered over emerged with a vengeance. Americans were concerned by Chinese transfer of missile and WMD technologies to Iran and missiles to Saudi Arabia. Americans were outraged by Chinese crackdown on several democracy movements in the 1980s, culminating in the 1989 massacre of students at Tiananmen square, and by the suppression of Tibetan moves for autonomy. And military and intelligence officials began to notice that the PLA was buying advanced weaponry from the former Soviet Union.

The George H. W. Bush and Bill Clinton administrations tried to find new justifications for the relationship. President Bush moved quickly to buck up the reeling Chinese Communist Party (CCP), which was isolated internationally after Tiananmen.[14] President Clinton settled on "comprehensive engagement"—arguing that the policy inevitably would lead to a democratic and less threatening China. The policy led to looser restrictions on high-technology sales that ended up in the hands of the PLA.

By the mid-1990s, despite alleged violations by Hughes and Loral of laws prohibiting assistance to the Chinese on satellite launch technology, President Clinton approved sales of even more advanced satellites than the Reagan administration had authorized. Once the door to technology transfer had been opened, powerful constituencies in the United States refused to let it shut.[15] As a consequence, the U.S. military may have to one day face a Chinese military that, in part, is armed with U.S. technology. The former Martin Marietta Company, for example, provided data that helped the Chinese improve upon its DF-21 intermediate range ballistic missile (IRBM).[16]

Lessons Learned?

The history of America's opening to and normalization with China is instructive as America embarks upon a similar process with India. Nixon and Kissinger began with some concrete ideas about why such a move was necessary. As administrations changed, those ideas morphed into a very different position. The benefits to China were clear, it was relieved of severe pressure from its clashes with the Soviets, secured agreement to derecognize and begin to isolate Taiwan, received a green light to attack Vietnam, and perhaps most importantly, entered into a trading relationship with America on favorable terms and got its hands on critical high technology. Together with Deng Xiaoping's own reforms, the trade relationship and high-technology transfers have helped turn China into an economic powerhouse today. And, as William Perry had predicted, "it had no particular reason to be friendly to the United States."[17]

Nixon had written an article in *Foreign Affairs* journal before he became President that argued that America had a broad interest in bringing China into the "family of nations." There is no doubt that, in part because of America's opening, the Chinese people are better off. Economic integration with the West played a pivotal role in China's escape from being a Maoist revolutionary society. However, China is today the only country in the world that can compete militarily with the United States.[18] It is one thing to assist China out of poverty and isolation, quite another to transfer technologies and engage in military cooperation that enabled China's rise as a military power.

The fervor with which the opening was pursued exaggerated China's importance at the time, thereby paving the way for an anti-Soviet military and intelligence partnership, the downsides of which we are facing today. In addition, expectations were raised so high that whenever China did not "deliver," the relationship could go into a tailspin.

Perhaps of most significance, Kissinger and Nixon's willingness to accept the Chinese position on Taiwan privately eliminated options that may have paved the way for a more enduring resolution between the two countries. Ignoring that there existed a majority Taiwanese population who did not believe they were citizens of China has caused grave complications today. Indeed, the deliberate ambiguity and chasm between private and public assurances to the Chinese have complicated the issue seriously. The insinuation to Beijing that we would or could deliver on those assurances always was false. Today the potential for war over Taiwan is no less than it was in 1972.

As a counterfactual, what would have happened if the United States had focused the relationship on economic and political reform instead? What if America had resisted Chinese attempts to define the relationship as, in Shultz's words, a series of obstacles that the United States must remove in order to maintain a good relationship for its own sake? What if America had slowed the normalization process down and pocketed a normalization with Vietnam in the late 1970s? What if the United States had taken heed of the growing Taiwanization of the island early on, before China raised the stakes? What if, when the CCP was reeling in 1989, President Bush had pressed for real political reform? We well may have seen a different China and a relationship characterized by less suspicion and mistrust. The way the PRC and the United States did business from the beginning seemed to preclude Washington from exercising more creative options when the opportunity arose.

WILL INDIA BE A BETTER PARTNER THAN CHINA?

The foregoing is meant to provide a framework of analysis as Washington and Delhi forge a "strategic partnership." India of 2006 is far from China of 1972.

India is a successful multi-ethnic democracy, respectful of the rights of citizens. Its economic growth since the early 1990s has been impressive, and when it chooses to, it plays a productive role on the international stage. The potential for U.S.-Indian strategic competition is limited.

But the relationship is being billed as a new "strategic partnership," and expectations on both sides are running high. The United States paid a relatively high cost up front for this partnership—changing its nonproliferation policy to recognize India as a nuclear weapons state despite its rejection of the Non Proliferation Treaty (NPT). Though some downplay the importance of U.S. concessions, they are costly nonetheless. The diplomacy entailed in getting China and Russia to stop proliferating to their own special friends—Pakistan and Iran—will be more complicated with a new non-NPT nuclear weapons state. And, on balance, India will emerge from the deal with more nuclear material that can be weaponized than it would have otherwise.[19] The nuclear deal may be the best solution to a vexing problem of squaring the Indo-American diplomatic circle, but Washington must acknowledge the risks: India will have more nuclear bomb making capacity to compete not only with China, but with Pakistan as well; and the nonproliferation regime has been damaged.

In order to evaluate whether the deal is worth the price, a number of questions must be addressed: What does the United States want out of the new partnership? What has India committed to giving thus far? What does India want? What has the United States committed to giving?

What the United States Wants.

The administration has articulated several rationales for the opening to India. Robert Blackwill, President Bush's first ambassador to India and a key architect of the new relationship, has laid out some hard headed rationales:

> Think first of the vital interests of the United States: prosecuting the global war on terror and reducing the staying power and effectiveness of the jihadi killers; preventing the spread of weapons of mass destruction, including to terrorist groups; dealing with the rise of Chinese power; ensuring the reliable supply of energy from the Persian Gulf; and keeping the global economy on track.[20]

India, he argues, shares those vital interests. Official statements and speeches such as the Joint Statement between President Bush and Prime Minister Singh are less clear on what the two sides want to accomplish. In the Joint Statement, the two leaders commit to promote and strengthen democracy worldwide, and combat terrorism relentlessly. The countries also commit to a "Next Step in Strategic Partnership" initiative which provides a framework for economic cooperation; the joint promotion of democracy, energy, and environmental cooperation; continued defense cooperation; and high-technology and space cooperation.[21]

In each of these areas, the United States commits to providing support and assistance to India, including the modernization of India's infrastructure, agricultural-technical assistance, the provision of civilian nuclear energy to India, and removing Indian companies from the Department of Commerce's Entity's list in order to advance space and high technology cooperation.

In speeches by President Bush and Secretary of State Condoleezza Rice, the theme of helping India become a great power is consistent. In the administration's view, India, like America, is a multiracial, pluralistic democracy with a growing economy, so its prominence on the world stage would be a net- positive. Though the President speaks of cooperation on global matters such as HIV/AIDS, proliferation, and a commitment to democracy, his administration's rhetoric focuses most intently on helping pull India up: India will be allowed more cooperation in space activities, access to civilian nuclear energy, high technology in agricultural and other matters, purchase or coproduction of advanced fighter jets, and it will be prodded to further liberalize its economy.

In short, the relationship is not a balanced diplomatic transaction as much as it is Washington's attempt to accommodate a rising and benign power. State Department Counselor Philip Zelikow has gone as far as to equate the opening with India to America's commitment to Western Europe and East Asia at the Cold War's onset. Washington would stake its claim to the areas bracketing the Eurasian landmass, and devote its strategic energy to securing and developing those parts of the world. In Zelikow's mind, America's new relationship with India reflects an American recognition that Central and South Asia today and in the future are as important as were Europe and East Asia in the Cold War.[22] This may be a rhetorical overreach—besides Afghanistan, the administration is not committing resources consistent with a new approach to the Eurasian landmass.

There are risks entailed in the administration's oversell approach. Congress and the public will want to see near-term results, but the policy, in fact, is not a diplomatic transaction, rather it is a long-term investment. The truth is that long-term improvement of relations with India is guided by a powerful strategic logic. India's economy has been growing at impressive rates over the past decade, and Delhi is trying to shed its legacy of nonalignment in order to play an active and responsible role on the international stage. India shares with the Unites States an intense sense of threat from jihadi terrorists, and is wary of a rising China's strategic intentions. Indeed, Indians argue that their own nuclear weapons programs was a response to China's support of Pakistan's WMD programs. Moreover, unlike China, India is pulling its people out of poverty within a pluralistic democratic system. As noted Indian analyst Raja Mohan has said, if this experiment works, it will be of great benefit to the entire democratic world.

The United States thus has a fundamental interest in assisting India's rise as a prosperous democracy that contributes to international security. More immediately, the United States would like to see India play the role of counterweight on China's western flank (with Japan doing the same in the east), although Washington complicates matters by not making this an explicit goal. And the United States seeks partners in its efforts to deny the Iranian regime nuclear weapons, to stem the tide of WMD proliferation, to keep the sea-lanes astride South and Southeast Asia safe, and to garner support for its democracy promotion agenda, particularly in the Muslim world. Finally, the United States wants Delhi's understanding of its need to maintain good relations with India's rival Pakistan.

What India Wants.

Indian economic growth since its 1991 reforms, its battle hardened and modernizing military, and its new pragmatic diplomatic stance have put it on the path to becoming a great power. Fundamentally, it wishes to be recognized as a great power today, at least on a par with China. India's nuclear testing in 1974 and 1998 and its succeeding "nuclear recognition" diplomacy were in service of achieving that goal. There in no question that Delhi equates great power status with recognition as a nuclear weapons state. The next diplomatic step, Delhi believes, would be a permanent seat on the UN Security Council.

Besides the grand objective of becoming a great power, India's immediate security concerns are jihadi terrorism (much of it Pakistan-supported), settlement of the Jammu and Kashmir issue on terms favorable to Delhi, maintaining hegemony in its immediate neighborhood, diversification of it energy supply and improved energy security as its energy demands grow, checking a China that Delhi believes is encroaching on its sphere of influence, and maintaining good relations with Iran both to ensure oil and gas supply and to stave off potential troublemaking by Tehran. With these strategic priorities in mind, from Delhi's perspective the deal is a major triumph and securing America's recognition as a nuclear weapons state is the crown jewel:

> The President told the Prime Minister that we will work to achieve full civil nuclear energy cooperation with India . . . and the United States will work with friends and allies to adjust international regimes to enable full civil nuclear cooperation and trade with India, including but not limited to expeditious consideration of fuel supplies for safeguarded nuclear reactors at Tarapur.[23]

It is difficult to overstate the signficance of this undertaking from Delhi's perspective. For years India had taken a strong position against the global nonproliferation regime, arguing that it was the strong countries' way of maintaining a monopoly on nuclear power. Furthermore, Delhi felt that a double standard had been applied to it vis-à-vis China on nuclear matters. And, following its 1998 nuclear tests, it feared that an American-Chinese-Pakistani axis would form against it on the question of its nuclear weapons. The joint-statement wiped away this legacy: Delhi was part of the nuclear club, and America is going to help it convince other members to confer the club's full benefits, notwithstanding the White House's argument that India would not be recognized as a nuclear weapons state for purposes of the NPT.

As Ashton Carter has pointed out, given the significance of the American concession (even if this was the most realistic option to the Indian nuclear question) America will pay a price for a special nonproliferation carve-out for India—and it is striking how little America received in return.[24] Besides nuclear technology, India also will be the beneficiary of American advanced defense and space technology. India, on the other hand, committed itself to continue with policies it already was pursuing—"combat terrorism relentlessly" and continue high level dialogues on the economy, space, defense, and energy.

