Evolution of India’s Nuclear Policy

India’s Nuclear Weapons Program: 1944-1960

The end of World War II marked a revolution in world affairs which fundamentally changed the role of warfare. Within the span of two years and two months, from 1945 to 1947, three critical events occurred whose reverberations have brought the threat of nuclear war in South Asia seemingly daily to the front pages of newspapers everywhere.

The three events were the establishment of the United Nations on 26 June 1945; the dramatic demonstration of the destruction of which even crude nuclear weapons are capable in August 1945; and the calamitous partition of British India into the modern states of India and Pakistan at midnight on 14-15 August 1947.

It is clear to everyone that the legacy of partition is a key driving force behind the nuclear standoff that now exists between India and Pakistan. Partition split apart a region that had been united for millenia amid communal massacres on a scale never before seen, leaving in its wake the unresolved issue of contested Kashmir - a Muslim-majority region held by Hindu-majority India. The skirmishing that has continued now for over sixty years, punctuated by outbreaks of full-scale war (in 1947, 1965, and 1971), have given both nations ample motivation to develop secret, confidential weapons to gain advantage over -- or restore balance with -- the other.

Another motivation for India's acquisition of nuclear weapons, less often considered in the West, is the potential threat and regional challenge presented by the nuclear-armed state of China, which faces India along much of its northern border. Disputes covering 80,000 square kilometers of this border region exist:

China currently occupies the Aksai Chin plateau adjacent to Ladakh in Kashmir; India occupies the North-East Frontier Agency claimed by China. India’s North-East Frontier Arunachal Pardesh is claimed by China.
These territorial disputes, a legacy of British rule, erupted into the Sino-Indian War on 20 October 1962, when China launched a massive attack on India to which India was powerless to respond. India had relied for years on a warm relationship with the Soviet Union as a counterweight to China, but with the USSR facing down the United States at the same moment in the Cuban Missile Crisis, India was shocked to find the Politburo suddenly switching to support China in an effort to bolster its own position. PM Nehru was forced to appeal to the U.S. for help. U.S. naval air forces arrived off the coast, but before the USAF could deploy to India, China halted its attack on 21 November and partially withdrew. China continues to hold the Aksai Chin region captured in the initial advance. The legacy of this incident was the discovery that the Soviet Union was an unreliable ally, and the deep resolve not to be at a similar disadvantage with respect to China in the future.

At the founding of the United Nations in 1945 the composition of the UN Security Council, the world's most influential and powerful international body, was fixed and has never changed from that time. By an accident of history India was not an independent state at that moment, and its only hope for representation at the conference was the Churchill administration, then in its closing days, which vehemently opposed India's national aspirations. As a result China - with a similar geographic size, population, and state of economic development - was given a seat on Security Council, but India was not. Nuclear weapons did not exist at the time the Security Council composition was debated, but over time the five Council members all acquired nuclear, then thermonuclear, arms. With the signing of the Nuclear Non-Proliferation Treaty in 1970, and the replacement on the Council of the non-nuclear Taipei Chinese government with the nuclear armed government in Beijing shortly thereafter, the de facto principle that Security Council permanent members and the "nuclear club" were one and the same was firmly established.

The crucial importance of the desire for recognition of India as a world power in driving forward the nuclear weapons program, even overshadowing considerations of military necessity and deterrence is underscored by remarks by former weapons program leader Raj Ramanna:
"There was never a discussion among us over whether we shouldn't make the bomb. How to do it was more important. For us it was a matter of prestige that would justify our ancient past. The question of deterrence came much later. Also, as Indian scientists we were keen to show our Western counterparts, who thought little of us those days, that we too could do it."¹

Thus it should be no surprise that India, now tied for third place among the world's largest economies (with Germany), and soon to become the most populous nation on Earth, has concluded that to be given its due in world affairs, it must become a member of the nuclear club as well.

What is notable however is how the world's largest democracy developed such capabilities. The decisions were made by a handful of people, with virtually no input or oversight by the public or the legislature. India's nuclear weapons program from its outset has answered only to the Prime Minister's office, and only the Prime Minister and a selected few of his or her appointees have ever had any say in its development and acquisition.

India's indigenous efforts in nuclear science and technology were established remarkably early. The first step was taken by Dr. Homi Jehangir Bhabha in March 1944 when he submitted a proposal to the Sir Dorab Tata Trust (established in honor of Bhabha's own uncle, Sir Dorab Tata) to found a nuclear research institute, over three years before independence and a year before the first nuclear weapon test. This led to the creation of the Tata Institute of Fundamental Research (TIFR) on 19 December 1945 with Bhabha as its first Director. The new government of India passed the Atomic Energy Act, on 15 April 1948, leading to the establishment of the Indian Atomic Energy Commission (IAEC) not quite one year after independence. At that time Prime Minister Pandit Jawaharlal Nehru declared:

“We must develop this atomic energy quite apart from war - indeed I think we must develop it for the purpose of using it for peaceful purposes. ... Of course, if

¹ Chengappa 2000: pg. 82
we are compelled as a nation to use it for other purposes, possibly no religious sentiments of any of us will stop the nation from using it that way.”

This note of ambivalence in Nehru's speech foreshadowed his policies on nuclear research for the next decade. Nehru took a prominent role in international politics, founding the Non-Aligned Movement, and advocating nuclear disarmament. However, he refused to foreclose India's nuclear option while other nations maintained nuclear arsenals and supported programs designed to bolster India's weapons potential.

In 1954 the Indian nuclear program began to move in a direction that would eventually lead to establishment of nuclear weapons capability. On 3 January 1954 the IAEC decided to set up a new facility - the Atomic Energy Establishment, Trombay (AEET), later to become the "Indian Los Alamos". On 3 August 1954 the Department of Atomic Energy (DAE) was created with Dr. Bhabha as Secretary. This department answered directly to the Prime Minister and has continued to do so down to the present day.

In 1955 construction began on India's first reactor, the 1 MW Apsara research reactor, with British assistance. And in September 1955, after more than a year of negotiation, Canada agreed to supply India with a powerful research reactor - the 40 MW Canada-India Reactor (CIR). Under the Eisenhower Administration's "Atoms for Peace" program the US agreed to supply 21 tons of heavy water for this reactor in February 1956, and the reactor was dubbed the Canada-India Reactor, U.S. or CIRUS (now commonly written as Cirus).

The reactor was a design ideal for producing weapons-grade plutonium, and was also extraordinarily large for research purposes, being capable of manufacturing enough plutonium for one to two bombs a year. The acquisition of Cirus was specifically intended by India to provide herself with a weapons option and this reactor produced the plutonium used in India's first nuclear test in 1974; provided the design prototype for India's more powerful Dhruva plutonium production "research" reactor; and is directly responsible for producing nearly half of the weapons grade

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2 Chengappa, pg. 79
plutonium currently believed to be in India's stockpile. The sale further set a precedent for similar technology transfers which greatly assisted Israel in obtaining its own plutonium production reactor from France shortly thereafter.

As a nation India has always placed a premium on self-sufficiency. It is, in fact, the most self-sufficient large economy in the world and does not import any nuclear fuel. [The traditionally closed nature of economy though accounts for the import/export based Chinese economy far outstripping its growth from the late seventies to the early nineties.] Due to its vast domestic resources of thorium (a potential fuel for breeder reactors) but limited supplies of uranium, from the start of its nuclear program India has always placed strong emphasis on the development of breeder reactor fuel cycles. Breeder reactors require highly concentrated fissionable material for reactor fuel: either highly enriched uranium or plutonium. This provided a peaceful rationale for developing a plutonium separation capability, but the principal impetus for the India's first fuel reprocessing plant was to obtain a nuclear option.

Discussions with American firms to construct India's first nuclear power plants at Tarapur were held in 1960-61. An interesting incident sheds light on Nehru's and Bhabha's thinking at that time. In 1960 Kenneth Nichols, a former U.S. Army engineer who played significant roles in the Manhattan Project, represented Westinghouse in discussions on power plant construction. In a meeting with Nehru and Bhabha, Nichols relates that Nehru turned to Bhabha and asked:

"Can you develop an atomic bomb?" Bhabha assured him that he could and in reply to Nehru's next question about time, he estimated that he would need about a year to do it. ... He concluded by saying to Bhabha "Well, don't do it until I tell you to."3

**Weapons Development: 1960-1967**

With the two projects to necessary to provide the materials for nuclear weapons underway, the Cirus production reactor and the Trombay plutonium plant,

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3 Perkovich 1999; pg. 36
Dr. Bhabha then turned his attention to acquiring information about nuclear weapons and initiating preliminary studies of weapon physics.

