Protection of Fissile Materials:
The Indian Experience

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Introduction

Both the global civilian nuclear energy and military nuclear weapon programs are revealing anomalous trends in the post-Cold war era. Thus, atomic power is under attack in the developed world. However, five new nuclear power plants—located in France, Japan, Romania and the United States—became operational in 1996. And the construction of three new atomic power reactors—two in China and one in Japan—began in 1996. The total number of nuclear power plants operating in the world has reached 443. Around thirty-six more are under construction in fourteen countries.[1] Rumors, therefore, of the imminent demise of the atomic energy industry have been vastly exaggerated. And the problem of protecting the fissile materials that these reactors are manufacturing is discretely expanding.

The problem of ensuring the security of fissile material stocks in nuclear weapons is becoming more acute, for three major reasons:

- First, the several arms control agreements reached between the United States and Russia have led to the retirement of entire classes of nuclear arms. The fissile materials released from their warheads require adequate storage arrangements to ensure their physical security. From the safety viewpoint, it is arguable that keeping fissile materials in the warheads is the best way to protect them.
- Second, the Cooperative Threat Reduction program has provided considerable reassurance regarding the containment of the "loose nukes" problem in the former Soviet Republics. Persistent reports continue, nevertheless, of nuclear materials being smuggled out of these countries, including Russia.[2]
- Third, the three crucial nuclear-capable states—Israel, India, and Pakistan—remain outside the NPT's discipline. India has not joined the CTBT (Comprehensive Test Ban Treaty) or the negotiations on the FMCT (Fissile Material Cut-off Treaty). India and Pakistan conducted their nuclear test series in May 1998 although it remains unclear whether they have weaponized or deployed nuclear weapons. But these tests have radically altered the structure of the international nuclear regime

This situation gets further complicated because no clear distinction is possible between the civil and military aspects of India's nuclear program. Its "nuclear option" derives from its civil nuclear facilities and installations. An overview of its nuclear program is therefore necessary. Ensuring the physical safety of fissile materials and their production facilities and installations has an external aspect. How India has ensured this in times of war and peace will be noted. This issue obviously has an internal security and environmental safety dimension. Therefore, the arrangements made for ensuring the physical safety of nuclear facilities and installations, environmental protection, and waste management will also be noted. Finally, the role of international regimes to mitigate the dangers associated with fissile materials, and what remains unfinished in this agenda is discussed.

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[1] *Financial Times*, 25 April 1997.

[2] USIS, "Chronology of Nuclear Smuggling Incidents," *Wireless File*, 22 March 1996. Apropos, each quarterly issue of the PPNN Newsbrief carries a section on "Illicit Nuclear Trafficking."

India's Nuclear Program

The strategic vision forming this program is its emphasis on exploiting India's vast resources of thorium (368,000 tons) and judiciously using its limited reserves (78,000 tons) of low grade (less than 0.1 percent) uranium ore. This vision was conceived within India's traditional policy of striving for self-reliance, especially in the area of sensitive technologies, which distinguished Nehru's domestic and foreign policy. Pressurized Heavy Water Reactors (PHWRs) were deliberately chosen, therefore, because they use natural uranium as fuel and do not require the heavy capital investments needed for establishing enrichment plants. Besides, "the natural uranium requirement for PHWR is the lowest and plutonium production is the highest. Finally, the infrastructure available in the country was suitable for undertaking manufacture of equipment for PHWR reactors."[3] This particular technological path has enabled India to proceed simultaneously in military and civil directions.

A three-stage atomic power program was initiated by India within this strategic vision, comprising:

- Stage-I—Construction of natural uranium, heavy water moderated reactors. Spent fuel was reprocessed to obtain plutonium.
- Stage-II—Reprocessed plutonium was used in Fast Breeder Reactors to derive U-233 from thorium. An advanced heavy water thermal reactor is also planned that would use "a Pu-239 enriched uranium fuel in the driver (booster) zone and U-233 enriched thorium fuel in the driven zone, [that] would generate a large part of its energy output from thorium through fission of in situ bred U-233."[4]
- Stage-III—Power reactors to be built with U-233-thorium fuel.