Many see India's two votes in the International Atomic Energy Agency (IAEA) that resulted in Iran's referral to the Security Council as a sign that India will ally itself with the United States on this key strategic question. Others point out that Indian officials themselves state that they worked hard on *behalf* of Tehran's interests, lobbying the European Union (EU) to water down the resolution.[25] In any case, India will not break its long-standing strategic ties to Iran anytime soon.[26]

If the relationship is thought of in terms of a "strategic partnership," then Dr. Carter is surely correct—the diplomatic transaction was weighted heavily toward the Indians. A strategic partnership conjures up images of Japan, Australia, and the United Kingdom (UK), where, in the latter two cases, the worldview is so similar that there is hardly a war fought by the United States where the other two are not involved.

And, one could imagine a series of American requests were the relationship truly thought of as a diplomatic transaction—military access for China contingencies would be helpful especially given the anti-access challenge in East Asia. A clear statement committing to the American position on Iranian denuclearization would be another legitimate American request, and more assistance with security and reconstruction in Iraq a third.

The problem is that India is nowhere near the point were it has either the will or ability to provide such assistance. True, as Raja Mohan has pointed out, America has not exactly invited India to "a containment party."[27] But it is unlikely that even if Washington had, Delhi would have accepted.

An examination of some important issues on the Indian-American agenda reveals the different prisms through which the two sides still view their respective security problems.

India and China: Uneven Convergence.

For many American strategists, the driving force behind the new partnership with Delhi is Washington's concerns about the long-term challenge of a stronger China. Should Beijing become more assertive and the relationship more confrontational, a solid U.S.-India relationship would position America well to maintain the security order in Asia.

For its part, India is wary of China's strategic intentions, its support for Pakistan, its moves into South Asia, and its increasing presence in the Indian ocean and relations with countries that sit at critical junctures along the Ocean. Indians are quick to remind Americans that they have been concerned about a "China threat" for decades, having fought a war against Beijing in 1962 and sharing a 4,000 km border, much of which is in dispute. But India also derives great benefits from having both an American and a Chinese card to play.

Delhi will welcome maritime security cooperation with the United States as a counter to Beijing's growing presence along the Indian Ocean. China has been busily constructing port facilities and surveillance and reconnaissance capabilities around the Indian Ocean as part of what some have termed a "string of pearls strategy." This, combined with investment in an elaborate rail and road infrastructure through South and Southeast Asia, are meant to provide China with an alternative to American dominated sea routes in delivering its oil and gas from the Persian Gulf back to Chinese ports on the East Coast.[28]

Part of India's logic of reaching out to the United States is to help it out of its perceived encirclement by China in the Indian Ocean and South Asia. Indeed, some within the Indian military perceive Chinese expansion of influence in Burma, Bangladesh, Nepal, Central Asia, and the Persian Gulf as a strategy of "encirclement of India." On the one hand, India will continue to compete with Beijing for influence in Southeast Asia and has increased its political cooperation with Vietnam, Indonesia, and Singapore. India's desire to counter Beijing's dominance over Burma will result in continued engagement with the Rangoon regime, much to the consternation of Washington.

Delhi no doubt will watch carefully China's measured commitment to a blue water navy as manifested in its growing nuclear submarine force and its development of some kind of aircraft carrier.[29] The consensus among Indian strategists is that "China should be kept out of the Indian Ocean."

India's May 2004 Maritime Doctrine sets an ambitious course for India's navy meant in part to deal with "extra-regional powers" operating from the Persian Gulf to the Malacca Strait. India has in mind both sea denial and, over time, blue water capabilities. It announced plans to purchase six French *Scorpene* diesel electric submarines and build six more in India, is negotiating with Russia for the transfer of another aircraft carrier, and announced plans to equip some of its surface destroyers with *Brhamos* antiship cruise missiles as an answer to China's equipping its *Soveremeny* destroyers with *Sunburns*. The Navy's allocation of the defense budget rose from $7.5 billion for the years 1997-2001, to $18.3 billion for 2002-07. However, given the ambitions of the navy, budget plans are underfunded.

On the other hand, India will continue to increase its cooperation with China. While it will not cede influence in Central, South, or even Southeast Asia to Beijing, neither will it cede too much influence to the United States. During the visit of Premier Wen Jiabiao to India in April 2005, Prime Minister Singh announced that "India and China can reshape the world."[30] The two countries have begun a free trade agreement (FTA) negotiation, and trade has been increasing at a rapid pace, up to 20 billion in 2005.[31] In addition, China formally abandoned its claim to the Himalayan province of Sikkim, set a strategic framework for resolving differences over their 2,175 mile-long border, and signed a series of agreements on technology sharing, civil aviation, and trade.

China agreed to support India's bid for a UN Council seat, and Foreign Minister Shyam Saran declared "we look upon each other as partners."[32] Recently Indian Defense Minister Pranab Mukherjee announced that India and China signed a military agreement that will expand military cooperation in the areas of joint military exercise and exchanges.[33]

India's approach to China, not unlike America's, is to engage warily. The American and Chinese militaries will compete for better ties with India, and India will pressure the United States to relax technology restriction, using its relationship with China as leverage. The task for Washington is to build a relationship of trust with the Indian military without falling into the trap of "proving its love" by signing on to ever more expansive technology transfer deals.

Defense Relations.

One major goal of America's defense strategy is to build what it calls "partnership capacity." This reflects a recognition that America will need new partners to assist in its daunting strategic tasks, which in Asia include keeping the sea lanes safe for commerce, continuing to support operations in Afghanistan, balancing China's growing power, deterring North Korean and Chinese aggression, and protecting growing energy interests in Central Asia.

The military relationship began with a focus on missile defense (India was one of the first countries to embrace the Bush administration's new approach to strategic defense[34]) and has blossomed into one of America's most active in Asia. The two countries have conducted "dissimilar" combat exercises such as flying exercises in which Indian pilots flying *Sukhoi* Su 30s defeated F-15s 90 percent of the time; mountain exercises in the Himalayas and Alaska; special forces exercises in jungles and underwater; joint maritime piracy and antisubmarine warfare exercises; and joint aircraft carrier exercises in the Indian Ocean as part of the annual Malabar exercises.[35]

In June 28, 2005, after a series of Under Secretary-level Defense Policy Group meetings, Secretary of Defense Donald Rumsfeld and Minister of Defense Pranab Mukherjee signed a "New Framework For the U.S.-India Defense Relationship," codifying the already active relationship. The two sides agreed that defeating terrorism; preventing the spread of WMD; and protecting the free flow of commerce by air, land, and sea were "shared security interests."[36] The two countries further agreed to enhance their capabilities to defeat terrorism and combat the proliferation of WMD as well as expand their interaction with other regional militaries. The document emphasizes the importance of defense trade as a means to "reinforce the strategic partnership" and "achieve greater interaction between our two armed forces."[37]

Through an intense program of exercises, the sale of weapons systems, and high-level exchanges, the Pentagon seeks to establish interoperability with India. The U.S Air Force envisions a networked command, control, communications, computers, intelligence, surveillance, and reconnaisance (C4ISR) system with all U.S. Pacific Command (PACOM) partners, including India, consisting of unmanned aerial vehicles (UAVs), shared early warning radar, and satellite imagery that could "protect vital areas from the threats of terrorism, piracy, smuggling, WMD proliferation, and potentially even ballistic missiles."[38] Whether India will want to be part of such a network is an open question, considering that it does not plan on joining the Proliferation Security Initiative (PSI), and its Ministry of Defense has recently talked of "spacing out" U.S.-Indian military contacts.[39]

For India, the sin qua non of the relationship is technology and weapons transfer—both dual use and lethal. The easing of restrictions on these items is both a sign that India in no longer considered an outlaw by the United States and an absolute necessity in Indian eyes for modernizing its military. Indeed, for India to project power, it needs high-end lift, refueling, and airborne early warning and control capabilities, and believes that the United States has state-of-the-art equipment. India is conducting tough negotiations on defense trade issues. For example, it has asked the United States to release one of its most advanced radars—the active electronically scanned array—as part of the United states offer of F-16 and F-18 fighter jets to the Indian Air Force. India is leveraging an intense competition to fulfill its combat fighter requirement.[40]

The focus on defense trade is complicated by a number of factors. On the one hand, a strong supply and defense industrial relationship will create the "connective tissue" of the defense relationship, and America should have bargained for preferential treatment as part of the grand deal. On the other hand, India, like China before it, is getting in the habit of creating litmus tests that require Washington to prove its commitment to the relationship by asking: How much state-of-the-art technology are you willing to give? There is also the problem of India's relationship with Iran and the kind of incentives that will be in place to transfer technology to Tehran, not to mention Moscow and Beijing. This is especially troublesome in missile related areas such as Space Launch Vehicles.

Indian and American strategists seem to agree that the most promising area of military cooperation will continue to be maritime security in what the Indians refer to as the "Indian Ocean Basin"—waters that extend from the Persian Gulf to the Strait of Malacca. Recent accelerations by Indian defense officials of its interest in keeping the South East Asian sea lanes safe from pirates and terrorists underscores this point.[41] Moreover, the two countries already have cooperated in sea lane protection in the Strait of Malacca at the beginning of Operation ENDURING FREEDOM, and the only joint structure in the Indian military is a Navy-led one on the Nicobar islands.

India's blue water aspirations, however, may be too ambitious. Though the Indian Navy wants to build a 3-carrier Navy by 2012, this will be difficult since it is retiring its sole extant carrier once the *Russian Admiral Gorshkov* arrives.[42] Indian naval officials expect that more ships will be decommissioned than commissioned by 2012.

The Strategic Weapons Problem.

India has in service the *Agni* ballistic missile that can carry nuclear warheads and can hit almost any target in Pakistan. The arsenal cannot yet hit vital Chinese targets—a strategic aspiration—but work on the new longer-range *Agni* is intended to provide India with that capability. In addition, the Navy is interested in developing a nuclear second strike submarine capability.[43] Though India's strategic weapons program is in large measure a response to the growing Chinese strategic arsenal, the United States should exercise caution in helping India along this road. The nuclear equation in Asia is changing rapidly, and is not an equation Americans should be confident about managing. With an improved Chinese arsenal, an improving Indian arsenal, and a nuclear Pakistan and North Korea, it is probably a matter of time before Japan decides it will need a nuclear arsenal as well.

Recent indications that India intends to add to its arsenal are worrisome. The United States has made it clear that no nuclear aid or fuel should be used to help India's strategic weapons program and that India should not continue nuclear testing. But in a recent speech to Parliament, Prime Minister Singh rejected those conditions as infringements of Indian sovereignty. He threatened that India must received an "uninterrupted supply" of foreign nuclear fuel, or it would suspend the IAEA inspection on civilian nuclear facilities that were part of the nuclear deal. Prime Minister Singh was equally emphatic about India's absolute right to process and enrich.[44]

While this speech may have been for purely domestic consumption, it is troubling enough for the United States to think carefully about transferring technologies that may even indirectly assist the strategic program. U.S.-Indian cooperation on space launch vehicles should be avoided until America gains greater confidence in India's nuclear intentions. The U.S. launching satellites off the Polar Launch Space Vehicle could lead to the transfer of multiple independent reentry vehicle (MIRV) rocket integration technologies. This would be an unfortunate repeat of the American experience with China.