During the early sixties India's worries regarding China greatly increased. Tensions over the border disputes with China rose from 1959 onward, leading to large scale troop deployments by both sides in early 1962. By 1961 India had become aware of China's nuclear program which gave greater impetus to India's efforts.

A number of public indications show India's increasing interest in nuclear arms. On 9 January 1961 Nehru stated that:

“We are approaching a stage when it is possible to for us .. to make atomic weapons.”

A few weeks later, on 2 February, Bhabha was asked how long this would take and he responded "about two years I suppose". In September 1962, at Bhabha's urge, Nehru passed the revised Atomic Energy Act giving the central government strict control over all decisions on atomic energy.

Following India's humiliating defeat by China in the Indo-Chinese border war of October-November 1962, the first formal demand for the development of nuclear weapons was made in Parliament, by the Jana Singh Party, in December 1962. Bhabha, well aware that a Chinese nuclear test was not far off (his estimate was then 12 to 18 months), also began secretly disturbing for a vigorous effort to match China's, going so far as to ask Nehru to authorize a nuclear test in Ladakh on the Chinese border.

Nehru died on 27 May 1964 and was succeeded by Lal Bahadur Shastri who took office on 2 June. That summer and fall expectations of a Chinese nuclear test steadily increased. PM Shastri, a Gandhian, was strongly opposed to pursuing the Indian nuclear option, and Bhabha began making public statements in favor of intended to increase public support and political pressure. On 4 October Bhabha repeated his estimate publicly that India could build a bomb within 18 months. Interestingly, a U.S. National Intelligence Estimate issued on 16 October thought India capable of developing a weapon in one to three years.
The much anticipated Chinese test finally came on 16 October 1964. Shastri’s initial reaction was to reiterate his opposition to India following the same path. But on 24 October 1964 Bhabha made a now famous speech on Indian radio. Bhabha argued that "atomic weapons give a State possessing them in adequate numbers a deterrent power against attack from a much stronger State". He further claimed that such weapons were remarkably cheap citing cost estimates provided by the U.S. AEC for projected Plowshare (peaceful nuclear explosive) devices - $350,000 for a 10 kt device, and $600,000 for a 2 Mt device. From this he estimated that "a stockpile of some 50 atomic bombs would cost under $21 million and a stockpile of 50 two-megaton hydrogen bombs something of the order of $31.5 million."\(^4\)

It seems Bhabha could not have been unaware of how inappropriate such cost estimates were to the circumstances of India. The U.S. Plowshare cost figures were based on the incremental cost of producing devices by a vast industrial complex costing tens of billions of dollars, which had already manufactured nuclear weapons numbering in the tens of thousands. And even so, it is very questionable that the U.S. Plowshare estimates - made by Ploware advocates - constituted anything like full cost accounting for the usage of this vast infrastructure. And this also ignored the fact that the delivery systems for nuclear weapons typically cost several times as much as the weapons themselves. The real cost to India, for any nuclear weapon program would be orders of magnitude greater than Bhabha's claims (China had spent over $4 billion in then-year dollars up to 1964 for its program).

Nonetheless his claims fueled debate about the desirability of India initiating a weapons program, and undermined support for Shastri and his "no weapon" policy within his own Congress party. With Bhabha continuing to campaign both publicly and behind the scenes, Shastri eventually found himself in an untenable position. The enormous public stature of Bhabha, and the tight control over nuclear information, left no effective scientific voice to act as a counterweight.

There is a saying in the nuclear non-proliferation community: “The difference between a peaceful nuclear explosive and a bomb are the tail finish.” Bhabha knew

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\(^4\) Perkovich 1999; pg. 67
(and in fact had said so publicly in the past) that nuclear explosives for peaceful purpose and for weapons use were essentially the same, and he had succeeded in bringing Shastri around to supporting their development. The gain for Shastri was that now he had Bhabha's support for the lobby for an explicit weapon program. At that time India was very vulnerable to the sanctions that an acknowledged weapon program would produce, and a "peaceful nuclear explosive" or PNE program was the only feasible way that weapons could be openly pursued. This fiction of a "PNE" would be maintained through India's first nuclear test in 1974 and up until 11 May 1998, after its second round of nuclear testing, when India finally acknowledged the objective of obtaining nuclear arms.

In April Shastri gave Bhabha formal approval to move ahead with nuclear explosive development. On 5 April 1965 Bhabha initiated the effort by setting up the nuclear explosive design group, Study of Nuclear Explosions for Peaceful Purposes (SNEPP). Bhabha selected Raja Ramanna - Director of Physics at AEET - to lead the effort.

Evidence suggests that India's new interest in the nuclear option was of great concern to Pakistan. Reports from the fall of 1964 into mid 1965 indicate considerable concern by President Ayub Khan, and his Foreign Minister Zulfikar Ali Bhutto (later President). In March both men met with Chou En-lai in Beijing, a meeting both felt had very positive results and developed Chinese support for Pakistan. It was in mid-1965 that Bhutto made his famous remark that "India has acquired nuclear weapons, then we should have to eat grass, to get one, or buy one, of our own." Under Bhutto's later presidency the foundations of Pakistan's nuclear program would be laid. Thus in 1965, the seeds of the Indo-Pakistani nuclear confrontation of three decades later had been sown.

George Perkovich suggests that it was fear of the changes in the balance of power that Idia's nuclear weapon program would bring that motivated Pakistan to initiate the Second Indo-Pakistani War that summer.\footnote{Perkovich 1999; pg. 108}
This war, the second major war in three years involving India, was fought in three phases. First Pakistani forces moved in to the Indian marshland of the Rann of Kutch in April. India attempted to repulse the incursion, but the rainy season threatened isolation of Indian troops, and they withdrew. Thus emboldened by this first probe Pakistan attacked an Indian outpost in Kargil, Kashmir. India counterattacked and seized territory that had been held by Pakistan. Shastri agreed to a ceasefire and withdrew from Pakistani territory, and adopted a conciliatory stance regarding the Rann of Kutch - a stance widely regarded in India as weakness. It was apparently similarly regarded in Pakistan, because on 1 September Pakistan launched a massive armored assault on Kashmir. This attack pushed into Indian held Kashmir and threatened Srinagar but then ground to a halt. Then on 6 September India counterattacked south of Kashmir driving 15 miles into Pakistan, threatening Lahore.

Despite superior U.S. supplied arms in Pakistani hands (especially armor), India maintained a strong position on the battlefield. Then on 17 September China, which had supported Pakistan throughout the conflict - even alleging Indian aggression in the face of a Pakistani assault, attempted to involve itself directly by threatening Indian positions on the Tibetan border. India firmly resisted Chinese pressure, supported by both the U.S. and the USSR.

The outcome of the war did a great deal to strengthen India's long-term resolve to acquire nuclear weapons. The alliance between U.S. armed Pakistan and nuclear-armed China presented India with a security threat that they could not ignore. Although India did find some support from the Superpowers with respect to Chinese pressure, but found that when faced with unprovoked attack - foreign "even handedness" cut off supplies and aid to both, indicating that India could not expect outside aid if threatened in the future.

It seems clear that at this point Bhabha felt he had authority to go ahead with developing and perhaps even testing an actual nuclear device, since in the wake of the war he seemed satisfied with the program then authorized. Homi Sethna, head of
the IAEC, has stated that Shastri told Bhabha during the war to go ahead with development but to hold off testing unless he had clearance from the cabinet.⁶

This initial effort to develop a "peaceful nuclear explosive" (PNE) existed almost entirely as an unwritten personal understanding between Dr. Bhabha and PM Shastri.

On 11 January 1966, just hours after he had signed the Tashkent Declaration formalizing the end of hostilities in the war with Pakistan, PM Shastri died of a heart attack. Just two weeks later on January 24, and the very day Shastri's successor Indira Gandhi was sworn in as Prime Minister, Dr. Homi Bhabha was killed while on a trip to Europe when the plane in which he was flying collided with Mount Blanc. India's impressively large nuclear establishment was suddenly left without any official plan or policy, to give it direction.