India's nuclear program has been described as one

> involving closed and combined fuel cycles and utilizing natural uranium, plutonium and thorium, and we consider it an effective path of "sustainable development" in the nuclear field. In our view, disposing of "spent fuel" as waste is not a prudent option, as is being advocated under the "once-through fuel cycle." Spent fuel has useful energy content and its fuel values should be recovered by reprocessing. Also, from the waste management point-of-view, the "closed fuel-cycle" is a much safer option.[5]

India has ten operating reactors—two BWRs (Boiling Water Reactors) and eight PHWRs—with a total rated capacity of 1900 MWe (Mega Watts electrical). It has four PHWRs of 220 MWe each and two PHWRs of 500 MWe each under construction and two Russian-aided PHWRs (1000 MWe each) and one FBR (Fast Breeder Reactor) (500 MWe) either awaiting sanction or under negotiation. Eight PHWRs (500 MWe each) are in the planning stage. In addition, India has established the Apsara (1956), Zerlina (1961), Purnima I, II, III experimental research reactors, apart from the larger 40 MWt (Mega Watts thermal) Cirus (1960), 100 MWt Dhruva (1985), and 15 Mwt Kamini (1985) FBTR (Fast Breeder Test Reactor).[6]

Over the years, India has established facilities to fabricate a wide range of nuclear fuels including metallic, mixed oxide and carbide fuels, besides alloy fuels using natural uranium, thorium, plutonium and U-233. India has a small plutonium reprocessing plant at the Bhabha Atomic Research Center, (BARC) "based on a declassified Purex design customized for India and built indigenously by [its] scientists and

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[3] Y.S.R. Prasad, "Nuclear Power Development: The Indian Experience," in *Nuclear Cooperation: Challenges and Prospects,* eds. Deepa Ollapally and S. Rajagopal (Bangalore: National Institute of Advanced Studies, 1997), p. 96.

[4] *Op. Cit.*, p. 97.

[5] "Support for Peaceful Use of Atomic Energy" (address by Dr. R. Chidambaram, Chairman, Atomic Energy Commission and Leader of the Indian Delegation at the 39th Regular Session of the International Atomic Energy Commission), reproduced in *Strategic Digest* November 1995, p. 1677.

[6] P.K. Iyengar, *Indian Nuclear Programme: Past, Present, and Future*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), Tables 1 and 2. Figures in brackets give the year in which these reactors became critical.

engineers."[7] It also has a second (100–150 ton) separation plant in Trombay. A third (200 ton?) plant in Kalpakkam is undergoing commissioning trials. Pilot gas-centrifuge uranium enrichment plants are working at BARC and Ratnahalli, presumably to sustain a nuclear submarine program.

The ambit of India's nuclear program informs that several sites need protection to ensure the safety of fissile materials. An attendant problem that requires discussion is their possible diversion by national and/or sub-national actors for clandestine purposes.

Extra-National Threats

Apropos, the location of India's nuclear facilities and installations is unusual in that its reactors are mostly located in coastal regions. Prominent examples are Trombay, Tarapur, Kaiga, Kudankulam, and Kalpakkam. These site locations were deliberately chosen to facilitate landing of the heavy and outsize structures required for their construction. The difficulties in transporting them over a thousand kilometers from ports to the Rajasthan project informed these perceptions. This became a Herculean task, because a "substantial amount of work had to be done on widening roads, strengthening bridges, and building by-passes to roads that passed through medieval walled cities."[8]

Though convenient from the construction viewpoint, the coastal locations of these nuclear facilities and installations has greatly complicated the planning of their defense against external threats. These could emanate from aerial or naval attacks launched from airfields across the border, apart from surface ships and submarines. A further threat arises from commando attacks launched from the seaward, apart from land direction. A particular danger in the Indo–Pak situation derives from the danger of sabotage of nuclear facilities and installations. The multi-dimensional nature of these threats emphasizes their extreme vulnerability to external attack.