There is a wiser two-fold course: Stop letting China get a pass on its own nuclear posture improvements, and persist with missile defense activity. Missile defense is entirely complementary of India's "no first use" and "force in being" posture intended to protect against strategic coercion by Pakistan or China. A diplomatic effort to curb Chinese strategic forces build-up would help stem the steady march to a more dangerous Asia characterized by even a low-intensity nuclear arms races.

INDIA AND IRAN: CAUSE FOR CAUTION

India's close relationship with Iran is also cause for caution, especially when it comes to technology transfer. During the visit of Iranian President Mohammad Khatami, Tehran and Delhi signed the New Delhi declaration in 2003 which commits them to "explore opportunities for cooperation in defense and agreed areas, including training and exchange of visits." Iran is seeking Indian help in operating missile boats, refitting T-72 tanks and armored personnel carriers, and upgrades for its MIG 29s which would build upon Delhi's past help in developing batteries for Iranian submarines.[45] The two have engaged in naval exercises, the significance of which has been played down by both the Americans and the Indians.[46]

India will continue to see Iran as an important source of energy—the state-owned Gas Authority of India, Ltd. reportedly has signed a $22 billion 25-year deal with the Iranians. And the two countries seem committed to building a pipeline, together with Pakistan, that would run from Iran to India via Pakistan.

India is interested in cutting off any potential Iranian troublemaking among India's own substantial Muslim population. And since the end of the Cold War, the two countries have worked together against

Sunni extremism in Central Asia and most significantly against the Taliban during the 1990s when Washington was not paying attention to events in Afghanistan.[47] Iran was a useful Muslim ally for Delhi as it sought to counter Pakistan's attempts to play the Muslim Card in the Kashmir dispute. Tehran even recognized Kashmir as an integral part of India. Pakistanis fear that Indians will develop bases in Iran for use in a potential Indo-Pak war.[48] In particular, Pakistanis are troubled by Delhi's agreement to expand the Iranian port of Chahbahar, which Islamabad thinks may have an Indian naval presence in the future. Delhi has expressed its own apprehension about Chinese involvement in the Pakistani port at Gwadar, a few hundred miles from Chahbahar.

In addition, Indian individuals and companies have been sanctioned to release nuclear related technology to Iran, and there are reports of pending sanctions on missile technology.[49] Given Iran's interest in improving its ballistic missile capabilities, Indian-Iranian interest in space launch cooperation is particularly troublesome.[50] There have been reports of ongoing Indian-Iranian space cooperation, and India has been the target of congressional legislation accusing it of assisting the Iranian missile program.[51]

The United States should be exceedingly cautious in proceeding with space launch cooperation with Delhi unless such strategic cooperation with Iran is ceased. Washington should recognize, however, that such cooperation will not end in the near-term. Delhi has cultivated ties with Iran to improve its position vis-à-vis Pakistan and to gain influence in Central Asia, two of its top foreign policy priorities. Ironically, the Sino-American rapprochement was premised upon the two countries facing a common threat in the Soviet Union.

Today, America views Iran as part of the greatest threat it faces, that of jihadi terrorism, but it is unlikely to get much by way of Delhi in facing this threat.

THE POWER GAP

The largest impediment to a strategic partnership in the near term is the power gap between the United States and India. U.S. GDP per capita is close to $40,000, while India's is closer to $3,000 (using purchasing power parity). The United States is responsible for more than a quarter of total global economic production, while India's contributes less than 2 percent. A quarter of Indians still live in poverty. By most estimates, just to pull its citizens out of poverty will require a decade of 7-8 percent of economic growth.

The U.S. military budget is double the total of the EU combined, over $400 billion. As Eliot Cohen has put it: "In virtually every sphere of warfare, the United States dominates. Above the air and below the sea" the U.S. military far surpasses any potential adversary. "No other power has the ability to move large and sophisticated forces around the globe; to coordinate and direct its own forces and those of its allies . . . and to support those troops with precision firepower and unsurpassed amounts of information and intelligence."[52]

While India's defense budget has been growing and is now over 15 billion dollars, Delhi's internal security requirements, and the ongoing tension with Pakistan over terrorism and Kashmir, means that Indian ability to project power is a long-term aspiration. Thus, if the goal is a diplomatic transaction of equal and mutual gains, Washington will surely be disappointed. If the goal is assisting India's emergence, the relationship ought to focus on minimizing the power gap.

In this context, the first order of business is economic development and reform for India. So far, Indian attempts to open its economy and take advantage of international capital and resources (like the Chinese have done) have been uneven. Nearly every expert group looking at India's economy calls for greater liberalization of the trade and investment regimes, investment in infrastructure, and rationalization of the regulatory climate. The U.S.-India Chief Executive Officer (CEO) Forum, convened by the two governments, stressed the need for a better foreign direct investment (FDI) climate in physical infrastructure, including power,roads, insurance, retail, and banking. [53]

Restrictions on imports and investments, as well as problematic infrastructure,[54] have kept India's volume of trade relatively low. American business sees a big potential market in India, and positive demographic trends as well as an English speaking population are looked upon favorably. But unless Indian decisionmakers undertake massive economic reform, India's great power aspirations will not be met. Morgan Stanley estimates that India will have to spend $100 billion a year on infrastructure by 2010 to achieve 8-9 percent annual economic growth.[55] This will be difficult for a government that is running fiscal deficits.

If Washington wants to advance its goal of helping India become a great power, it seriously should consider a bilateral FTA. The primary objective would be to provide a mechanism to force open the Indian economy through market mechanisms. As economic analysts of India have observed, such an agreement would serve as "an effective mechanism for locking in reform policies, mobilizing domestic political support for liberalization, and spurring additional trade liberalization . . ."[56] And

Americans would develop vested commercial interests in India that would provide a connective tissue that is difficult to break. Skeptics will argue that an FTA would divert trade, and that the Indian economy is not ready for such an agreement. But Washington has concluded, or is in the process of concluding, FTAs with Morocco, Oman, and Singapore—according to political as well as economic criteria set forth by then U.S. Trade Representative Robert Zoellick. India meets much of the criteria.[57]

Attempting to bridge the power gap will be difficult, given India's culture of autonomy and independence and its reluctance to have interference with either. For the project to succeed, humility will be needed on both sides. Washington needs to be humble about how much advise and influence India is ready to accept. India needs to accept that its power right now is largely incipient, and that America is ready and willing to provide it with a boost.

CONCLUSION

Ashley Tellis, one of the artichects of the new relationship with India, has said:

> The question . . . ought not be "What will India do for us" . . . rather the real question ought to be, "Is a strong democratic (even perpetually independent) India in American national interest? If the answer to the question is "yes," then the real discussion about the evolution of the U.S.-Indian relationship ought to focus on how the United States can assist the growth of Indian power . . .[58]

Dr Tellis adds that the administration strategy of promoting India's rise is "directed first and foremost, towards constructing a geopolitical order in Asia that is conducive to peace and prosperity."

George Perkovich has written, "If India can democratically lift all of its citizens to a decent quality of life without trampling on basic liberties and harming its neighbors, the Indian people will have accomplished perhaps the greatest success in human history."[59]

Both the Tellis and Perkovich goals are well worth pursuing. But Washington must enter this relationship without illusions. Now that the nuclear deal is complete, Washington needs to mitigate its risks so long as India continues its partnerships with Iran and Beijing.

The Shultz approach rather than the Kissinger and Brzezinski approach should guide the U.S.-Indian relationship. The two countries should focus on what is doable and most important. The first order of business is promoting economic reform in India. Delhi will not become a great power otherwise. Wise economic statecraft in both capitals can have a significant impact on India's future. Working towards an FTA would have the dual advantage of catalyzing liberalization in India and tying the two countries closer together in ways that advantage both. Military cooperation should continue, especially in the maritime arena.

But the United States should heed the lessons of its relations with China. Washington will live to regret it if the relationship is defined as a series of obstacles that it must clear to secure Indian cooperation. Technology transfer should be done if it is in Washington's interests, not as proof of Washington's commitment to the overall relationship. The Pentagon in return should work toward access agreements to protect its interests on the Eurasian landmass and with respect to China.

On the other hand, Washington must realize that India will not sever ties with Tehran anytime soon. India sees its interests as convergent with Iran on the issue of Sunni extremism in Central Asia, energy security, and

Pakistan. With this is mind, Washington should avoid cooperation in space launch vehicles until India weans itself away from strategic cooperation with Iran.

Nor is there need to make too much of nuclear power as an answer to India's overwhelming need for energy. Delhi will still rely heavily on oil and gas to fuel its growth. Washington can help Delhi's energy security by adding it generously to existing development and production consortia, realizing that Delhi has come late to the game.

And Washington should not expect much in the way of combined democracy promotion; India's protection of the Burmese junta from international isolation is cause for skepticism.[60] Washington will be disappointed if it expects too much help from Delhi on the "freedom agenda."

India will be a better strategic partner than China, but it will take Washington's largesse to achieve that goal. Washington is not interested in creating a satellite or client state; it genuinely is interested in having a prosperous, democratic, and powerful India as a partner. The road will be a bumpy one, and in overselling the partnership and giving too much on the nuclear deal, Washington has not started off well. But, with sustained and deft diplomacy and an economics first approach, the payoff will be worth the price.

ENDNOTES - CHAPTER 10

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4. Mann, pp. 28-29.

5. John H. Holdridge, "Through China's Backdoor," in Holdridge, *et al*., eds., *War and Peace with China: First-Hand Experiences in the Foreign Service of the United States*, Lanham, MD: University Press of America, 1994, p. 124.

6. Mann, pp. 35-36.

7. For example, as the normalization talks stalled, Washington agreed to provide the Chinese with high-speed computers. See Willam Burr, "The Kissinger Transcripts," p. 375.

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9. Mann, pp. 86-88.

10. *Ibid*., p. 100.

11. Edward N. Luttwak, "Against the China Card," *Commentary*, Vol. 66, No. 4, October 1978, p. 43.

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TITLE I—UNITED STATES AND INDIA NUCLEAR COOPERATION

SEC. 101. SHORT TITLE.

This title may be cited as the ''Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006''.

SEC. 102. SENSE OF CONGRESS.

It is the sense of Congress that—

(1) preventing the proliferation of nuclear weapons, other weapons of mass destruction, the means to produce them, and the means to deliver them are critical objectives for United States foreign policy;

(2) sustaining the Nuclear Non-Proliferation Treaty (NPT) and strengthening its implementation, particularly its verification and compliance, is the keystone of United States nonproliferation policy;

(3) the NPT has been a significant success in preventing the acquisition of nuclear weapons capabilities and maintaining a stable international security situation;

(4) countries that have never become a party to the NPT and remain outside that treaty's legal regime pose a potential challenge to the achievement of the overall goals of global nonproliferation, because those countries have not undertaken the NPT obligation to prohibit the spread of nuclear weapons capabilities;

(5) it is in the interest of the United States to the fullest extent possible to ensure that those countries that are not States Party to the NPT are responsible in the disposition of any nuclear technology they develop;

(6) it is in the interest of the United States to enter into an agreement for nuclear cooperation arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) with a country that has never been a State Party to the NPT if—

(A) the country has demonstrated responsible behavior with respect to the nonproliferation of technology related to nuclear weapons and the means to deliver them;

(B) the country has a functioning and uninterrupted democratic system of government, has a foreign policy that is congruent to that of the United States, and is working with the United States on key foreign policy initiatives related to nonproliferation;

(C) such cooperation induces the country to promulgate and implement substantially improved protections against the proliferation of technology related to nuclear weapons and the means to deliver them, and to refrain from actions that would further the development of its nuclear weapons program; and

(D) such cooperation will induce the country to give greater political and material support to the achievement of United States global and regional nonproliferation objectives, especially with respect to dissuading, isolating, and, if necessary, sanctioning and containing states that sponsor terrorism and terrorist groups that are seeking to acquire a nuclear weapons capability or other weapons of mass destruction capability and the means to deliver such weapons;

(7) the United States should continue its policy of engagement, collaboration, and exchanges with and between India and Pakistan;

(8) strong bilateral relations with India are in the national interest of the United States;

(9) the United States and India share common democratic values and the potential for increasing and sustained economic engagement;

(10) commerce in civil nuclear energy with India by the United States and other countries has the potential to benefit the people of all countries;

(11) such commerce also represents a significant change in United States policy regarding commerce with countries

that are not States Party to the NPT, which remains the foundation of the international nonproliferation regime;

(12) any commerce in civil nuclear energy with India by the United States and other countries must be achieved in a manner that minimizes the risk of nuclear proliferation or regional arms races and maximizes India's adherence to international nonproliferation regimes, including, in particular, the guidelines of the Nuclear Suppliers Group (NSG); and

(13) the United States should not seek to facilitate or encourage the continuation of nuclear exports to India by any other party if such exports are terminated under United States law.