But Bhabha had by now shaped India's nuclear establishment and policy making environment to such an extent that the patterns he established would persist for decades after this death. Under Bhabha, the drive toward building the infrastructure for nuclear explosives, and the advocacy for developing such explosives had come from the nuclear scientists themselves - not from civilian government, and certainly not from the Indian military which virtually no role in the planning or decision making. The advance of the nuclear explosives program would also be conducted without any serious public debate over the decisions taken, and without consultation of parliament. The desire of weapons developers to continual advance the program would be offset though by the fact that the support for the program was not based on a broad consensus among key decision makers. Thus the program's fortunes were hostage to the personal preferences of the Chairman of the IAEC, and the mood and attention of the Prime Minister.

In 1966 India's diplomatic policy towards nuclear weapons made a fateful shift. While international interest in non-proliferation, focusing on restricting the spread of nuclear weapons to any additional states, India's Nehruvian policy of broadly opposing nuclear arms developed a pointed new emphasis. Indian negotiator

⁶ Chengappa 2000: pg. 102
V.C. Trivedi adopted the stance advocating non-proliferation and nuclear disarmament as long as it was universal - that no club of permanent nuclear powers should be permitted. As long as existing nuclear powers resisted disarmament, they left other nations no choice but to pursue the same option as they saw necessary. The quid pro quo was clear - India would not eschew nuclear arms unless the existing nuclear states also did. This fundamental logic led to India refusing to sign the Nuclear Non-Proliferation Treaty and voting against it on 12 June 1968, and has informed Indian nuclear diplomacy ever since.

The new and inexperienced prime minister's views on the nuclear option were unfocused and tentative, but she tended to follow along with Sarabhai's view that nuclear weapons were useless unless part of a comprehensive and hugely expensive defense system, far beyond India's means. Over the next few years, as she grew more savvy and confident, her views on the PNE program shifted. Whether or not it was due to an explicit change in government policy, late in 1967 the new effort to develop nuclear explosives got underway at BARC, an effort that would continue uninterrupted until it culminated in a successful nuclear test less than seven years later.

The Jana Sangh would remain the most vocal and consistent advocate of developing nuclear weapons of any Indian political party. In the Lok Sabha debate in 1964 one rising leader of the party who captured attention was Atal Behari Vajpayee. Years later the Jana Sangh would develop into the Bharatiya Janata Party (BJP). It was the BJP which, upon taking office in 1998 with Vajpayee as Prime Minister, would conduct the 1998 Shakti test series and bring India into the open as a nuclear armed state.

**India's First Bomb: 1967-1974**

Late in 1967 the scientific leadership at BARC led by Homi Sethna and Raja Ramanna undertook a new effort to develop nuclear explosives, one that was larger and more intense than any previous efforts. One that would lead to the successful design of a nuclear device, a device that India would successfully test.
It is not completely clear why they decided to revive the effort and move forward at that time, but due to the convergence of a number of trends perhaps the time simply seemed ripe. China had just exploded a thermonuclear device in 1967, and had become very belligerent - moving troops into disputed areas and making threats. And India’s supply of separated plutonium, necessary for anything beyond purely theoretical work, was slowly accumulating. Some researchers (like Perkovich) have concluded that the new effort was begun at the initiative of the scientists involved. Chengappa however states that Gandhi Ji directly approved the new effort at the urging of her new secretary Parmeshwar Narain Haksar⁷, and that she specifically told Vikram Sarabhai, chairman of the IAEC, not to interfere. In any case Sarabhai did not try to stop this work when he became aware of it and appears by the spring of 1969 to have become at least a moderate supporter of the program.

India’s nuclear weapons program moved in to full swing with Raja Ramanna at the helm. As Ramanna admitted in an interview on 10 October 1997, the "Peaceful Nuclear Explosive" (PNE) program - implying an intention to develop the nuclear explosives for civilian engineering work - was simply a cover for a program aimed from the beginning to develop a weapons capability, in truth there was little if any interest in Plowshare type peaceful applications. On the other hand, there was also no involvement of the military in the development program. There was no attempt to devise a military role for the nuclear explosive, or to seek the military’s input for requirements. The military's public statements on nuclear weapons at this time were far from enthusiastic - essentially mirroring Sarabhai’s views - so the advocates of nuclear weapons development had little incentive to seek their collaboration.

Even with the peaceful cover story, India found it necessary to keep as a low a profile on the project as possible to avoid inevitable attempts by other nations to obstruct it by denying access to nuclear technology and knowledge.

The 1971 Indo-Pakistani War influenced India’s resolve to test a nuclear device, but in a curious and indirect way. This war developed when the bi-regional state of Pakistan, split into East and West Pakistan on either side of India, held its

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⁷ Chengappa 2000, pg. 112
first national election in December 1970. The dominant party of the more populous East Pakistan won a majority of the seats in parliament, but West Pakistan, accustomed to monopolizing political and military power, responded by ignoring the election result. And on 25 March 1971 West Pakistan forces arrested the winner Mujibur Rahman, and launched a campaign brutal military repression on the Bengalis of East Pakistan. This resulted in tens of millions of refugees spilling into India, some of whom took up arms against the Pakistani government. By autumn the Indian-East Pakistani border had become something close to a combat zone, with India and Pakistan trading intense firing across the border, while armed rebels operated from safe havens in India. In late November PM Gandhi authorized Indian forces to cross the border to "pursue" Pakistani forces. Pakistan responded by a massive strike against Indian airbases in western India on 3 December, and declaring war on 4 December. India had spent months preparing for this escalation, indeed had deliberately provoked it, and launched an overwhelming 3-pronged attack into East Pakistan. Unable to hold back the Indian invasion, Pakistan attempted to counter attack in Kashmir, gaining several miles of territory before being halted by Indian forces. The Indian army on the other hand had surrounded Dacca, the capital of East Pakistan by 15 December, and its garrison surrendered the next day. On 17 December a cease-fire was accepted by both sides, effectively ending the war.

The war had been a crushing defeat for Pakistan, which had lost more than half its population. As the crisis developed throughout 1971 China and Pakistan had grown closer to the U.S. while India had grown closer to the Soviet Union. The keystone of the Nixon administration's foreign policy had been its reapproachment with China (announced 15 July), to place the Soviet Union between the pincers of two major opposing powers. Pakistan had played a critical role in facilitating secret negotiations with China. India had at the same time strengthened its ties to the U.S.S.R. culminating in a formal treaty of friendship on 9 August. Chinese support for Pakistan during the most extreme crisis of Pakistan's existence came to nought however. China failed to provide any significant assistance for Pakistan, such as applying pressure on India's border. The net result was that Pakistan suffered both a serious military defeat, demonstrating its inferiority to India in military terms, and a
permanent irreparable loss in its strategic position by the new found independence of East Pakistan. And the much feared Pakistan-China axis had turned out to be a "paper tiger".

Unsurprisingly this did bolster India's sense of security, but it did not stem the momentum toward the testing of a nuclear device as one might have supposed.

And the hostile attitude taken toward India by the U.S. during the crisis had along lasting effect on Indian attitudes. Pres. Nixon and Sec. of State Kissinger chose to view India's actions as hostilities aimed at a U.S. ally and thus as an act hostile to the United States, rather than a case of a western-style democracy coming to the defense of a people being brutally persecuted by a military dictatorship for attempting to exercise its democratic rights. The U.S. even went so far as to dispatch an aircraft carrier battle group to the Indian Ocean in an ill-conceived, obscurely reasoned, and ineffectual attempt to pressure India. The feeling that a superpower had attempted to coerce India in affairs affecting India's vital interests became a cause celebrate for advocates of the nuclear option (although they never clearly explained how a limited nuclear capability would counter U.S. pressure).

Bhabhani Sen Gupta ably described the shift in India's views toward the nuclear option in the wake of the 1971 war:

The Chinese bomb ceased to be the main argument for the Indian bomb, perhaps because of the Chinese inability to help Pakistan in the 1971 war and also because of the initiatives taken by India to normalize relations with China. The arguments for the bomb now were that without it India could not expect to be admitted to the corridors of global power, nor enjoy the status of the dominant regional power; that the bomb might quicken the process of normalizing relations with China; that it would proclaim India's independence on the Soviet Union and compel the United States to change its attitude of hostility or benign neglect.8

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8 Gupta 1983; pg. 4
By the beginning of 1972 the basic design for India's first nuclear device was complete, and other parts of the program for developing the necessary expertise to implement the design were coming along.