The protection of India's nuclear program became a major concern during the planning exercises undertaken before the Indo–Pak war of 1971. The British legacy, which guides such exercises, requires identification and prioritization of "vital areas" and "vital points" for allocation of available air defense assets. During the event, nuclear facilities and installations were accorded the highest priority, along with on-shore and off-shore oil installations. But the assessment was also made that aerial attacks upon Indian nuclear facilities and installations were unlikely given two considerations: (1) the type of platforms and weapons then available to Pakistan and (2) the premise that Pakistan would not commit its limited air power to attacking non-military targets. This assessment proved accurate, but for somewhat different reasons. These were the reluctance of the Pakistan Air Force to commit its long-range Mirage-III E fighter-bombers in the conflict and the virtual immobilization of its squadrons as their Bengali technicians (some 30 percent of the Pakistan Air Force) could not be trusted with servicing their combat aircraft.

The most likely danger to nuclear facilities and installations was assessed to arise from commando raids being mounted from the seaward direction in appreciation of Pakistan's acquisition of mini-submarines of the "sea chariot" genre that were primarily intended for special operations. The counter-measures taken were strengthening the perimeter defenses around nuclear facilities and installations, and increasing the patrolling of the coastline. The possibility of internal sabotage also received attention. Employee records were reviewed and, where necessary, relocations to less sensitive positions were effected.

The nature of external threats to India's nuclear facilities and installations has changed over the years. The direct threat has increased with Pakistan's acquisition of long-range, high-performance F16 aircraft,

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[7] Frank Von Hippel, *India's and Pakistan's Nuclear-Energy Choices and Their Proliferation Implications*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), p. 4.

[8] M. R. Srinivasan, *An Appraisal of India's Civil Nuclear Power Programme*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), p. 3.

apart from airborne, ship-borne and submarine-borne missiles that could be delivered from standoff ranges. The vulnerability of nuclear assets to conventional attacks and the horrendous radiological damage that would ensue from their destruction motivated a search for diplomatic solutions to address this problem. This resulted in an agreement being signed in December 1988 by India and Pakistan codifying their intention to spare each other's designated nuclear facilities and installations from attack.[9] The Agreement on the Prohibition of Attack against Nuclear Installations and Facilities was ratified in 1991. It came into force in 1992 after the two countries exchanged the list of nuclear facilities and installations identified for this purpose. The operative clause in this agreement adumbrates:

> (1) Each party shall refrain from undertaking, encouraging, or participating in, directly or indirectly, any action aimed at causing the destruction of, or damage to, any nuclear installation or facility in the other country. (2) The term "nuclear installation or facility" includes nuclear power and research reactors, fuel fabrication, uranium enrichment, fresh or irradiated nuclear fuel and materials in any form and establishment storing significant quantities of radioactive materials.[10]

Some doubts initially arose whether all the nuclear facilities and installations had been duly listed. But these suspicions have abated following successive exchanges of these lists each year as provided in the Agreement. A plain reading of the agreement's operative clause informs that, apart from its confidence-building merits, its primary purpose was preventing the dispersal of fissile materials resulting in radiological damage. The non-attack agreement is a beneficial measure, therefore, to ensure the security of fissile materials and eliminate radiological warfare from South Asia.

Intra-National Threats

The internal security threat arises, at one level, from the possible diversion of fissile materials from power reactors by national or sub-national entities. The empirical evidence would confirm, however, that anxieties in this regard are largely illusory. Not a single case of diversion from power reactors by either national or sub-national entities has been proven, although some 443 nuclear reactors are operating in the world. A techno-political reason explains this phenomenon. Competent technical opinion informs that plutonium separated from spent fuel can no doubt be used for weapon purposes: hence, "reactor-grade plutonium must be regarded as potential weapons material."[11] However, the yield from such nuclear devices would be unpredictable and primarily derive from the sophistication of its design. Therefore, a regular nuclear testing program would be needed to gain confidence in the efficacy of such crude, first-generation, fission weapons, especially by a new nuclear weapons power that chooses to use reactor-grade plutonium.

Furthermore, a conviction that such a nuclear device would assuredly function *in extremis* might assure the nuclear scientists and engineers involved in its manufacture. No such faith could imbue the political leadership in a new nuclear nation, who need to function in the real world of real political thinkers. Nor would their military—inveterate realists—find it possible to place their full confidence in untested nuclear devices manufactured by using reactor grade plutonium. This line of argumentation calls into question popular beliefs that a new nuclear state would premise its security on reactor-grade plutonium-based devices.