SEC. 103. STATEMENTS OF POLICY.

(a) IN GENERAL.—The following shall be the policies of the United States:

(1) Oppose the development of a capability to produce nuclear weapons by any non-nuclear weapon state, within or outside of the NPT.

(2) Encourage States Party to the NPT to interpret the right to ''develop research, production and use of nuclear energy for peaceful purposes'', as set forth in Article IV of the NPT, as being a right that applies only to the extent that it is consistent with the object and purpose of the NPT to prevent the spread of nuclear weapons and nuclear weapons capabilities, including by refraining from all nuclear cooperation with any State Party that the International Atomic Energy Agency (IAEA) determines is not in full compliance with its NPT obligations, including its safeguards obligations.

(3) Act in a manner fully consistent with the Guidelines for Nuclear Transfers and the Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software and Related Technology developed by the

NSG, and decisions related to the those guidelines, and the rules and practices regarding NSG decisionmaking.

(4) Strengthen the NSG guidelines and decisions concerning consultation by members regarding violations of supplier and recipient understandings by instituting the practice of a timely and coordinated response by NSG members to all such violations, including termination of nuclear transfers to an involved recipient, that discourages individual NSG members from continuing cooperation with such recipient until such time as a consensus regarding a coordinated response has been achieved.

(5) Given the special sensitivity of equipment and technologies related to the enrichment of uranium, the reprocessing of spent nuclear fuel, and the production of heavy water, work with members of the NSG, individually and collectively, to further restrict the transfers of such equipment and technologies, including to India.

(6) Seek to prevent the transfer to a country of nuclear equipment, materials, or technology from other participating governments in the NSG or from any other source if nuclear transfers to that country are suspended or terminated pursuant to this title, the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), or any other United States law.

(b) WITH RESPECT TO SOUTH ASIA.—The following shall be the policies of the United States with respect to South Asia:

(1) Achieve, at the earliest possible date, a moratorium on the production of fissile material for nuclear explosive purposes by India, Pakistan, and the People's Republic of China.

(2) Achieve, at the earliest possible date, the conclusion and implementation of a treaty banning the production of fissile material for nuclear weapons to which both the United States and India become parties.

(3) Secure India's—

(A) full participation in the Proliferation Security Initiative;

(B) formal commitment to the Statement of Interdiction Principles of such Initiative;

(C) public announcement of its decision to conform its export control laws, regulations, and policies with the Australia Group and with the Guidelines, Procedures, Criteria, and Control Lists of the Wassenaar Arrangement;

(D) demonstration of satisfactory progress toward implementing the decision described in subparagraph (C); and

(E) ratification of or accession to the Convention on Supplementary Compensation for Nuclear Damage, done at Vienna on September 12, 1997.

(4) Secure India's full and active participation in United States efforts to dissuade, isolate, and, if necessary, sanction and contain Iran for its efforts to acquire weapons of mass destruction, including a nuclear weapons capability and the capability to enrich uranium or reprocess nuclear fuel, and the means to deliver weapons of mass destruction.

(5) Seek to halt the increase of nuclear weapon arsenals in South Asia and to promote their reduction and eventual elimination.

(6) Ensure that spent fuel generated in India's civilian nuclear power reactors is not transferred to the United States except pursuant to the Congressional review procedures required under section 131 f. of the Atomic Energy Act of 1954 (42 U.S.C. 2160 (f)).

(7) Pending implementation of the multilateral moratorium described in paragraph (1) or the treaty described in paragraph (2), encourage India not to increase its production of fissile material at unsafeguarded nuclear facilities.

(8) Ensure that any safeguards agreement or Additional Protocol to which India is a party with the IAEA can reliably safeguard any export or reexport to India of any nuclear materials and equipment.

(9) Ensure that the text and implementation of any agreement for cooperation with India arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) meet the requirements set forth in subsections a.(1) and a.(3) through a.(9) of such section.

(10) Any nuclear power reactor fuel reserve provided to the Government of India for use in safeguarded civilian nuclear facilities should be commensurate with reasonable reactor operating requirements.

SEC. 104. WAIVER AUTHORITY AND CONGRESSIONAL APPROVAL.

(a) IN GENERAL.—If the President makes the determination described in subsection (b), the President may—

(1) exempt a proposed agreement for cooperation with India arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) from the requirement of subsection a.(2) of such section;

(2) waive the application of section 128 of the Atomic Energy Act of 1954 (42 U.S.C. 2157) with respect to exports to India; and

(3) waive with respect to India the application of—

(A) section 129 a.(1)(D) of the Atomic Energy Act of 1954 (42 U.S.C. 2158(a)(1)(D)); and

(B) section 129 of such Act (42 U.S.C. 2158) regarding any actions that occurred before July 18, 2005.

(b) DETERMINATION BY THE PRESIDENT.—The determination referred to in subsection (a) is a determination by the President that the following actions have occurred:

(1) India has provided the United States and the IAEA with a credible plan to separate civil and military nuclear facilities, materials, and programs, and has filed

a declaration regarding its civil facilities and materials with the IAEA.

(2) India and the IAEA have concluded all legal steps required prior to signature by the parties of an agreement requiring the application of IAEA safeguards in perpetuity in accordance with IAEA standards, principles, and practices (including IAEA Board of Governors Document GOV/1621 (1973)) to India's civil nuclear facilities, materials, and programs as declared in the plan described in paragraph (1), including materials used in or produced through the use of India's civil nuclear facilities.

(3) India and the IAEA are making substantial progress toward concluding an Additional Protocol consistent with IAEA principles, practices, and policies that would apply to India's civil nuclear program.

(4) India is working actively with the United States for the early conclusion of a multilateral treaty on the cessation of the production of fissile materials for use in nuclear weapons or other nuclear explosive devices.

(5) India is working with and supporting United States and international efforts to prevent the spread of enrichment and reprocessing technology to any state that does not already possess full-scale, functioning enrichment or reprocessing plants.

(6) India is taking the necessary steps to secure nuclear and other sensitive materials and technology, including through—

(A) the enactment and effective enforcement of comprehensive export control legislation and regulations;

(B) harmonization of its export control laws, regulations, policies, and practices with the guidelines and practices of the Missile Technology Control Regime (MTCR) and the NSG; and

(C) adherence to the MTCR and the NSG in accordance with the procedures of those regimes for unilateral adherence.

(7) The NSG has decided by consensus to permit supply to India of nuclear items covered by the guidelines of the NSG.

(c) SUBMISSION TO CONGRESS.—

(1) IN GENERAL.—The President shall submit to the appropriate congressional committees the determination made pursuant to subsection (b), together with a report detailing the basis for the determination.

(2) INFORMATION TO BE INCLUDED.—To the fullest extent available to the United States, the report referred to in paragraph (1) shall include the following information:

(A) A summary of the plan provided by India to the United States and the IAEA to separate India's civil and military nuclear facilities, materials, and programs, and the declaration made by India to the IAEA identifying India's civil facilities to be placed under IAEA safeguards, including an analysis of the credibility of such plan and declaration, together with copies of the plan and declaration.

(B) A summary of the agreement that has been entered into between India and the IAEA requiring the application of safeguards in accordance with IAEA practices to India's civil nuclear facilities as declared in the plan described in subparagraph (A), together with a copy of the agreement, and a description of the progress toward its full implementation.

(C) A summary of the progress made toward conclusion and implementation of an Additional Protocol between India and the IAEA, including a description of the scope of such Additional Protocol.

(D) A description of the steps that India is taking to work with the United States for the conclusion of a multilateral treaty banning the production of fissile material for nuclear weapons, including a description of the steps that the United States has taken and will take to encourage India to identify and declare a date by which India would be willing to stop production of fissile material for nuclear weapons unilaterally or pursuant to a multilateral moratorium or treaty.

(E) A description of the steps India is taking to prevent the spread of nuclear-related technology, including enrichment and reprocessing technology or materials that can be used to acquire a nuclear weapons capability, as well as the support that India is providing to the United States to further United States objectives to restrict the spread of such technology.

(F) A description of the steps that India is taking to secure materials and technology applicable for the development, acquisition, or manufacture of weapons of mass destruction and the means to deliver such weapons through the application of comprehensive export control legislation and regulations, and through harmonization with and adherence to MTCR, NSG, Australia Group, and Wassenaar Arrangement guidelines, compliance with United Nations Security Council Resolution 1540, and participation in the Proliferation Security Initiative.

(G) A description and assessment of the specific measures that India has taken to fully and actively participate in United States and international efforts to dissuade, isolate, and, if necessary, sanction and contain Iran for its efforts to acquire weapons of mass destruction, including a nuclear weapons capability and the capability to enrich uranium or reprocess nuclear fuel and the means to deliver weapons of mass destruction.

(H) A description of the decision of the NSG relating to nuclear cooperation with India, including whether nuclear cooperation by the United States under an agreement for cooperation arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) is consistent with the decision, practices, and policies of the NSG.

(I) A description of the scope of peaceful cooperation envisioned by the United States and India that will be implemented under the agreement for nuclear cooperation, including whether such cooperation will include the provision of enrichment and reprocessing technology.

(J) A description of the steps taken to ensure that proposed United States civil nuclear cooperation with India will not in any way assist India's nuclear weapons program.

(d) RESTRICTIONS ON NUCLEAR TRANSFERS.—

(1) IN GENERAL.—Pursuant to the obligations of the United States under Article I of the NPT, nothing in this title constitutes authority to carry out any civil nuclear cooperation between the United States and a country that is not a nuclear-weapon State Party to the NPT that would in any way assist, encourage, or induce that country to manufacture or otherwise acquire nuclear weapons or nuclear explosive devices.

(2) NSG TRANSFER GUIDELINES.—Notwithstanding the entry into force of an agreement for cooperation with India arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) and pursuant to this title, no item subject to such agreement or subject to the transfer guidelines of the NSG, or to NSG decisions related thereto, may be transferred to India if such transfer would be inconsistent with the transfer guidelines of the NSG in effect on the date of the transfer.