The decision to go ahead and manufacture the device and prepare for a test was made later in the year, while Indira Gandhi was still near the peak of her post-war popularity. Early in the year PM Gandhi had seemed ambivalent about the wisdom of conducting an actual test. But by this time the internal momentum of the nuclear development program, the now well established popularity of the nuclear option among India's literate urban elite, the lack of any significant restraining counsel, and Gandhi's sense of strength all seem to have combined to make the decision one of when, not if, the test would come. The decision to move forward was made by PM Gandhi on 7 September 1972, a day in which she toured BARC on the occasion of the tenth convocation of the Indian Institute of Technology at Bombay. During this tour she was shown a wooden model of the device. Upon seeing the model she gave the scientists present verbal authorization to construct it and prepare for testing, but not to test it without explicit approval from herself.

One change made by Sethna soon after assuming the chairmanship was to split the Indian space program, then part of the Department of Atomic Energy, into a separate agency - observing quite reasonably that to have the DAE developing both nuclear explosives and missile technology would wave a red flag for observers concerned about proliferation, no matter what claims were made about the peaceful intent of both programs.

**Smiling Buddha: 1974**

“The Pokhran test was a bomb, I can tell you now... An explosion is an explosion, a gun is a gun, whether you shoot at someone or shoot at the ground... I just want to make clear that the test was not all that peaceful.”

Raj Ramanna, Former Director of India's Nuclear Program, 10 October 1997 (speaking to the Press Trust of India)
While touring the Bhabha Atomic Research Center (BARC) on 7 September 1972 Prime Minister Indira Gandhi gave verbal authorization to the scientists to manufacture the nuclear device they had designed and prepare it for a test. Following this okay, the practical work of engineering to implement the paper design began. Work also began on locating, surveying, and preparing a suitable test site. Throughout the development of this device, more formally dubbed the "Peaceful Nuclear Explosive" or PNE, but commonly called Smiling Buddha, very few records of any kind were kept either on the development process or the decision making involved in its development and testing. This was intentional to help preserve secrecy, but it has resulted in the events being documented almost entirely by oral reports many years later.

In keeping with the great secrecy involved in India's efforts to develop and test its first nuclear explosive device, the project employed no more than 75 scientists and engineers working on it in the period from 1967 to 1974. Of course this does not count the thousands of individuals required to build and operate the infrastructure supporting BARC and to produce the plutonium for the device.

The detonators developed for the device were lead azide spark gap detonators. These detonators are capable of the very high speed operation needed for an implosion system but are much less sophisticated that the exploding bridge wire (EBW) detonators developed by Alvarez during the Manhattan Project. Spark gap detonators are the most unsafe type of detonator, since static discharges or power surges from lightning strikes can set them off. These detonators were only used for the 1974 test, and were later replaced by safer types (presumably EBWs).9 In these detonators are said to have a margin of error of 7 microseconds, a figure that is so large that it is probably incorrect (a figure under 1 microsecond would more plausible).

High speed gas tube switches were developed to trigger the device by the laser division of BARC.

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9 Chengappa 2000: pg. 184
Obtaining the plutonium for the core presented a problem. In 1970 the Phoenix plutonium plant developed a serious leak and had to be shut down. Initial estimates were that the plant could be put back into operation within a year, but by late 1972 it was clear that another year or more would be required before it could again produce separated plutonium. After construction of Purnima there was little plutonium left from which to fabricate the core. So eight months after it began operation, Ramanna ordered Purnima shut down in January 1973 so that part of its fuel could be used to manufacture the nuclear device. This type of solid core device requires about 6 kg of plutonium (the Gadget and the Fat Man bomb each used 6.2 kg; but the design yield of the Indian device was smaller), and Purnima contained 18 kg. Thus in 1974 India's entire inventory of plutonium could have manufactured no more than three bombs.

Instead of fabricating the core as two hemispheres as was done during the Manhattan Project, Soni and Kakodkar designed the core to be made in a number of slices (probably six) that stacked to form a sphere. To ensure a snug fit, the mating surfaces of the slices tapered off with a twist so that they would lock together securely. This design, which they first modeled this in brass, allowed them to work with smaller pieces of plutonium. The actual plutonium core was fabricated by a team led by P.R. Roy of BARC's radio-metallurgy department, who had also made the plutonium fuel rods for Purnima.

The work on the neutron initiator began in mid 1972, and became one of the "critical paths" of the project, a task that prevented completion of preparations before May 1974. The team lead, V.K. Iya, recognizing the difficulties in development after his sojourn at Saclay had recommended in 1965 that development of an initiator be begun immediately. At the start of the project T.S. Murthy estimated it would take 18 months if they were given everything they needed (and estimate that turned out to be too optimistic). A principal difficulty was in learning the techniques to manufacture and handle the large amounts of polonium required (this had been a problem in the Manhattan Project as well).
The initiator was christened the Flower; Chengappa explains "it is believed that the Indian team deposited the polonium on a platinum gauze in the configuration of a lotus to allow maximum surface area". Chengappa claims that the polonium-bearing gauze was enclosed in a tantalum metal sphere, which was nested in a uranium metal shell that had embedded in it beryllium pellets. The system was designed so that the implosion shock wave would drive the beryllium pellets through the tantalum shell to mix with the polonium. Perkovich states that the beryllium was designed to create shape charges, implying a beryllium shell with wedge shaped grooves (like the Manhattan Project's Urchin), or conical or polygonal pits which would form penetrating jets of beryllium when the collapsed. Perkovich gives the diameter of the Flower and 1.5 cm, Chengappa as "about 2 cm".

The Flower was not ready until around 4 May 1974. To get it to Pokhran in time Iyengar and Murthy carried it aboard a regular Indian Airlines flight in a thermos bottle.

A final step in nuclear design verification was taken on 19 February 1974, when a "tickling the dragon's tail" experiment was conducted. The core for the test device was assembled and mounted on a track so that two large blocks of paraffin wax, simulating the high explosive that would surround the core, could be slowly advanced while the neutron emissions from the core were monitored. After 24 hours, the experiment was successfully complete showing that the design was safe to assemble, and that the criticality formulas were correct.

Also in February successful test firings of hemispherical assemblies of the implosion lens were conducted.

The task of sinking the shaft for the test was assigned to the 61 Engineering Regiment stationed in Jodhpur. Ramanna first contacted the regiment commander, Lt. Col. Subherwal, in May 1973 to dig the shaft. The Army did not cooperate until June when PM Gandhi ordered Gen. Bewoor to proceed. The unit had no prior experience in digging shafts and the work got underway with difficulty. The shaft construction project was code named Operation Dry Enterprise, and the engineers and soldiers were told that they were digging a well to supply the Pokhran test range.
The project was set back in January 1974 when, unfortunately they *did* hit water when the shaft tunneled into an aquifer that underlies Pokhran (that this seems to have been a surprise indicates an astonishing lack of preparation, since exploratory drilling would have quickly revealed this). Efforts to pump out or contain the flow of water failed and the shaft had to be abandoned. A new shaft was begun at the site of the abandoned village of Malki which was known to have dug several dry unsuccessful wells many years before. Sinking the new shaft began in February 1974 and was completed only days before the 18 May test.

The fact that two shafts were constructed may account for reports that India actually made two tests in 1974, the first of which failed.

Ramanna indicates in his autobiography that a round of decision making meetings occurred in 1974 prior to the test. The meetings included only Ramanna, Sethna, Nag Chaudhuri, Haksar and Dhar. The first was held probably in February when successful tests indicated the device was nearing completion. The final meeting occurred a "few weeks" prior to the 18 May test. Both Dhar and Haksar opposed the test to varying degrees, the three PNE program leaders supported it strongly. It was of course PM Gandhi’s decision, and she ordered it to go ahead.

The completed core (probably packed as separate pieces) was transported to Pokhran from Trombay under the direct supervision of Chidambaram and Roy. They rode in an army convoy carrying the plutonium core packed in a special case for the 900 km journey, which took three days.

The explosive lenses and other components of the implosion system came from TBRL by truck along with high speed cameras to record the detonation.

The device was assembled in a hut 40 m from the shaft. Assembly began on 13 May with a team made up of Soni, Kakodkar, Iyengar, Venkatesan and Balakrishnan. During the assembly process the plutonium core was mounted in a copper disk to act as a heat sink and remove the decay heat. Nonetheless due to the extreme desert heat the core components did not fit together properly, and the assembly attempt was unsuccessful. The next day attempts were started earlier in the day and succeeded, so assembly moved on the lenses. Each of 12 lenses weighed
approximately 100 kg and required 4 people to lift. Once both halves of the device were complete, each with 6 lenses, the upper half was raised with a crane to put in place. While this was going on one of the lenses slipped out of its mount and fell to the ground, becoming chipped. There was one (and only one) spare lens on hand to serve as a replacement. The assembly operation was complete after nightfall. The assembled device was hexagonal, yellow, about 1.25 m in diameter and weighed 1400 kg. The device was mounted on a hexagonal metal tripod, and transported to the shaft on rails which the army kept covered with sand.