The conclusion is unavoidable that power reactors are unlikely to find use in a weapons program. It is also unlikely that reactor-grade plutonium would commend itself to sub-national groups for terrorist

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[9] The full text of the Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities can be found on the ACDIS homepage at <http://acdisweb.acdis.uiuc.edu/homepage_docs/resource_docs/infotreatydocs/nucl.html> or in *Crisis Prevention: Confidence Building and Reconciliation in South Asia,* Michael Krepon and Amit Sevak, eds. (New Delhi: Manohar, 1996), pp. 254–55.

[10] Ibid.

[11] Frank Von Hippel, *India's and Pakistan's Nuclear-Energy Choices and Their Proliferation Implications*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), p. 5.

activities, because spent fuel cannot be handled "without remotely-controlled equipment and heavy radiation shielding. . . . The radiation level will remain high and require remote handling for at least 50 to 100 years."[12] Besides, the spent fuel would have to be reprocessed before the plutonium therein could be extracted for weapon purposes. These are activities that are far beyond the technical capacity of sub-national groups.

The issue now boils down to how much of the Indian nuclear program could be labeled "proliferation sensitive." Its power and research reactors do not use highly enriched uranium. India has no uranium enrichment facilities of any significance. Whether MOX fuel for the Tarapur BWRs could be designated as "proliferation sensitive" is an arguable proposition. Its handling might be easier and it may also be vulnerable to interdiction during transportation, but the plutonium therein would be reactor-grade and require chemical reprocessing. This could hardly interest national or sub-national groups. They could as well rely on chemical or biological weapons. Although it has been conceded that the "record of such [WMD] attacks is very, very slim . . . the catastrophic impact of a terrorist attack using these substances more than justifies a major effort to deter such attacks."[13] This logic could only be extended with great difficulty to the nuclear dimension.

That leaves the two research reactors, namely Cirus (40 MWt) and Dhruva (100 MWt) and the Kamini FBTR (15 MWt), that could be used for manufacturing weapons-grade plutonium. The plutonium for the 1974 Pokharan device incidentally came from Cirus. It was separated in the plutonium reprocessing plant at BARC. This plant along with the two other plutonium-reprocessing plants could be designated as "proliferation sensitive." This considerably reduces the dimensions of the problem of protecting fissile materials in the Indian program. It requires initial emphasis that no leakage of fissile materials has ever been reported from India. The record of the nuclear weapon powers is not that impeccable. Attention might also be drawn here to leakages of fissile materials that purportedly benefited Israel and to reports of fissile materials being transferred to nuclear aspirants.[14]

The problem of nuclear materials being smuggled out of the former Republics of the Soviet Union is especially worrisome. Most of the detections have been made in Germany where the police and intelligence agencies are vigilant. There are practically no detections of leakages from the Central Asian Republics that lie in close proximity to the recognized nuclear aspirants. Does this mean no smuggling of nuclear materials, equipment and technology is occurring from these countries? Or, is this supposition based on the premise that detections have not taken place?

What are the arrangements for physical security of India's nuclear facilities and installations, accident prevention, radiation monitoring, and radioactive waste management in India?

Physical Safety

It must be emphasized here that India's Atomic Energy Commission functions within the exclusive control of the Central (Union) Government, which is inscribed in the provisions of the Indian Constitution. The Atomic Energy Act, 1962 reserves all powers to "produce, develop, use, and dispose of atomic energy"; "manufacture or otherwise produce any prescribed or radioactive substance"; "buy or otherwise acquire,

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[12] Brian Chow, *Civilian Nuclear Programs in Indian and Pakistan*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), p. 8.

[13] USIS Backgrounder, "Terrorism Remains a Global Threat," *Wireless File*, 1 May 1997, p. 2.

[14] See, for example, the testimony of R. James Woolsey, director, Central Intelligence Agency, before the Senate Governmental Affairs Committee on 24 February 1994. He specifically deposed that: "Beijing prior to joining the Nonproliferation Treaty in 1992 probably provided some nuclear weapons-related assistance to Islamabad that may have included training, may have included equipment."

store, and transport" such substances; restrict information and entry into " prohibited areas"; provide for the "production and supply of electricity from atomic energy"; and so on to the Central Government.[15]

This ensures that all responsibility for physical security of nuclear facilities and installations devolves upon the Central Government. For purely historical reasons this is provided by the State Armed Forces in the Maharashtra province, where the oldest nuclear facilities and installations are situated. In conformity with the general policy of the Government of India, the security of the Commission's nuclear facilities and installations is provided by the Central Industrial Security Force. This is a para-military force working under the administrative control of the Central Government and having its own integral units for special operations. Air-defense cover is provided by the Indian Army.