(3) TERMINATION OF NUCLEAR TRANSFERS TO INDIA.—

(A) IN GENERAL.—Notwithstanding the entry into force of an agreement for cooperation with India arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) and pursuant to this title, and except as provided under subparagraph (B), exports of nuclear and nuclear-related material, equipment, or technology to India shall be terminated if there is any materially significant transfer by an Indian person of—

(i) nuclear or nuclear-related material, equipment, or technology that is not consistent with NSG guidelines or decisions, or

(ii) ballistic missiles or missile-related equipment or technology that is not consistent with MTCR guidelines, unless the President determines that cessation of such exports would be seriously prejudicial to the achievement of United States nonproliferation objectives or otherwise jeopardize the common defense and security.

(B) EXCEPTION.—The President may choose not to terminate exports of nuclear and nuclear-related material, equipment, and technology to India under subparagraph (A) if—

(i) the transfer covered under such subparagraph was made without the knowledge of the Government of India;

(ii) at the time of the transfer, either the Government of India did not own, control, or direct the Indian person that made the transfer or the Indian person that made the transfer is a natural person who acted without the knowledge of any entity described in subparagraph (B) or (C) of section 110(5); and

(iii) the President certifies to the appropriate congressional committees that the Government of

India has taken or is taking appropriate judicial or other enforcement actions against the Indian person with respect to such transfer.

(4) EXPORTS, REEXPORTS, TRANSFERS, AND RETRANSFERS TO INDIA RELATED TO ENRICHMENT, REPROCESSING, AND HEAVY WATER PRODUCTION.—

(A) IN GENERAL.—

(i) NUCLEAR REGULATORY COMMISSION.— The Nuclear Regulatory Commission may only issue licenses for the export or reexport to India of any equipment, components, or materials related to the enrichment of uranium, the reprocessing of spent nuclear fuel, or the production of heavy water if the requirements of subparagraph (B) are met.

(ii) SECRETARY OF ENERGY.—The Secretary of Energy may only issue authorizations for the transfer or retransfer to India of any equipment, materials, or technology related to the enrichment of uranium, the reprocessing of spent nuclear fuel, or the production of heavy water (including under the terms of a subsequent arrangement under section 131 of the Atomic Energy Act of 1954 (42 U.S.C. 2160)) if the requirements of subparagraph (B) are met.

(B) REQUIREMENTS FOR APPROVALS.— Exports, reexports, transfers, and retransfers referred to in subparagraph (A) may only be approved if—

(i) the end user—

(I) is a multinational facility participating in an IAEA-approved program to provide alternatives to national fuel cycle capabilities; or

(II) is a facility participating in, and the export, reexport, transfer, or retransfer is associated with, a bilateral or multinational program to develop a proliferation-resistant fuel cycle;

(ii) appropriate measures are in place at any facility referred to in clause (i) to ensure that no sensitive nuclear technology, as defined in section 4(5) of the Nuclear Nonproliferation Act of 1978 (22 U.S.C. 3203(5)), will be diverted to any person, site, facility, location, or program not under IAEA safeguards; and

(iii) the President determines that the export, reexport, transfer, or retransfer will not assist in the manufacture or acquisition of nuclear explosive devices or the production of fissile material for military purposes.

(5) NUCLEAR EXPORT ACCOUNTABILITY PROGRAM.—

(A) IN GENERAL.—The President shall ensure that all appropriate measures are taken to maintain accountability with respect to nuclear materials, equipment, and technology sold, leased, exported, or reexported to India so as to ensure—

(i) full implementation of the protections required under section 123 a.(1) of the Atomic Energy Act of 1954 (42 U.S.C. 2153 (a)(1)); and

(ii) United States compliance with Article I of the NPT.

(B) MEASURES.—The measures taken pursuant to subparagraph (A) shall include the following:

(i) Obtaining and implementing assurances and conditions pursuant to the export licensing authorities of the Nuclear Regulatory Commission and the Department of Commerce and the authorizing authorities of the Department of Energy, including, as appropriate, conditions regarding end-use monitoring.

(ii) A detailed system of reporting and accounting for technology transfers, including any retransfers in India, authorized by the Department of Energy pursuant to section 57 b. of the Atomic Energy Act of 1954 (42 U.S.C. 2077(b)). Such system shall be capable of providing assurances that—

(I) the identified recipients of the nuclear technology are authorized to receive the nuclear technology;

(II) the nuclear technology identified for transfer will be used only for peaceful safeguarded nuclear activities and will not be used for any military or nuclear explosive purpose; and

(III) the nuclear technology identified for transfer will not be retransferred without the prior consent of the United States, and facilities, equipment, or materials derived through the use of transferred technology will not be transferred without the prior consent of the United States.

(iii) In the event the IAEA is unable to implement safeguards as required by an agreement for cooperation arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153), appropriate assurance that arrangements will be put in place expeditiously that are consistent with the requirements of section 123 a.(1) of such Act (42 U.S.C. 2153(a)(1)) regarding the maintenance of safeguards as set forth in the agreement regardless of whether the agreement is terminated or suspended for any reason.

(C) IMPLEMENTATION.—The measures described in subparagraph (B) shall be implemented to provide reasonable assurances that the recipient is complying with the relevant requirements, terms, and conditions of any licenses issued by the United States regarding such exports, including those relating to the use, retransfer, safe handling, secure transit, and storage of such exports.

(e) JOINT RESOLUTION OF APPROVAL REQUIREMENT.—Section 123 d. of the Atomic Energy Act of 1954 (42 U.S.C.

2153(d)) is amended in the second proviso by inserting after ''that subsection'' the following: '', or an agreement exempted pursuant to section 104(a)(1) of the Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006,''.

(f) SUNSET.—The authority provided under subsection (a)(1) to exempt an agreement shall terminate upon the enactment of a joint resolution under section 123 d. of the Atomic Energy Act of 1954 (42 U.S.C. 2153(d)) approving such an agreement.

(g) REPORTING TO CONGRESS.—

(1) INFORMATION ON NUCLEAR ACTIVITIES OF INDIA.—The President shall keep the appropriate congressional committees fully and currently informed of the facts and implications of any significant nuclear activities of India, including—

(A) any material noncompliance on the part of the Government of India with—

(i) the nonproliferation commitments undertaken in the Joint Statement of July 18, 2005, between the President of the United States and the Prime Minister of India;

(ii) the separation plan presented in the national parliament of India on March 7, 2006, and in greater detail on May 11, 2006;

(iii) a safeguards agreement between the Government of India and the IAEA;

(iv) an Additional Protocol between the Government of India and the IAEA;

(v) an agreement for cooperation between the Government of India and the United States Government arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) or any subsequent arrangement under section 131 of such Act (42 U.S.C. 2160);

(vi) the terms and conditions of any approved licenses regarding the export or reexport of nuclear material or dual-use material, equipment, or technology; and

(vii) United States laws and regulations regarding such licenses;

(B) the construction of a nuclear facility in India after the date of the enactment of this title;

(C) significant changes in the production by India of nuclear weapons or in the types or amounts of fissile material produced; and

(D) changes in the purpose or operational status of any unsafeguarded nuclear fuel cycle activities in India.

(2) IMPLEMENTATION AND COMPLIANCE REPORT.—Not later than 180 days after the date on which an agreement for cooperation with India arranged pursuant to section 123 of the Atomic Energy Act of 1954 (42 U.S.C. 2153) enters into force, and annually thereafter, the President shall submit to the appropriate congressional committees a report including—

(A) a description of any additional nuclear facilities and nuclear materials that the Government of India has placed or intends to place under IAEA safeguards;

(B) a comprehensive listing of—

(i) all licenses that have been approved by the Nuclear Regulatory Commission and the Secretary of Energy for exports and reexports to India under parts 110 and 810 of title 10, Code of Federal Regulations;

(ii) any licenses approved by the Department of Commerce for the export or reexport to India of commodities, related technology, and software which are controlled for nuclear nonproliferation reasons on the Nuclear Referral List of the Commerce Control List maintained under part 774 of title 15, Code of Federal Regulation, or any successor regulation;

(iii) any other United States authorizations for the export or reexport to India of nuclear materials and equipment; and

(iv) with respect to each such license or other form of authorization described in clauses (i), (ii), and (iii)—

(I) the number or other identifying information of each license or authorization;

(II) the name or names of the authorized end user or end users;

(III) the name of the site, facility, or location in India to which the export or reexport was made;

(IV) the terms and conditions included on such licenses and authorizations;

(V) any post-shipment verification procedures that will be applied to such exports or reexports; and

(VI) the term of validity of each such license or authorization;

(C) a description of any significant nuclear commerce between India and other countries, including any such trade that—

(i) is not consistent with applicable guidelines or decisions of the NSG; or

(ii) would not meet the standards applied to exports or reexports of such material, equipment, or technology of United States origin;

(D) either—

(i) an assessment that India is in full compliance with the commitments and obligations contained in the agreements and other documents referenced in clauses (i) through (vi) of paragraph (1)(A); or

(ii) an identification and analysis of all compliance issues arising with regard to 27 the adherence by India to its commitments and obligations, including—

(I) the measures the United States Government has taken to remedy or otherwise respond to such compliance issues;

(II) the responses of the Government of India to such measures;

(III) the measures the United States Government plans to take to this end in the coming year; and

(IV) an assessment of the implications of any continued noncompliance, including whether nuclear commerce with India remains in the national security interest of the United States;

(E)(i) an assessment of whether India is fully and actively participating in United States and international efforts to dissuade, isolate, and, if necessary, sanction and contain Iran for its efforts to acquire weapons of mass destruction, including a nuclear weapons capability (including the capability to enrich uranium or reprocess nuclear fuel), and the means to deliver weapons of mass destruction, including a description of the specific measures that India has taken in this regard; and

(ii) if India is not assessed to be fully and actively participating in such efforts, a description of—

(I) the measures the United States Government has taken to secure India's full and active participation in such efforts;

(II) the responses of the Government of India to such measures; and

(III) the measures the United States Government plans to take in the coming year to secure India's full and active participation;

(F) an analysis of whether United States civil nuclear cooperation with India is in any way assisting India's nuclear weapons program, including through—

(i) the use of any United States equipment, technology, or nuclear material by India in an unsafeguarded nuclear facility or nuclear-weapons related complex;

(ii) the replication and subsequent use of any United States technology by India 31 in an unsafeguarded nuclear facility or unsafeguarded nuclear weapons-related complex, or for any activity related to the research, development, testing, or manufacture of nuclear explosive devices; and

(iii) the provision of nuclear fuel in such a manner as to facilitate the increased production by India of highly enriched uranium or plutonium in unsafeguarded nuclear facilities;

(G) a detailed description of—

(i) United States efforts to promote national or regional progress by India and Pakistan in disclosing, securing, limiting, and reducing their fissile material stockpiles, including stockpiles for military purposes, pending creation of a world-wide fissile material cut-off regime, including the institution of a Fissile Material Cut-off Treaty;

(ii) the responses of India and Pakistan to such efforts; and

(iii) assistance that the United States is providing, or would be able to provide, to India and Pakistan to promote the objectives in clause (i), consistent with its obligations under international law and existing agreements;

(H) an estimate of—

(i) the amount of uranium mined and milled in India during the previous year;

(ii) the amount of such uranium that has likely been used or allocated for the production of nuclear explosive devices; and

(iii) the rate of production in India of—

(I) fissile material for nuclear explosive devices; and

(II) nuclear explosive devices;

(I) an estimate of the amount of electricity India's nuclear reactors produced for civil purposes during the previous year and the proportion of such production that can be attributed to India's declared civil reactors;

(J) an analysis as to whether imported uranium has affected the rate of production in India of nuclear explosive devices;

(K) a detailed description of efforts and progress made toward the achievement of India's—

(i) full participation in the Proliferation Security Initiative;

(ii) formal commitment to the Statement of Interdiction Principles of such Initiative;

(iii) public announcement of its decision to conform its export control laws, regulations, and policies with the Australia Group and with the Guidelines, Procedures, Criteria, and Controls List of the Wassenaar Arrangement; and

(iv) effective implementation of the decision described in clause (iii); and

(L) the disposal during the previous year of spent nuclear fuel from India's civilian nuclear program, and any plans or activities relating to future disposal of such spent nuclear fuel.