The device was lowered into the shaft on the morning of 15 May. It was placed in a side cavity at the bottom of the L-shaped shaft. Moisture oozing from the shaft side gave concern about the integrity of the firing circuit, and Balakrishnan volunteered to go down the shaft to check it. Finally the shaft was sealed with sand and cement.

The team retired to an observation bunker 5 km away for the test on 18 May. The entire team of senior leaders and contributors to the PNE project appear to have been present. In addition to the assembly team, also present were Ramanna, Sethna, Nag Chaudhuri, Chidambaram, Sikka, Srinivasan, Dastidar, presumably Murthy and Roy who had helped deliver the nuclear components, Gen. Bewoor, and Lt. Col. Subherwal.

The test was scheduled for 8 a.m., but it was delayed for five minutes because V.S. Sethi, an engineer from TBRL, became stranded at the test site while checking the high speed cameras when his jeep wouldn't start. Sethi hiked out in time for the test to go as scheduled, but the army's efforts to recover the jeep delayed the shot. Finally at 8:05 a.m. Dastidar pushed the firing button.

Aside from the PNE development team members actually at Pokhran, the only other Indians who knew of the test in advance for sure were PM Gandhi and her close advisers Haksar and Dhar. There is disagreement about when the Defense Minister Jagjivan Ram was notified. According to Perkovich\textsuperscript{10} Ram learned of the

\textsuperscript{10} Perkovich 1999; pg. 174

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test on 8 May (but was not consulted for his opinion). Chengappa\textsuperscript{11} asserts that he only learned of the test after the shot. Perkovich also says that the Minister of External Affairs Swaran Singh was given 48 hour advance notice.

Efforts to notify the Prime Minister about the success of the test met with some difficulty. Sethna tried to contact P.N. Dhar in the Prime Minister's Office by prearrangement through a field telephone that had been set up at the bunker, but when he finally succeeded in making a connection (after several attempts) the line went dead before he could pass on the information. Subherwal drove Sethna to Pokhran village to make another call, but Sethna had forgotten Dhar's number. Subherwal finally established contact through the telephone operator (after encountering considerable resistance in putting the call through) so that the message could be delivered. However Dhar had already been successfully informed by Gen. Bewoor ten minutes earlier, also by a call placed at Pokhran village.

This test has been known since its public announcement as "Smiling Buddha", a name apparently given to it by Dhar, but the origin of this appellation is somewhat mysterious. The test actually had no formal code name prior to the shot (a pattern that would be repeated with the second test series 24 years later). The test was coincidentally conducted on the Buddhist festival day of Buddha Purnima, perhaps the reason that the association with the Buddha came about. Chengappa relates that the story that Sethna passed on the message to Dhar with the code phrase "The Buddha is smiling" is probably a myth.\textsuperscript{12} Haksar refused to confirm the story in an interview before his death, Sethna denies he used such a code phrase, and Dhar agrees that this phrase was not used, and claims he was not responsible for it. Ramanna claims that he had been told by Sethna that the code phrase had been used, and that the phrase was Dhar's idea. Sethna believes that Dhar made up the code name after the test. [There is a bit of a parallel here between the naming of India's first test, and the origin of the name "Trinity" used for the first U.S. test. This test is known to have been named by Robert Oppenheimer, but the reasons for the name are controversial.]

\textsuperscript{11} Chengappa 2000; pg. 12
\textsuperscript{12} Chengappa 2000; pg. 3
The yield of the PNE has also remained controversial. Although occasional press reports have given ranges all the way up to 20 kt, and as low as 2 kt, the official yield was set early on at 12 kt (post Operation Shakti claims have raised it to 13 kt). Outside seismic data, and analysis of the crater features indicates a lower figure. Analysts usually estimate the yield at 4 to 6 kt using conventional seismic magnitude-to-yield conversion formulas. In recent years both Homi Sethna and P.K. Iyengar have conceded that the official yield is an exaggeration. Iyengar has variously stated that the yield was actually 8-10 kt, that the device was designed to yield 10 kt, and that the yield was 8 kt 'exactly as predicted'. Careful analysis of hard rock cratering effects establishes a tight bound around 8 kt for the yield however. For a detailed discussion of this issue see What Are the Real Test Yields?.

In the wake of the test, the scientists that had produced it became national heroes. In 1975 Setha, Ramanna, and Nag Chaudhuri received the Padma Vibhushan -- India's second highest civilian award. Iyengar, Chidambaram, Venkatesan, Dastidar, and Seshadri received the third highest award, the Padma Shri.

The test caused an immediate revival in Gandhi's popularity, which had flagged considerably from its high after the 1971 war. Jana Sangh response etc.

Table : 2.1 Smiling Budha

<table>
<thead>
<tr>
<th>Test</th>
<th>Smiling Buddha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>8:05 18 May 1974 (IST)</td>
</tr>
<tr>
<td>Location:</td>
<td>Pokhran, Thar Desert, Rajasthan, India 27.095 deg N, 71.752 E</td>
</tr>
<tr>
<td>Test Height and Type:</td>
<td>Underground, -107 m</td>
</tr>
<tr>
<td>Yield:</td>
<td>8 kt (12-13 kt claimed)</td>
</tr>
</tbody>
</table>

The crater produced by this detonation of a plutonium implosion device has been reported to have a radius of 47 meters with a crater depth of 10 meters. Recent
high resolution commercial satellite imaging\textsuperscript{13} shows an apparent crater radius of 60 m. This is inconsistent with know cratering phenomenology, and suggests the crater site has been altered. The shot was fired 1.5 km southwest of the abandoned village of Malka, but was 24.8 km northwest of the town of Pokhran (which is usually given as the test site).

The "Smiling Buddha" device was manufactured from plutonium produced at the Cirus reactor at BARC. The basic design had been developed by 1972, when manufacture of the test device began at PM Gandhi's order. It took two years to separate, purify, and fabricate the plutonium metal, and to manufacture the implosion lens systems and associated electronics. Most of the work was done at BARC, but the explosive lenses were made by the Defense Research and Development Organization (DRDO). The neutron initiator was a Polonium-210/Beryllium type (like those used in early U.S. bombs) code-named "Flower". Apparently both the development of "Flower" and the precise implosion electronics gave considerable trouble.

This test was declared at the time to be for "peaceful purposes". Although this assertion can be dismissed (especially in light of Raj Ramanna's recent admissions), the bomb was certainly an experimental test device, not a weapon in deployable form.

\textbf{The Long Pause: 1974-1989}

A long hiatus in overt nuclear weapons development followed the 1974 test. The driving force behind the development of the Peaceful Nuclear Explosive (or PNE), as it was officially called, had always been the scientists at BARC rather than any initiative from the military, the Prime Minister, of any other part of the Indian government. They had required no encouragement and had worked toward such a test whenever they had not been actually prevented from doing so. This shared mission, of proving that India as a country and they as scientists were equal to such a task, had given the BARC leadership a unity of purpose that overcame any tensions

\textsuperscript{13} Ikonos on 3 February 2000
among them. After the test, this unity was lost and the teamwork that had developed the PNE collapsed.

The disintegration unfolded during the remainder of 1974. Initially the test was well received by the Indian public and the Lok Sabha. PM Gandhi's poll rating jumped - from very low to above average; the opposition Jana Sangh party was enthusiastic. But by September, Gandhi’s popularity had fallen to the lowest level ever.

International reaction was negative, but varied. Henry Kissinger (operating in a leadership vacuum in the wake of Pres. Nixon's resignation) atoned for his policy blunders toward India in 1971 by declining to take a critical stance, and actively working to improve U.S.-Indian ties. On the other hand the U.S. also boosted aid to the increasingly beleaguered Pakistan, including restarting military aid. The test sharply escalated international attention to proliferation, and support for India's nuclear program from abroad disappeared. Canada cut off virtually all nuclear assistance four days after the test, bringing two nuclear power projects - Rajasthan II reactor and the Kota heavy water plant - to a halt. Indeed the nuclear non-proliferation regime that exists today came about as a direct result of this test.