Within nuclear facilities and installations physical barriers deny access to their functional areas. Further, access control is maintained over the personnel working in them. The level of protection within these functional areas is graduated, depending on the sensitivity of materials therein. Electronic systems are used for this purpose. Apparently, strict accounting procedures are followed and materials unaccounted for (MUF) is not perceived as a significant problem. This recital makes clear that the physical security of nuclear facilities and installations has been accorded the highest priority in India. It would be virtually impossible for sub-national groups to enter them and make away with fissile materials.

But a new dimension to this problem has been added by India's five nuclear tests in May 1998. Subsequent revelations show that Indian nuclear scientists and engineers in BARC had been working steadily for several years on perfecting these nuclear devices; their explosion within a few weeks of being ordered also suggests they were available in a state of advanced readiness for testing. Several questions arise: were only five nuclear devices manufactured? Or are there others ready in BARC for further testing and/or a weaponization and deployment program? Are they being stored in different locations in the interest of their protection from external attack or internal sabotage? This has further implications for their command and control, but more so for their physical safety. Nothing is known for certain about how the Atomic Energy Commission is ensuring the physical safety of these devices and their components. It is popularly believed that these devices are being kept in an unassembled state, which then creates serious doubts about their value for purposes of ensuring deterrence.

Environmental Protection

The institutional arrangements for ensuring environmental safety practices in nuclear facilities and installations are the responsibility of the Atomic Energy Regulatory Board (AERB). It functions with a large degree of autonomy but within the Atomic Energy Commission. This arrangement is subject to some criticism on the point that this affects the impartiality of the AERB. However, the Board claims that its safety standards are stricter than those prescribed by the International Commission on Radiological Protection (ICRP).

Technical exchanges are held by the Commission to share its operational safety experience with other bodies, apart from holding training programs for employees, supervising pollution and environmental control measures around plant premises, and undertaking safety research and environmental surveillance through monitoring stations.[16] Waste treatment, conditioning, and disposal systems are in operation at various nuclear plants. Waste immobilization Plants are under construction in Trombay and Kalpakkam. Suitable geological sites are being investigated for the final disposal of immobilized high level waste.[17] Incorporation of Intermediate Level Waste in a cement matrix is proceeding, and a process for treating these wastes with organic resins is being studied.

[15] A copy of this legislation may be seen in *The A.I.R. Manual*, (Unrepealed Central Acts), Civil and Criminal, Volume 2, 5th Edition. Section 3 is germane here.

[16] Government of India, Department of Atomic Energy, *Annual Report, 1994–95*, pp. 3.15 and 3.16.

[17] *Op. Cit.*, pp.3.14 and 3.15.

It might straightway be conceded that the Indian nuclear program, not unlike other national programs, has not been accident-free. These have included "collapse during construction of a containment dome at Kaiga, a serious fire at Narora, exposure of 350 workers at Tarapur to radiation exceeding five rems (current limit two rems), leaks from pipes in waste-storage facilities, exposure to plutonium at Trombay, and to ultra-toxic tritium at Rajasthan. . . ."[18] It has officially been counter-argued that "The 120 reactor years of operating experience has been free of any incident leading to release of radioactivity into the environment."[19] What is being urged, apropos, by the Commission is that accidents, in the very nature of all industrial activity, cannot be wholly avoided. But no accident has occurred thus far in India comparable to the serious mishaps reported in several parts of the world.

The International Dimension

A very limited portion of India's nuclear program is under safeguards. This includes its two 160 MWe Tarapur BWRs, and the spent fuel produced by them after they went critical in 1969. The two 220 MWe RAPP PHWRs are also under safeguards. Furthermore, the Tarapur reprocessing facility, which was designated to separate plutonium from the spent fuel of the RAPP reactors, also comes under safeguards for the duration of this activity. The remaining part of India's nuclear program—comprising fuel fabrication facilities, research and power reactors, reprocessing plants, and pilot enrichment plants—are not under international safeguards, but function under India's autonomous control.