(3) SUBMITTAL WITH OTHER ANNUAL REPORTS.—

(A) REPORT ON PROLIFERATION PREVENTION.—Each annual report submitted under paragraph (2) after the initial report may be submitted together with the annual report on proliferation prevention required under section 601(a) of the Nuclear Non-Proliferation Act of 1978 (22 U.S.C. 3281(a)).

(B) REPORT ON PROGRESS TOWARD REGIONAL NONPROLIFERATION.—The information required to be submitted under paragraph (2)(F) after the initial report may be submitted together with the annual report on progress toward regional nonproliferation required under section 620F(c) of the Foreign Assistance Act of 1961 (22 U.S.C. 2376(c)).

(4) FORM.—Each report submitted under this subsection shall be submitted in unclassified form, but may contain a classified annex.

SEC. 105. UNITED STATES COMPLIANCE WITH ITS NUCLEAR NONPROLIFERATION TREATY OBLIGATIONS.

Nothing in this title constitutes authority for any action in violation of an obligation of the United States under the NPT.

SEC. 106. INOPERABILITY OF DETERMINATION AND WAIVERS.

A determination and any waiver under section 104 shall cease to be effective if the President determines that India has detonated a nuclear explosive device after the date of the enactment of this title.

SEC. 107. MTCR ADHERENT STATUS.

Congress finds that India is not an MTCR adherent for the purposes of section 73 of the Arms Export Control Act (22 U.S.C. 2797b).

SEC. 108. TECHNICAL AMENDMENT.

Section 1112(c)(4) of the Arms Control and Nonproliferation Act of 1999 (title XI of the Admiral James W. Nance and Meg Donovan Foreign Relations Authorization Act, Fiscal Years 2000 and 2001 (as enacted into law by section 1000(a)(7) of Public Law 106–113 and contained in appendix G of that Act; 113 Stat. 1501A– 486)) is amended—

(1) in subparagraph (B), by striking ''and'' after the semicolon at the end;

(2) by redesignating subparagraph (C) as sub-paragraph (D); and

(3) by inserting after subparagraph (B) the following new subparagraph:

''(C) so much of the reports required under section 104 of the Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006 as relates to verification or compliance matters; and''.

SEC. 109. UNITED STATES-INDIA SCIENTIFIC COOPERATIVE NUCLEAR NONPROLIFERATION PROGRAM.

(a) ESTABLISHMENT.—The Secretary of Energy, acting through the Administrator of the National Nuclear Security Administration, is authorized to establish a cooperative nuclear nonproliferation program to pursue jointly with scientists from the United States and India a program to further common nuclear nonproliferation goals, including scientific research and development efforts, with an emphasis on nuclear safeguards (in this section referred to as ''the program'').

(b) CONSULTATION.—The program shall be carried out in consultation with the Secretary of State and the Secretary of Defense.

(c) NATIONAL ACADEMIES RECOMMENDATIONS.—

(1) IN GENERAL.—The Secretary of Energy shall enter into an agreement with the National Academies to develop recommendations for the implementation of the program.

(2) RECOMMENDATIONS.—The agreement entered into under paragraph (1) shall provide for the preparation by qualified individuals with relevant expertise and knowledge and the communication to the Secretary of Energy each fiscal year of—

(A) recommendations for research and related programs designed to overcome existing

technological barriers to nuclear nonproliferation; and

(B) an assessment of whether activities and programs funded under this section are achieving the goals of the activities and programs.

(3) PUBLIC AVAILABILITY.—The recommendations and assessments prepared under this subsection shall be made publicly available.

(d) CONSISTENCY WITH NUCLEAR NON-PROLIFERATION TREATY.—All United States activities related to the program shall be consistent with United States obligations under the Nuclear Non-Proliferation Treaty.

(e) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated such sums as may be necessary to carry out this section for each of fiscal years 2007 through 2011.

SEC. 110. DEFINITIONS.

In this title:

(1) The term ''Additional Protocol'' means a protocol additional to a safeguards agreement with the IAEA, as negotiated between a country and the IAEA based on a Model Additional Protocol as set forth in IAEA information circular (INFCIRC) 540.

(2) The term ''appropriate congressional committees'' means the Committee on Foreign Relations of the Senate and the Committee on International Relations of the House of Representatives.

(3) The term ''dual-use material, equipment, or technology'' means material, equipment, or technology that may be used in nuclear or nonnuclear applications.

(4) The term ''IAEA safeguards'' has the meaning given the term in section 830(3) of the Nuclear Proliferation Prevention Act of 1994 (22 U.S.C. 6305(3)).

(5) The term ''Indian person'' means—

(A) a natural person that is a citizen of India or is subject to the jurisdiction of the Government of India;

(B) a corporation, business association, partnership, society, trust, or any other nongovernmental entity, organization, or group, that is organized under the laws of India or has its principal place of business in India; and

(C) any Indian governmental entity, including any governmental entity operating as a business enterprise.

(6) The terms ''Missile Technology Control Regime'', ''MTCR'', and ''MTCR adherent'' have the meanings given the terms in section 74 of the Arms Export Control Act (22 U.S.C. 2797c).

(7) The term ''nuclear materials and equipment'' means source material, special nuclear material, production and utilization facilities and any components thereof, and any other items or materials that are determined to have significance for nuclear explosive purposes pursuant to subsection 109 b. of the Atomic Energy Act of 1954 (42 U.S.C. 2139(b)).

(8) The terms ''Nuclear Non-Proliferation Treaty'' and ''NPT'' mean the Treaty on the Non-Proliferation of Nuclear Weapons, done at Washington, London, and Moscow July 1, 1968, and entered into force March 5, 1970 (21 UST 483).

(9) The terms ''Nuclear Suppliers Group'' and ''NSG'' refer to a group, which met initially in 1975 and has met at least annually since 1992, of Participating Governments that have promulgated and agreed to adhere to Guidelines for Nuclear Transfers (currently IAEA INFCIRC/254/Rev.8/ Part 1) and Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology (currently IAEA INFCIRC/254/ Rev.7/Part 2).

(10) The terms ''nuclear weapon'' and ''nuclear explosive device'' mean any device designed to produce an instantaneous release of an amount of nuclear energy from special nuclear material that is greater than the amount of energy that would be released from the detonation of one point of trinitrotoluene (TNT).

(11) The term ''process'' includes the term ''reprocess''.

(12) The terms ''reprocessing'' and ''reprocess'' refer to the separation of irradiated nuclear materials and fission products from spent nuclear fuel.

(13) The term ''sensitive nuclear technology'' means any information, including information incorporated in a production or utilization facility or important component part thereof, that is not available to the public and which is important to the design, construction, fabrication, operation, or maintenance of a uranium enrichment or nuclear fuel reprocessing facility or a facility for the production of heavy water.

(14) The term ''source material'' has the meaning given the term in section 11 z. of the Atomic Energy Act of 1954 (42 U.S.C. 2014(z)).

(15) The term ''special nuclear material'' has the meaning given the term in section 11 aa. of the Atomic Energy Act of 1954 (42 U.S.C. 2014(aa)).

(16) The term ''unsafeguarded nuclear fuel-cycle activity'' means research on, or development, design, manufacture, construction, operation, or maintenance of—

(A) any existing or future reactor, critical facility, conversion plant, fabrication plant, reprocessing plant,

plant for the separation of isotopes of source or special fissionable material, or separate storage installation with respect to which there is no obligation to accept IAEA safeguards at the relevant reactor, facility, plant, or installation that contains source or special fissionable material; or

(B) any existing or future heavy water production plant with respect to which there is no obligation to accept IAEA safeguards on any nuclear material produced by or used in connection with any heavy water produced therefrom.

TITLE II—UNITED STATES ADDITIONAL PROTOCOL IMPLEMENTATION

SEC. 201. SHORT TITLE.

This title may be cited as the ''United States Additional Protocol Implementation Act''.

SEC. 202. FINDINGS.

Congress makes the following findings:

(1) The proliferation of nuclear weapons and other nuclear explosive devices poses a grave threat to the national security of the United States and its vital national interests.

(2) The Nuclear Non-Proliferation Treaty has proven critical to limiting such proliferation.

(3) For the Nuclear Non-Proliferation Treaty to be effective, each of the non-nuclear-weapon State Parties must conclude a comprehensive safeguards agreement with the IAEA, and such agreements must be honored and enforced.

(4) Recent events emphasize the urgency of strengthening the effectiveness and improving the efficiency of the safeguards system. This can best be accomplished by providing IAEA inspectors with more information about,

and broader access to, nuclear activities within the territory of non-nuclear-weapon State Parties.

(5) The proposed scope of such expanded information and access has been negotiated by the member states of the IAEA in the form of a Model Additional Protocol to its existing safeguards agreements, and universal acceptance of Additional Protocols by non-nuclear weapons states is essential to enhancing the effectiveness of the Nuclear Non-Proliferation Treaty.

(6) On June 12, 1998, the United States, as a nuclear-weapon State Party, signed an Additional Protocol that is based on the Model Additional Protocol, but which also contains measures, consistent with its existing safeguards agreements with its members, that protect the right of the United States to exclude the application of IAEA safeguards to locations and activities with direct national security significance or to locations or information associated with such activities.

(7) Implementation of the Additional Protocol in the United States in a manner consistent with United States obligations under the Nuclear Non-Proliferation Treaty may encourage other parties to the Nuclear Non-Proliferation Treaty, especially non-nuclear-weapon State Parties, to conclude Additional Protocols and thereby strengthen the Nuclear Non-Proliferation Treaty safeguards system and help reduce the threat of nuclear proliferation, which is of direct and substantial benefit to the United States.

(8) Implementation of the Additional Protocol by the United States is not required and is completely voluntary given its status as a nuclear-weapon State Party, but the United States has acceded to the Additional Protocol to demonstrate its commitment to the nuclear non-proliferation regime and to make United States civil nuclear activities available to the same IAEA inspections as are applied in the case of non-nuclear-weapon State Parties.

(9) In accordance with the national security exclusion contained in Article 1.b of its Additional Protocol, the United States will not allow any inspection activities, nor make any declaration of any information with respect to, locations, information, and activities of direct national security significance to the United States.

(10) Implementation of the Additional Protocol will conform to the principles set forth in the letter of April 30, 2002, from the United States Permanent Representative to the International Atomic Energy Agency and the Vienna Office of the United Nations to the Director General of the International Atomic Energy Agency.

SEC. 203. DEFINITIONS.

In this title:

(1) ADDITIONAL PROTOCOL.—The term ''Additional Protocol'', when used in the singular form, means the Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America, with Annexes, signed at Vienna June 12, 1998 (T. Doc. 107–7).

(2) APPROPRIATE CONGRESSIONAL COMMITTEES.—The term ''appropriate congressional committees'' means the Committee on Armed Services, the Committee on Foreign Relations, and the Committee on Appropriations of the Senate and the Committee on Armed Services, the Committee on International Relations, the Committee on Science, and the Committee on Appropriations of the House of Representatives.