Pakistani PM Ali Bhutto increased funding for his own nuclear program, which had been started in January 1972, but found itself hamstrung by the nuclear technology restrictions imposed abroad after the Indian test.

The impact of the test on India's civilian nuclear program was severe. The civilian nuclear power program had struggled for years to gain credibility, its progress crippled by the lack of indigenous resources and almost wholly dependent on imported technology and technical assistance. No effort had gone into analyzing the likely international reaction to the PNE, or in preparing the nuclear power program for the effects of an embargo. The cut-off of supplies of heavy water, and of technical assistance in building its own heavy water plants hit India particularly hard as its reactor designs were all dependent upon it. Even worse, the group that had triggered these handicaps was treated with accolades while the engineers that bore their consequence struggled on in anonymity.
The adverse international reaction, and its effect on aid and access to technology came as a surprise since foreign policy experts had not been consulted for an assessment prior to the test. The luster of the test wore off in other ways - it soon became clear that the test had produced no information of scientific value for peaceful uses or otherwise, beyond the simple demonstration that the device actually worked. Once the popularity boost of the 1974 test had swiftly faded Gandhi came to feel that her decision to break with Nehru's policies had been for no gain, and she lost interest in the program. Her visit to Pokhran on 22 December was perfunctory.

Although Gandhi declared that India was not pursuing the nuclear option, she did authorize preliminary work on developing a fusion boosted fission design. At BARC efforts were begun to organize projects in fusion boosting, levitated pit design for greater implosion compression, and improved neutron initiators. Sethna and Ramanna had begun feuding however, as differences in style and approach came to the surface, aided by bad blood that had built up over various disagreements through the years, and the pressures and temptations of sudden fame. The visit by Indira Gandhi to Pokhran in December was the breaking point, Sethna and Ramanna rarely spoke after that. The Indian nuclear program was left with a vacuum of leadership and even basic management. The effects of the feud trickled down through the organization, with those closely associated with Ramanna (like PK Iyengar) feeling persecuted. Early in 1975 a group had been set up to work on the fusion boosted design headed by M. Srinivasan, but progress was slow.

In June 1975 Indira Gandhi was convicted of election law violations; her response was to declare martial law on 25 June - suspending democracy for the only time in the history of Indian independence. Twenty six political organizations were banned and over 100,000 Indian citizens were arrested. During her next two years as dictator the nuclear programs languished, and then she was defeated in the general election in early 1977.

Morarji Desai had been an opponent of pursuing the nuclear option for years before becoming Prime Minister in March 1977, and vocally opposed peaceful nuclear tests or otherwise, and the nuclear option, throughout his term in office. The
feud between Sethna and Ramanna continued to fester, paralyzing BARC. Finally in June 1978, in an effort to defuse the situation Desai had Ramanna removed from his position as director of BARC. In compensation the famed Ramanna was made secretary of defense research, scientific advisor to the Ministry of Defense, and later also Director General of DRDO (Defense Research and Development Organization), positioning that would later give Ramanna considerably increased influence. This didn't improve the situation at BARC though since Sethna continued to harass Ramanna's allies, keeping the nuclear program demoralized. Worse still, Ramanna's supporters successfully thwarted Sethna's efforts to replace Ramanna - leaving BARC without a director.

Despite P.M. Morarji Desai's opposition to nuclear explosives, and the chaotic state of BARC, the Desai era was not entirely without progress in nuclear weapon development. Shortly after taking office P.M. Morarji Desai gave verbal authorization for efforts to improve the 1974 device design, to make it more compact so that it could actually be delivered.14 In 1978 he approved the purchase of four squadrons of Jaguar aircraft, the first aircraft acquired by India that were suitable for nuclear weapons delivery. Also in 1977 work began on a new larger 100 MW plutonium production reactor at Trombay named R-5, but usually called "Dhruva" (other accounts place the start of the Dhruva project in 1973 - possibly indicating a preliminary phase of planning). Efforts to rectify the severe shortage of heavy water had mixed success. In 1976 and 1977 assurances of 200 tonnes were obtained from the Soviets, the first 50 tonnes without safeguards, but for the rest India was forced to accept safeguard monitoring. In late 1977 the Baroda heavy water plant went on-line but in December it suffered an explosion and had to be shut down. India's civilian nuclear power program, already more than a decade behind schedule, fell even further behind.

Disturbing developments occurred in Pakistan during 1977 and 1978. It had happened in 1971, an attempt to conduct national elections led to chaos and military action. PM Zulfikar Bhutto held elections in March, which his party (the Pakistan

14 Chengappa 2000; p. 219
Peoples Party) won, leading to charges of fraud; in April Bhutto declared martial law in three major cities; in June this order was declared illegal by the supreme court and was rescinded, new elections were scheduled for October; on 5 July Army General Zia-ul-Haq launched a coup that took over the government. The military quickly took control of the nuclear weapons program, placing Pakistan's nuclear arms outside of the authority of the civilian government (when it has had one). It was during 1977-78 that India, and other nations, became aware of the scope of Pakistan's nuclear program. It soon became apparent that unlike many abortive nuclear projects initiated in other nations, Pakistan's program was huge, lavishly funded, well organized, and likely to succeed. The creation of a vast militarized nuclear weapons program in a neighboring enemy state seems to have provided little immediate impetus to India's own program however.

The P.M. Morarji Desai government was fairly short lived. Internal dissension led to the collapse of the governing coalition in early-mid 1979. First Desai was replaced as head of the Janata government by Charan Singh, and then when elections were held in August Indira Gandhi was re-elected with 65% of the seats in the Lok Sabha.

1979 witnessed additional events that adversely shifted the Pakistani situation in the eyes of India. In March U.S. intelligence announced that the Kahuta uranium enrichment plant in Pakistan had been commissioned. On 4 April the hard line nature of Zia-ul-Haq's regime was emphasized when former prime minister Bhutto was hanged. Finally on 25 December the Soviet Union invaded Afghanistan, ensuring that despite its nuclear weapons program Pakistan would be the beneficiary of a massive infusion of U.S. weaponry, as well as U.S. economic and diplomatic support. The possibility that the U.S. would impose sanctions of any kind on Pakistan to undermine its nuclear program became slim, then nil when the aggressively anti-Soviet Reagan administration came to power. By this time concern over China had faded from view, and relations between India and China were becoming warmer.
Indira Gandhi returned to power with a renewed interest in the nuclear weapons program. Now stationed in New Delhi, Raja Ramanna had much greater opportunity to influence the Prime Minister. In January 1981, Indira Gandhi reappointed Ramanna as Director of BARC, in addition to his other positions. That month he proposed to her that India begin work on constructing and testing the two weapon designs that had been developed in the intervening 6 years - the fusion boosted device, and the compact pure fission device. The weight of the fission device had been shrunk from 1400 kg to 170-200 kg, along with many other improvements in its components. Gandhi agreed, and in February two new test shafts work began on sinking two new shafts at Pokhran. Construction work continued on the test shafts into May 1982; these shafts would remain idle for 17 years, until the 1998 Pokhran II (Operation Shakti) test series when these shafts would be code named "White House" and "Taj Mahal".

This work was quickly detected by U.S. satellites, and this activity was made public by Sen Alan Cranston in April (he also revealed that Pakistan was constructing a test shaft in Baluchistan). In August 1981 Mumbai journalist Yogi Aggarwal reported that the end of 1980 work was accelerated at BARC for manufacturing bomb components, including the preparation of 12 kilograms of plutonium metal. He also revealed that plutonium from the CIRUS reactor was now being separated at the Tarapur processing plant which began operation in 1977. He specifically claimed that plutonium had been diverted from Tarapur for weapons use in March and April of 1981 [Perkovich 1999; p. 228-229].

In May 1982 (according to Chengappa), the time had arrived to decide whether to conduct the new nuclear tests. For the first time a leader of the Indian armed forces, Army Gen. K.V. Krishna Rao, was pushing for the nuclear option. On the other hand both Gandhi and the Reagan administration were working on a rapprochement to improve Indian-U.S. relations, and this time PM Gandhi was very much aware of India's vulnerability to likely international repercussions. Gandhi had also introduced a new element into the nuclear decision making process. Upto until them Gandhi had held the portfolio of Defense Minister herself, now she transferred it to Ramaswami Venkataraman, a highly experienced, highly respected, and
politically savvy senior official. Now a powerful and independent source of counsel, well aware of political and foreign policy implications, had been added to the nuclear decision making process. Unfortunately this was not the shape of things to come, while nuclear decisions in the future tended to have a broader institutional base than they had up through Smiling Buddha and afterward, up at least until the 1998 Shakti tests a formal policy making apparatus never became established and decisions (including the 1998 decision to test) remained ad hoc.