India has not entered either the Nuclear Nonproliferation Treaty or the Comprehensive Test Ban Treaty for reasons that need not detain us here. It has also strenuously resisted attempts to impose full-scope safeguards on its indigenously established and autonomously controlled nuclear facilities and installations. This was the price sought by the United States for continuing supplies of low-enriched uranium to India for the Tarapur reactors after the Pokharan Explosion in 1974 and enactment of the U.S. Nuclear Nonproliferation Act in 1978. A complete embargo was placed on nuclear exports to India thereafter by the Nuclear Suppliers Group (London Club). These prohibitions have been intensified after India's nuclear tests in May 1998 with the imposition of economic sanctions by the G-8 countries.

The embargo has extended to the supply of critical safety equipment for Tarapur, despite its grave implications for the large population living in this area. Supply of more efficiently designed LWRs (Light Water Reactors), which India is seeking for its nuclear power program, has also been embargoed. Its willingness to place these imported reactors under IAEA safeguards has not found favor with Western suppliers on the grounds that India's prior acceptance of full-scope safeguards on its nuclear program is essential. This would extend the ambit of international safeguards to India's "enrichment plants, reprocessing plants, and plutonium production reactors [that] are even more proliferation-prone than nuclear power plants,"[20] and place its entire nuclear program under international control. Such a dispensation is wholly unacceptable to India and posits within the domestic political debate as a national sovereignty issue.

The United States will be according the same priority to finalizing a Fissile Materials Cut-off Treaty as it did to securing the CTBT. It would be following up on the UN General Assembly resolution (December 1993) calling for early negotiation of a "non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other explosive devices."[21] India had co-sponsored this resolution. These are early days for the negotiation of the FMCT. Several contentious issues remain unresolved.

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[18] Praful Bidwai, "Nuclear Meltdown: Fuelling Fears over Foreign Entry," *The Times of India*. 28 February 1997.

[19] Y.S.R. Prasad, "Nuclear Power Development:The Indian Experience," in *Nuclear Cooperation: Challenges and Prospects,* eds. Deepa Ollapally and S. Rajagopal (Bangalore: National Institute of Advanced Studies, 1997), p. 98.

[20] Brian Chow, *Civilian Nuclear Programs in Indian and Pakistan*, (paper presented at Conference on "Civilian Nuclear Power and Technology" organized by The Asia Society and Japan Institute of International Affairs in New York, 19–21 June 1996), p. 4.

[21] UN General Assembly Resolution 48/75 L, December 1993 entitled "Prohibition of the Production of Fissile Material for Nuclear Weapons or Other Nuclear Explosive Devices."

But India might have three other possible reservations to the FMCT that should be noted. These are:

First, its ambit. Extending this treaty to identifiable military production facilities and installations is justifiable. But, if the proposed "internationally and effectively verifiable" arrangements were designed to extend over its entire nuclear program, the question could be raised whether the FMCT is designed to seek the cessation of fissile materials production for military purposes or is truly intended to impose full-scope safeguards upon the nuclear-capable states to bring them within the discipline of the international nuclear regime. Earlier India had resisted joining the FMCT negotiations and raised the same objections it had to entering the CTBT. Its position has since changed, and it is now cooperating with the Ad Hoc Committee established to draft this Treaty.

Second, its scope. The FMCT only addresses future production of fissile materials for military purposes. It does not address past stocks. Unless the huge military stocks of fissile materials with the nuclear weapon powers are immobilized, it would be discriminatory to freeze further production by the nuclear capable states. Greater thought needs to be accorded to this anomaly by addressing it in a separate protocol.

Third, the proposed FMCT would assuredly contain an entry-into-force clause. This would definitely require India and other nuclear capable states to join and ratify the treaty before it comes into effect. This position would again posit in India as a sovereignty issue and inflame domestic resistance to entering the FMCT.

These reservations by India can be placed in perspective by noting the inventories of weapon-grade plutonium and uranium within the nuclear-weapon powers and nuclear-capable states as shown in Table 1.