(3) COMPLEMENTARY ACCESS.—The term ''complementary access'' means the exercise of the IAEA's access rights as set forth in Articles 4 to 6 of the Additional Protocol.

(4) EXECUTIVE AGENCY.—The term ''executive agency'' has the meaning given such term in section 105 of title 5, United States Code.

(5) FACILITY.—The term ''facility'' has the meaning set forth in Article 18i. of the Additional Protocol.

(6) IAEA.—The term ''IAEA'' means the International Atomic Energy Agency.

(7) JUDGE OF THE UNITED STATES.—The term ''judge of the United States'' means a United States district judge, or a United States magistrate judge appointed under the authority of chapter 43 of title 28, United States Code.

(8) LOCATION.—The term ''location'' means any geographic point or area declared or identified by the United States or specified by the International Atomic Energy Agency.

(9) NUCLEAR NON-PROLIFERATION TREATY.— The term ''Nuclear Non-Proliferation Treaty'' means the Treaty on the Non-Proliferation of Nuclear Weapons, done at Washington, London, and Moscow July 1, 1968, and entered into force March 5, 1970 (21 UST 483).

(10) NUCLEAR-WEAPON STATE PARTY AND NON-NUCLEAR-WEAPON STATE PARTY.—The terms ''nuclear-weapon State Party'' and ''non-nuclear-weapon State Party'' have the meanings given such terms in the Nuclear Non-Proliferation Treaty.

(11) PERSON.—The term ''person'', except as otherwise provided, means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, any State or any political subdivision thereof, or any political entity within a State, any foreign government or nation or any agency, instrumentality, or political subdivision of any such government or nation, or other entity located in the United States.

(12) SITE.—The term ''site'' has the meaning set forth in Article 18b. of the Additional Protocol.

(13) UNITED STATES.—The term ''United States'', when used as a geographic reference, means the several States of the United States, the District of Columbia, and the commonwealths, territories, and possessions of the United

States and includes all places under the jurisdiction or control of the United States, including—

(A) the territorial sea and the overlying airspace;

(B) any civil aircraft of the United States or public aircraft, as such terms are defined in paragraphs (17) and (41), respectively, of section 40102(a) of title 49, United States Code; and

(C) any vessel of the United States, as such term is defined in section 3(b) of the Maritime Drug Law Enforcement Act (46 U.S.C. App. 1903(b)).

(14) WIDE-AREA ENVIRONMENTAL SAMPLING.—The term ''wide-area environmental sampling'' has the meaning set forth in Article 18g. of the Additional Protocol.

SEC. 204. SEVERABILITY.

If any provision of this title, or the application of such provision to any person or circumstance, is held invalid, the remainder of this title, or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby.

Subtitle A—General Provisions

SEC. 211. AUTHORITY.

(a) IN GENERAL.—The President is authorized to implement and carry out the provisions of this title and the Additional Protocol and shall designate through Executive order which executive agency or agencies of the United States, which may include but are not limited to the Department of State, the Department of Defense, the Department of Justice, the Department of Commerce, the Department of Energy, and the Nuclear Regulatory Commission, shall issue or amend and enforce regulations in order to implement this title and the provisions of the Additional Protocol.

(b) INCLUDED AUTHORITY.—For any executive agency designated under subsection (a) that does not currently possess the authority to conduct site vulnerability assessments and related activities, the authority provided in subsection (a) includes such authority.

(c) EXCEPTION.—The authority described in subsection (b) does not supersede or otherwise modify any existing authority of any Federal department or agency already having such authority.

Subtitle B—Complementary Access

SEC. 221. REQUIREMENT FOR AUTHORITY TO CONDUCT COMPLEMENTARY ACCESS.

(a) PROHIBITION.—No complementary access to any location in the United States shall take place pursuant to the Additional Protocol without the authorization of the United States Government in accordance with the requirements of this title.

(b) AUTHORITY.—

(1) IN GENERAL.—Complementary access to any location in the United States subject to access under the Additional Protocol is authorized in accordance with this title.

(2) UNITED STATES REPRESENTATIVES.—

(A) RESTRICTIONS.—In the event of complementary access to a privately owned or operated location, no employee of the Environmental Protection Agency or of the Mine Safety and Health Administration or the Occupational Safety and Health Administration of the Department of Labor may participate in the access.

(B) NUMBER.—The number of designated United States representatives accompanying IAEA inspectors shall be kept to the minimum necessary.

SEC. 222. PROCEDURES FOR COMPLEMENTARY ACCESS.

(a) IN GENERAL.—Each instance of complementary access to a location in the United States under the Additional Protocol shall be conducted in accordance with this subtitle.

(b) NOTICE.—

(1) IN GENERAL.—Complementary access referred to in subsection (a) may occur only upon the issuance of an actual written notice by the United States Government to the owner, operator, occupant, or agent in charge of the location to be subject to complementary access.

(2) TIME OF NOTIFICATION.—The notice under paragraph (1) shall be submitted to such owner, operator, occupant, or agent as soon as possible after the United States Government has received notification that the IAEA seeks complementary access. Notices may be posted prominently at the location if the United States Government is unable to provide actual written notice to such owner, operator, occupant, or agent.

(3) CONTENT OF NOTICE.—

(A) IN GENERAL.—The notice required by paragraph (1) shall specify—

(i) the purpose for the complementary access;

(ii) the basis for the selection of the facility, site, or other location for the complementary access sought;

(iii) the activities that will be carried out during the complementary access;

(iv) the time and date that the complementary access is expected to begin, and the anticipated period covered by the complementary access; and

(v) the names and titles of the inspectors.

(4) SEPARATE NOTICES REQUIRED.—A separate notice shall be provided each time that complementary access is sought by the IAEA.

(c) CREDENTIALS.—The complementary access team of the IAEA and representatives or designees of the United States Government shall display appropriate identifying credentials to the owner, operator, occupant, or agent in charge of the location before gaining entry in connection with complementary access.

(d) SCOPE.—

(1) IN GENERAL.—Except as provided in a warrant issued under section 223, and subject to the rights of the United States Government under the Additional Protocol to limit complementary access, complementary access to a location pursuant to this title may extend to all activities specifically permitted for such locations under Article 6 of the Additional Protocol.

(2) EXCEPTION.—Unless required by the Additional Protocol, no inspection under this title shall extend to—

(A) financial data (other than production data);

(B) sales and marketing data (other than shipment data);

(C) pricing data;

(D) personnel data;

(E) patent data;

(F) data maintained for compliance with environmental or occupational health and safety regulations; or

(G) research data.

(e) ENVIRONMENT, HEALTH, SAFETY, AND SECURITY.—In carrying out their activities, members of the IAEA complementary access team and representatives or designees of the United States Government shall observe applicable environmental, health, safety, and security regulations established at the location subject to complementary access, including those for protection of controlled environments within a facility and for personal safety.

SEC. 223. CONSENTS, WARRANTS, AND COMPLEMENTARY ACCESS.

(a) IN GENERAL.—

(1) PROCEDURE.—

(A) CONSENT.—Except as provided in paragraph (2), an appropriate official of the United States Government shall seek or have the consent of the owner, operator, occupant, or agent in charge of a location prior to entering that location in connection with complementary access pursuant to sections 221 and 222. The owner, operator, occupant, or agent in charge of the location may withhold consent for any reason or no reason.

(B) ADMINISTRATIVE SEARCH WARRANT.—In the absence of consent, the United States Government may seek an administrative search warrant from a judge of the United States under subsection (b). Proceedings regarding the issuance of an administrative search warrant shall be conducted ex parte, unless otherwise requested by the United States Government.

(2) EXPEDITED ACCESS.—For purposes of obtaining access to a location pursuant to Article 4b.(ii) of the Additional Protocol in order to satisfy United States obligations under the Additional Protocol when notice of two hours or less is required, the United States Government may gain entry to such location in connection with complementary access, to the extent such access is consistent with the Fourth Amendment to the United States Constitution, without obtaining either a warrant or consent.

(b) ADMINISTRATIVE SEARCH WARRANTS FOR COMPLEMENTARY ACCESS.—

(1) OBTAINING ADMINISTRATIVE SEARCH WARRANTS.—For complementary access conducted in the United States pursuant to the Additional Protocol, and for which the acquisition of a warrant is required, the United States Government shall first obtain an administrative search warrant from a judge of the United States. The United States Government shall provide to such judge all appropriate information regarding the basis for the selection of the facility, site, or other location to which complementary access is sought.

(2) CONTENT OF AFFIDAVITS FOR ADMINISTRATIVE SEARCH WARRANTS.—A judge of the United States shall promptly issue an administrative search warrant authorizing the requested complementary access upon an affidavit submitted by the United States Government—

(A) stating that the Additional Protocol is in force;

(B) stating that the designated facility, site, or other location is subject to complementary access under the Additional Protocol;

(C) stating that the purpose of the complementary access is consistent with Article 4 of the Additional Protocol;

(D) stating that the requested complementary access is in accordance with Article 4 of the Additional Protocol;

(E) containing assurances that the scope of the IAEA's complementary access, as well as what it may collect, shall be limited to the access provided for in Article 6 of the Additional Protocol;

(F) listing the items, documents, and areas to be searched and seized;

(G) stating the earliest commencement and the anticipated duration of the complementary access period, as well as the expected times of day during which such complementary access will take place; and

(H) stating that the location to which entry in connection with complementary access is sought was selected either—

(i) because there is probable cause, on the basis of specific evidence, to believe that information required to be reported regarding a location pursuant to regulations promulgated under this title is incorrect or incomplete, and that the location to be accessed contains evidence regarding that violation; or

(ii) pursuant to a reasonable general administrative plan based upon specific neutral criteria.

(3) CONTENT OF WARRANTS.—A warrant issued under paragraph (2) shall specify the same matters required of an affidavit under that paragraph. In addition, each warrant shall contain the identities of the representatives of the IAEA on the complementary access team and the identities of the representatives or designees of the United States Government required to display identifying credentials under section 222(c).

SEC. 224. PROHIBITED ACTS RELATING TO COMPLEMENTARY ACCESS.

It shall be unlawful for any person willfully to fail or refuse to permit, or to disrupt, delay, or otherwise impede, a complementary access authorized by this subtitle or an entry in connection with such access.

Subtitle C—Confidentiality of Information

SEC. 231. PROTECTION OF CONFIDENTIALITY OF INFORMATION.

Information reported to, or otherwise acquired by, the United States Government under this title or under the Additional Protocol shall be exempt from disclosure under section 552 of title 5, United States Code.

Subtitle D—Enforcement

SEC. 241. RECORDKEEPING VIOLATIONS.

It shall be unlawful for any person willfully to fail or refuse—

(1) to establish or maintain any record required by any regulation prescribed under this title;

(2) to submit any report, notice, or other information to the United States Government in accordance with any regulation prescribed under this title; or

(3) to permit access to or copying of any record by the United States Government in accordance with any regulation prescribed under this title.

SEC. 242. PENALTIES.

(a) CIVIL.—

(1) PENALTY AMOUNTS.—Any person that is determined, in accordance with paragraph (2), to have violated section 224 or section 241 shall be required by order to pay a civil penalty in an amount not to exceed $25,000 for each violation. For the purposes of this paragraph, each day during which a violation of section 224 continues shall constitute a separate violation of that section.

(2) NOTICE AND HEARING.—

(A) IN GENERAL.—Before imposing a penalty against a person under paragraph (1), the head of an executive agency designated under section 211(a) shall provide the person with notice of the order. If, within 15 days after receiving the notice, the person requests a hearing, the head of the designated executive agency shall initiate a hearing on the violation.