Indira Gandhi held a meeting with Ramanna and Venkataraman as well as her new science adviser V.S. Arunachalam, and her top advisers Principal Secretary P.C. Alexander and Cabinet Secretary K. Rao Sahib, to decide on whether the test would be conducted. Chengappa and Perkovich offer somewhat different accounts of this meeting. Chengappa places it in May, and asserts that no decision was made at the meeting; but that Gandhi approved the test (or tests) after the meeting ended. Perkovich says that it was late in the year, even in early 1983, and that Gandhi did approve the test at the meeting. Both agree that within hours of her decision to test, she reversed herself and decided against it.

The key role of the threat of international sanctions is borne out by the fact that Indira Gandhi never revisited her decision after her rejection, refusing to permit even a rehearing of the matter even as the security situation with Pakistan grew more serious over the next three years and the growing interest within the military for exercising the nuclear option. This last trend found its greatest expression in a 30 page letter to the Defense Minister drafted by the joint chiefs of staff in June 1983, the first time the Indian military went on record supporting the acquisition of nuclear weapons.15

Despite Gandhi’s rejection of testing, India’s nuclear infrastructure continued to advance. One of the most notable achievements of the new leadership provided by Venkataraman and Arunachalam was the establishment of an ambitious ballistic missile program in 1983 that would lead to the successful development of the short range Prithvi missile, and the long range Agni missile series that are a key element of

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15 Chengappa 2000, pp. 286-287
India's nuclear arsenal today. India had developed a significant level of missile related technology as a result of the Department of Space's solid fuel SLV-3 (Satellite Launch Vehicle), begun in 1973 and first successful test launched in July 1980; and as a result of "Project Devil", an attempt to reverse engineer the Soviet SA-2 liquid fuel surface-to-air missile by the Defense Research and Development Laboratory (DRDL) at Hyderabad. This latter project, initiated under the leadership of Dr. Dr. Basanti Dulal Nag Chaudhuri (who had supported the development of the device for "Smiling Buddha", the 1974 nuclear test at Pokhran), was failure and was cancelled in 1978; nonetheless significant experience and technical skill was obtained which provided the basis for additional work on liquid fueled missiles.

The new missile effort was based at DRDL and was led by Dr. Avil Pakir Jainulabdeen Abdul Kalam, an extremely talented engineer and project manager who had been instrumental in the success of the SLV-3 program. Kalam had been transferred to DRDL in 1982 at the instigation of Raja Ramanna, and in 1983 had put together an ambitious development program for five missiles based on a family of related technologies. Venkataraman not only endorsed the program, he encouraged Kalam to be even more aggressive and develop all of the missiles in parallel rather than one at a time. In August 1983 the Integrated Guided Missile Development Programme (IGMDP) was born with a budget of 38.8 billion rupees ($370 million). One of the reasons for the ambitious nature of the program was that the Indians correctly anticipated the tightening of international restrictions on the export of missile technology, which was realized as the Missile Technology Control Regime that was signed in 1987.

Both the Prithvi and the Agni were intended to carry nuclear warheads. The Prithvi was a 150 km liquid fueled missile derived from "Project Devil", and the Agni was a long range (1500+ km) two stage solid fuel (first stage)/liquid fuel (upper stage) design derived both from the SLV-3 and "Project Devil".

Even without approving the testing the new lightweight fission bomb, Gandhi authorized India's first attempt to weaponize a nuclear weapon - that is, package it so that it could be delivered by the military in wartime, and develop the necessary
support systems so that it would be integrated into military operations. It is not enough to have a nuclear explosive device, or even to install it in a bomb casing with suitable fuzing and safety systems. Aircraft have to modified to carry it, and techniques for everything from delivery, to routine maintenance, to security must be developed. In late 1982 Arunachalam began a project to develop these capabilities. Dr. Nagapattinam Sambasiva Venkatesan, who had previously directed the laboratory which developed the bomb's high explosive implosion system, had now moved to the Armament Research and Development Establishment (ARDE) in Pune and was given the task of developing the ballistic case for the bomb. Arunachalam also contacted Air Marshal Chandrakant Gole, the deputy chief of air staff, to arrange for the adaptation and testing of a Jaguar combat aircraft for the role of nuclear bomb delivery. Unfortunately the Indian Air Force was not informed about the project (the purpose for which the test Jaguar had been allocated was not disclosed) although they had little trouble in guessing. The modified aircraft thus remained entirely outside the regular military system.  

This initial attempt to develop a usable nuclear weapon capability was stillborn. A more professional weaponization effort made several years later that eventually incorporated the full participation of the Air Force showed the importance of consulting with the Air Force from the outset to develop a viable weapon system. This later effort had several false starts, took over four years to complete, and found the Jaguar to be an unsuitable delivery aircraft. This smaller armament lab run project clearly produced nothing usable.

After returning to BARC Ramanna pushed forward efforts in other areas. The work on Dhruva had been languishing but Ramanna made its completion a top priority in 1981, making Anil Kakodkar a principal engineer on the project (later to play an important role an the 1998 test series). Perhaps stimulated by Pakistan's evident success with uranium enrichment, Ramanna initiated an Indian uranium enrichment program in the early 1980s. Approved by Indira Gandh and run by BARC, this highly classified project was located at Mysore, Karnataka. Reminiscent

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16 Chengappa 2000, pp. 284-285
of the "tube alloy" code name used by the Manhattan Project's uranium enrichment program, this project was deemed the "Rare Minerals Plant".

The cut-off of legal external supplies of heavy water, and the failure of Indian domestic production efforts, created a serious problem for India's reactor projects in the 1980s. This affected not only Dhruva, but a number of civilian reactors such as Madras I (also called MAPS I). India resolved the problem through covert means, importing over 180 tonnes of heavy water from China (60 tonnes), Norway (15 tonnes), and the Soviet Union (at least 4.7 tonnes) through a German middleman, Alfred Hempel by the end of 1983. None of the supplier nations knew of the destination of these shipments, and the revelation that India was receiving Hempel's shipments probably caused the cessation of supply from China and Norway.

In the early 1980s it was clear that none of India's principal problems - economic development and internal stability - could be aided with nuclear weapons, a fact that diverted interest in testing or deployment. The internal stability problem arose from separatist movements in north eastern and north western India. By far the most serious was the Sikh movement in Punjab to create a new state of Khalistan.

Inevitably any part of the Indian national territory would be deemed essential by the Indian state, but Punjab was more essential than most. The most productive agricultural region in an agricultural economy struggling to feed itself, it was also adjacent to Kashmir - the fortified, restive, and contested region bordering Pakistan. In the early 1980s an armed insurrection took hold in Punjab led by Sant Bhindranwale, who made the Sikh's sacred Golden Temple of Amritsar his headquarters and fortress in 1982. Efforts to stabilize the situation failed, and on 5 June 1984 "Operation Blue Star" was carried out by the Indian Army under the command of Gen K. Sundarji - the assault on the Golden Temple. At least 493 Sikhs were killed in the attack (the Indian government official count, though outside observers estimate hundreds more died) including Bhindranwale, as well as 83 soldiers. Although it inflamed Sikh anger, and thus did nothing to reconcile Punjab, the attack accomplished its objective in breaking the back of organized armed opposition to Indian rule. In a sense though the Sikhs had the last word. India
arranged a formal settlement with the principal political party in Punjab - the Akali Dal - in 1985, giving Punjab sovereignty over the Sikh-majority city of Chandigarh, which became the capital of Punjab. But it was not Indira Gandhi who made this settlement, it was her son Rajiv. Indira Gandhi was assassinated by her Sikh bodyguards on 31 October 1984.