These numbers make clear that the proliferation, safety, environmental, and associated problems arising from military stocks of fissile materials apply more closely to the nuclear weapon states, especially the CIS nations and the United States. A serious address of this problem requires the nuclear powers to evolve credible measures for ensuring the safe custody and speedy reduction of their military stocks of fissile materials. Strengthening IAEA safeguards over the nonnuclear weapon states and preventing them from developing clandestine nuclear capabilities is a laudable objective to mitigate the horizontal proliferation danger. But these safeguards need to be extended over the huge military stocks with the nuclear weapon states, in the interests of equity, transparency, and international control being imposed over them.

Table 1: Weapon-Grade Plutonium and Uranium Held by the Nuclear-Weapon Powers and Nuclear-Capable States

State	*Plutonium*	*Percentage in Weapons*	*Uranium**	*Percentage in Weapons*
C.I.S.	131 +/–20	30	1025 +/–30%	20
USA	85 +/–3	40	640 +/–10%	30
France	4.8 +/–30	40	25 +/–20%	40
China	3.5 +/–50	30	20 +/–25%	40
UK	2.4 +/–20	40	10 +/–25%	60
Israel	0.44 +/–25	—	—	—
India	0.35 +/–30	—	—	—
Pakistan	—	—	0.21+/–30%	—

Notes: * Depicts highly enriched uranium (weapons-grade equivalent). All estimates are in tons for the period ending December 1993.
Source: *SIPRI Yearbook 1996: Armaments, Disarmament, and International Security* (Oxford: Oxford University Press, 1996), pp. 625–26. Adapted from D. AIbright, et al., *SIPRI Yearbook 1995: Armaments Disarmament and International Security* (Oxford: Oxford University Press, 1995), Table 9.2, p. 320.

Conclusions

The following recommendations can be made to gain all these objectives in a more equitable and realistic fashion.

- The storage and utilization of plutonium and immobilization of reactor wastes presents unusual technical and political challenges. A global consensus is urgently required to address this problem and its related complexities. The IAEA should take the lead in this matter to evolve the consensus necessary.
- The major danger of horizontal proliferation arises from leakages of fissile materials from the former Republics of the Soviet Union. This underlines the need for greater international cooperation in regard to intelligence-sharing, policing, and joint investigation arrangements. The Interpol could be strengthened for this purpose or another organization established to exclusively counter the smuggling of nuclear materials.
- India has traditionally rejected bilateral constraints being imposed upon it, along with Pakistan, in regard to nuclear disarmament measures. Following its nuclear tests India has declared that it was "prepared to consider being an adherent to some of the undertakings in the Comprehensive Test Ban Treaty. . . . [and] participate in the negotiations for the conclusion of a fissile material cut-off treaty in the Geneva based Conference on Disarmament."[22] Later, India declared that it would observe a "voluntary moratorium and refrain from conducting underground nuclear test explosions."[23] India could similarly declare a moratorium on further manufacture of fissile material for weapon purposes. This moratorium could be strengthened further by temporarily shutting down one of its reprocessing facilities; or accepting this moratorium on condition that the nuclear weapon powers keep reducing their nuclear arsenals; or placing its civilian and dual purpose nuclear facilities and installations under safeguards, symmetrically along with the nuclear weapon powers.
- Furthermore, the dilemma of asymmetry in national stockpiles can only be resolved by disabling them from use for military purposes. This would require the nuclear weapon powers to disclose their past military stocks of fissile materials, transferring them to civilian stockpiles, establishing international safeguards over such depositories, evolving a procedure for withdrawals therefrom for civilian purposes, and developing a challenge procedure to ensure against possible cheating. The nuclear weapon powers have already agreed to report past fissile materials manufacturing activities to IAEA on a detailed format. This is a helpful step forward. The initiation of collateral steps, like separating warheads from missiles and placing them under international control, would assuredly improve the atmospherics for proceeding towards nuclear disarmament and passage of the FMCT and nuclear disarmament. In essence, an equitable balance needs to be established between the rights and obligations of all parties to a FMCT, this is imperative to progress toward its fruition.

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[22] Text of Official Statement may be seen in *The Hindu*, 12 May 1998.

[23] See Prime Minister's statement in Parliament, *The Hindu*, 28 May 1998.