(B) CONDUCT OF HEARING.—Any hearing so requested shall be conducted before an administrative judge. The hearing shall be conducted in accordance with the requirements of section 554 of title 5, United States Code. If no hearing is so requested, the order imposed by the head of the designated agency shall constitute a final agency action.

(C) ISSUANCE OF ORDERS.—If the administrative judge determines, upon the preponderance of the evidence received, that a person named in the complaint has violated section 224 or section 241, the administrative judge shall state the findings of fact and conclusions of law, and issue and serve on such person an order described in paragraph (1).

(D) FACTORS FOR DETERMINATION OF PENALTY AMOUNTS.—In determining the amount of any civil penalty, the administrative judge or the head of the designated agency shall take into account the nature, circumstances, extent, and gravity of the violation or violations and, with respect to the violator, the ability to pay, effect on ability to continue to do business, any history of such violations, the degree of culpability, the existence of an internal compliance program, and such other matters as justice may require.

(E) CONTENT OF NOTICE.—For the purposes of this paragraph, notice shall be in writing and shall be verifiably served upon the person or persons subject to an order described in paragraph (1). In addition, the notice shall—

(i) set forth the time, date, and specific nature of the alleged violation or violations; and

(ii) specify the administrative and judicial remedies available to the person or persons subject to the order, including the availability of a hearing and subsequent appeal.

(3) ADMINISTRATIVE APPELLATE REVIEW.— The decision and order of an administrative judge shall be the recommended decision and order and shall be

referred to the head of the designated executive agency for final decision and order. If, within 60 days, the head of the designated executive agency does not modify or vacate the decision and order, it shall become a final agency action under this subsection.

(4) JUDICIAL REVIEW.—A person adversely affected by a final order may, within 30 days after the date the final order is issued, file a petition in the Court of Appeals for the District of Columbia Circuit or in the Court of Appeals for the district in which the violation occurred.

(5) ENFORCEMENT OF FINAL ORDERS.—

(A) IN GENERAL.—If a person fails to comply with a final order issued against such person under this subsection and—

(i) the person has not filed a petition for judicial review of the order in accordance with paragraph (4), or

(ii) a court in an action brought under paragraph (4) has entered a final judgment in favor of the designated executive agency, the head of the designated executive agency shall commence a civil action to seek compliance with the final order in any appropriate district court of the United States.

(B) NO REVIEW.—In any such civil action, the validity and appropriateness of the final order shall not be subject to review.

(C) INTEREST.—Payment of penalties assessed in a final order under this section shall include interest at currently prevailing rates calculated from the date of expiration of the 60day period referred to in paragraph (3) or the date of such final order, as the case may be.

(b) CRIMINAL.—Any person who violates section 224 or section 241 may, in addition to or in lieu of any civil penalty which may be imposed under subsection (a) for such violation, be fined under title 18, United States Code, imprisoned for not more than five years, or both.

SEC. 243. SPECIFIC ENFORCEMENT.

(a) JURISDICTION.—The district courts of the United States shall have jurisdiction over civil actions brought by the head of an executive agency designated under section 211(a)—

(1) to restrain any conduct in violation of section 224 or section 241; or

(2) to compel the taking of any action required by or under this title or the Additional Protocol.

(b) CIVIL ACTIONS.—

(1) IN GENERAL.—A civil action described in subsection (a) may be brought—

(A) in the case of a civil action described in paragraph (1) of such subsection, in the United States district court for the judicial district in which any act, omission, or transaction constituting a violation of section 224 or section 241 occurred or in which the defendant is found or transacts business; or

(B) in the case of a civil action described in paragraph (2) of such subsection, in the United States district court for the judicial district in which the defendant is found or transacts business.

(2) SERVICE OF PROCESS.—In any such civil action, process shall be served on a defendant wherever the defendant may reside or may be found.

Subtitle E—Environmental Sampling

SEC. 251. NOTIFICATION TO CONGRESS OF IAEA BOARD APPROVAL OF WIDE-AREA ENVIRONMENTAL SAMPLING.

(a) IN GENERAL.—Not later than 30 days after the date on which the Board of Governors of the IAEA approves wide-area environmental sampling for use as a safeguards verification tool, the President shall notify the appropriate congressional committees.

(b) CONTENT.—The notification under subsection (a) shall contain—

(1) a description of the specific methods and sampling techniques approved by the Board of Governors that are to be employed for purposes of wide-area sampling;

(2) a statement as to whether or not such sampling may be conducted in the United States under the Additional Protocol; and

(3) an assessment of the ability of the approved methods and sampling techniques to detect, identify, and determine the conduct, type, and nature of nuclear activities.

SEC. 252. APPLICATION OF NATIONAL SECURITY EXCLUSION TO WIDE-AREA ENVIRONMENTAL SAMPLING.

In accordance with Article 1(b) of the Additional Protocol, the United States shall not permit any wide-area environmental sampling proposed by the IAEA to be conducted at a specified location in the United States under Article 9 of the Additional Protocol unless the President has determined and reported to the appropriate congressional committees with respect to that proposed use of environmental sampling that—

(1) the proposed use of wide-area environmental sampling is necessary to increase the capability of the IAEA to detect undeclared nuclear activities in the territory of a non-nuclear-weapon State Party;

(2) the proposed use of wide-area environmental sampling will not result in access by the IAEA to locations, activities, or information of direct national security significance; and

(3) the United States—

(A) has been provided sufficient opportunity for consultation with the IAEA if the IAEA has requested complementary access involving wide-area environmental sampling; or

(B) has requested under Article 8 of the Additional Protocol that the IAEA engage in complementary access in the United States that involves the use of wide-area environmental sampling.

SEC. 253. APPLICATION OF NATIONAL SECURITY EXCLUSION TO LOCATION-SPECIFIC ENVIRONMENTAL SAMPLING.

In accordance with Article 1(b) of the Additional Protocol, the United States shall not permit any location-specific environmental sampling in the United States under Article 5 of the Additional Protocol unless the President has determined and reported to the appropriate congressional committees with respect to that proposed use of environmental sampling that—

(1) the proposed use of location-specific environmental sampling is necessary to increase the capability of the IAEA to detect undeclared nuclear activities in the territory of a non-nuclear-weapon State Party;

(2) the proposed use of location-specific environmental sampling will not result in access by the IAEA to locations, activities, or information of direct national security significance; and

(3) with respect to the proposed use of environmental sampling, the United States—

(A) has been provided sufficient opportunity for consultation with the IAEA if the IAEA has requested complementary access involving location-specific environmental sampling; or

(B) has requested under Article 8 of the Additional Protocol that the IAEA engage in complementary access in the United States that involves the use of location-specific environmental sampling.

SEC. 254. RULE OF CONSTRUCTION.

As used in this subtitle, the term ''necessary to increase the capability of the IAEA to detect undeclared nuclear activities in the territory of a non-nuclear-weapon State Party'' shall not be construed to encompass proposed uses of environmental sampling that might assist the IAEA in detecting undeclared nuclear activities in the territory of a non-nuclear-weapon State Party by—

(1) setting a good example of cooperation in the conduct of such sampling; or

(2) facilitating the formation of a political consensus or political support for such sampling in the territory of a non-nuclear-weapon State Party.

Subtitle F—Protection of National Security Information and Activities

SEC. 261. PROTECTION OF CERTAIN INFORMATION.

(a) LOCATIONS AND FACILITIES OF DIRECT NATIONAL SECURITY SIGNIFICANCE.—No current or former Department of Defense or Department of Energy location, site, or facility of direct national security significance shall be declared or be subject to IAEA inspection under the Additional Protocol.

(b) INFORMATION OF DIRECT NATIONAL SECURITY SIGNIFICANCE.—No information of direct national security significance regarding any location, site, or facility associated with activities of the Department of Defense or the Department of Energy shall be provided under the Additional Protocol.

(c) RESTRICTED DATA.—Nothing in this title shall be construed to permit the communication or disclosure to the IAEA or IAEA employees of restricted data controlled by the provisions of the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), including in particular ''Restricted Data'' as defined under paragraph (1) of section 11 y. of such Act (42 U.S.C. 2014(y)).

(d) CLASSIFIED INFORMATION.—Nothing in this Act shall be construed to permit the communication or disclosure to the IAEA or IAEA employees of national security information and other classified information.

SEC. 262. IAEA INSPECTIONS AND VISITS.

(a) CERTAIN INDIVIDUALS PROHIBITED FROM OBTAINING ACCESS.—No national of a country designated by the Secretary of State under section 620A of the Foreign Assistance Act of 1961 (22 U.S.C. 2371) as a government supporting acts of international terrorism shall be permitted access to the United States to carry out an inspection activity under the Additional Protocol or a related safeguards agreement.

(b) PRESENCE OF UNITED STATES GOVERNMENT PERSONNEL.—IAEA inspectors shall be accompanied at all times by United States Government personnel when inspecting sites, locations, facilities, or activities in the United States under the Additional Protocol.

(c) VULNERABILITY AND RELATED ASSESSMENTS.—The President shall conduct vulnerability, counterintelligence, and related assessments not less than every 5 years to ensure that information of direct national security significance remains protected at all sites, locations, facilities, and activities in the United States that are subject to IAEA inspection under the Additional Protocol.

Subtitle G—Reports

SEC. 271. REPORT ON INITIAL UNITED STATES DECLARATION.

Not later than 60 days before submitting the initial United States declaration to the IAEA under the Additional Protocol, the President shall submit to Congress a list of the sites, locations, facilities, and activities in the United States that the President intends to declare to the IAEA, and a report thereon.

SEC. 272. REPORT ON REVISIONS TO INITIAL UNITED STATES DECLARATION.

Not later than 60 days before submitting to the IAEA any revisions to the United States declaration submitted under the Additional Protocol, the President shall submit to Congress a list of any sites, locations, facilities, or activities in the United States that the President intends to add to or remove from the declaration, and a report thereon.

SEC. 273. CONTENT OF REPORTS ON UNITED STATES DECLARATIONS.

The reports required under section 271 and section 272 shall present the reasons for each site, location, facility, and activity being declared or being removed from the declaration list and shall certify that—

(1) each site, location, facility, and activity included in the list has been examined by each agency with national security equities with respect to such site, location, facility, or activity; and

(2) appropriate measures have been taken to ensure that information of direct national security significance will not be compromised at any such site, location, facility, or activity in connection with an IAEA inspection.

SEC. 274. REPORT ON EFFORTS TO PROMOTE THE IMPLEMENTATION OF ADDITIONAL PROTOCOLS.

Not later than 180 days after the entry into force of the Additional Protocol, the President shall submit to the appropriate congressional committees a report on—

(1) measures that have been or should be taken to achieve the adoption of additional protocols to existing safeguards agreements signed by non-nuclear-weapon State Parties; and

(2) assistance that has been or should be provided by the United States to the IAEA in order to promote the effective implementation of additional protocols to existing safeguards agreements signed by non-nuclear-weapon State Parties and the verification of the compliance of such parties with IAEA obligations, with a plan for providing any needed additional funding.

SEC. 275. NOTICE OF IAEA NOTIFICATIONS.

The President shall notify Congress of any notifications issued by the IAEA to the United States under Article 10 of the Additional Protocol.

Subtitle H—Authorization of Appropriations

SEC. 281. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as may be necessary to carry out this title.

ABOUT THE CONTRIBUTORS

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