Rajiv Gandhi, an airline pilot by profession, became Prime Minister less than 9 hours after Indira Gandhi’s death, but ratified his position with the largest landslide in India's history, taking 415 out of 542 seats in the Lok Sabha in late December. Rajiv Gandhi's general orientation was toward technology and modern technological culture, thus he took great interest in the technical aspects of issues and actively promoted technological advance. He had a strong antipathy to nuclear weapons and did not support testing or deploy, and the refinement of weapon designs, and laboratory research required to support further advances in nuclear arms. His policies toward nuclear weapons thus were basically a continuation of the approach of his mother during her second term in office. Also like Indira Gandhi in her later years he had an ambivalent relationship with the scientific leadership at BARC - supporting their work but treating their advice skeptically, leaning perhaps even farther toward skepticism than Indira. In large part his opposition to proceeding with testing or deployment was because of his technology orientation. Rajiv recognized that India needed access to the advanced technology of the United States and that detectable progress toward acquiring nuclear weapons would slam many of those doors shut. In addition there seems to have been significant antipathy by Gandhi toward Ramanna, the leading figure in the nuclear establishment.

The mid-eighties saw indications of the growing nuclear capability of Pakistan pile up. Drawn to the limelight, the leader of Pakistan's uranium enrichment program Dr. Abdul Qader Khan held periodic interviews boasting about Pakistan's nuclear prowess. It was in such an interview in February 1984 that he first made the claim that Pakistan had achieved nuclear weapons capability. Periodic revelations confirming the successful advance of the Pakistani program turned up with some regularity. In July 1984 the New York Times reported that US intelligence had learned that the previous year that China had supplied Pakistan with the design of an
actual tested nuclear device. In March 1985 a West German court convicted a German businessman of smuggling a complete uranium hexafluoride manufacturing plant to Pakistan. Also in March the US concluded that Pakistan had made such progress in uranium enrichment capability that the Reagan administration sought an assurance from President Zia that Pakistan would refrain from enriching uranium above the level of 5%. In July 1985 it was reported by ABC that Pakistan had successfully conducted a "cold" implosion test - firing a complete implosion system with an inert natural uranium core. Taken together these indicators pointed to Pakistan acquiring the ability of conducting a nuclear test if it chose to do so within the next year. One factor helping to dampen Indian reaction to these developments is a distinct Indian tendency to discount Pakistani capabilities and accomplishments, even in the face of evidence.

Dhruva went critical on 8 August 1985, but soon after start-up serious problems arose requiring a shut-down. Radioactive contamination detected in the coolant system, indicating a severe fuel leak. The problem was traced to vibrations induced by the cooling system which coincided with the natural resonance frequency of the core. The strong vibrations caused stress on the fuel elements, leading to failure of the aluminum cladding. The problem was solved by attaching spring clips to each of the 192 fuel elements thereby damping the oscillations. It was restarted in December 1986 and operated at one-quarter power from then until spring of 1987. Dhruva finally achieved full power on 17 January 1988, becoming the workhorse of the Indian nuclear weapons production program.  

During Rajiv Gandhi’s term in office infrastructure was developed to support the manufacture of more sophisticated lightweight fission weapons. In 1984 India had imported 100 kg of high purity beryllium from West Germany, enough to provide the neutron reflecting tampers for a dozen or more weapons, but now India commissioned its own beryllium production plant in Mumbai, drawing on indigenous ores from Kerala. Around this time India also acquired a vacuum hot pressing machine, suitable for forming large high-quality beryllium forgings. Work

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17 Albright et al 1997; p. 226
also began at BARC to lay the foundation of thermonuclear weapon development programme and to manufacturing of boosted fission weapons. The Department of Atomic Energy (DAE) announced that it would develop an inertial confinement fusion facility, a research tool that produces on a small scale physical conditions similar to those found in thermonuclear weapons. BARC also began manufacturing tritium by irradiating lithium in nuclear reactors, useful for neutron initiators and boosting fuel for fission weapons; and developing the capability of isotope enrichment of lithium - useful for tritium production and as fusion fuel for thermonuclear weapons. Throughout Rajiv Gandhi's term in office the BARC and DRDO establishments continued to develop and refine weapon designs and related technologies in the laboratory and the testing ground, much as they had since the early 60s. This was standard operating procedure within the nuclear establishment, they felt within their authority to proceed with weapon development without specific direction from the administration as long as they didn't proceed with the final assembly of a device.

India's first effort to formulate a nuclear policy and the determine the means needed to implement it was an informal but authoritative study group that was set up in November 1985 to answer queries by Rajiv Gandhi regarding defense planning. It encompassed the three services (Navy Chief of Staff Adm. Tahliani, Army Vice Chief of Staff Gen. K. Sundarji, Deputy Cheif of Air Staff John Greene), leaders of BARC (Ramanna), the DRDO (Abdul Kalam), and the AEC (Chidambaram), and India's most prominent strategic analyst K. Subrahmanyam. The outcome of the group's deliberations was to recommend building a minimum deterrent force with a strict no first use policy. The arsenal envisioned was 70 to 100 warheads, and would require a 9% boost to the defense budget for 10 years to finance (about $5.6 billion).

No formal action was taken on this report, but it appears to have inspired Rajiv Gandhi to take additional preparedness measures. In 1986 Gandhi instructed Arunachalam to develop a properly engineered aircraft delivery system, with suitable control and security measures and improved reliability to replace the stopgap system developed two years earlier. Arunachalam recruited K. Santhanam as technology adviser on the project. The development effort of the improved bomb system was
code named "New Armament Breaking Ammunition and Projectile", or NABAP, and was headed by Muthuswamy Balakrishnan at the Terminal Ballistics Research Laboratory (TBRL) in Chadigarh. Venkatesan, Director of ARDE, was given the task of developing a superior aerodynamic case for the weapon and associated carriage and release mechanisms and to manufacture a certain number of units. This time the Air Force was involved in the development activities from the beginning, with Deputy Chief of Air Staff Surinder Kumar Mehra heading the Air Force team participating in the project. Problems with the existing bomb design and integration plan quickly surfaced. The bombs developed by the DRDO and ARDE turned out to weigh too much for the Jaguar and had ground clearance of only two inches. By late 1986 the Air Force rejected the Jaguar as unsuitable, and efforts switched to integrating the bomb with the recently acquired Mirage 2000. Considerable integration difficulties continued to be encountered and final qualification of deployed delivery system was not complete until May 1994. Dr. Badri-Maharaj, author of The Armageddon Factor, has stated that a rudimentary delivery system was in place from 1986-88, presumably referring to the developmental Mirage 2000 delivery system [Indian Express, 18 June 2000]. This effort provided India with its first genuinely usable nuclear weapons capability. By the end of the 80s the Indian Air Force, now equipped with nuclear capable Mig-27 as well, began routinely practicing loft bombing techniques for nuclear bomb delivery.

There were some significant ups and downs in the Indo-Pakistani relationship from late 1985 through early 1987. The rapidly developing Pakistani nuclear capability provided motivation to establish a was of life between the two nations. In December 1985 Zia and Gandhi met in New Delhi and agreed to a pact not to engage in attacks on each others nuclear facilities (a situation that would leave India rather the worse off due to the proximity of its production reactors to urbanized areas). It would not be signed until 31 December 1988, or fully implemented (through an exchange of data about their facilities) until 1993. In the year following this promising

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18 Chengappa 2000, p. 327
19 Chengappa 2000; p. 382
development, an ambitious but poorly managed military exercise by India lead to an unexpected crisis.

This crisis was precipitated by Brasstacks Exercise, the largest military exercise in Indian history conducted to test and demonstrate India's ability to deal with a major war with Pakistan. This exercise was planned by Gen. K. Sundarji, now Army Chief of Staff and began in July 1986. It reached its crisis stage in December when India had a total of nine divisions deployed in Rajasthan adjacent to the Pakistani province of Sindh. India had not undertaken any measures to alleviate Pakistan's concerns about having such a massive armed force so close to its border, such as inviting observers, or sending advance notice of maneuvers. Pakistan accordingly mobilized its own forces - sending Army Reserve North and Army Reserve South to locations close to India's border where they could strike at Punjab or Kashmir. Pakistan's concern was not unwarranted, military maneuvers have been used to mask planned attacks before - notably Operation Badr, the stunningly successful Egyptian and Syrian surprise attack that opened the 1973 Yom Kippur War. Poor intelligence and communications, and a disengaged and volaile Rajiv Gandhi made a bad situation worse in January, leading to an atmosphere of real crisis on 18 January 1987. Gandhi's decision to begin airlifting troops to Punjab on 20 January threatened to escalate the crisis out of control. But both governments soon after tried to bring the situation under control. A hotline was activated between India and Pakistan on 23 January, and a systematic plan for standing down agreed to on 4 February. A curious footnote to the exercise were threatening remarks by A.Q. Khan to Indian journalist Kuldip Nayar on 28 January, near the height of the crisis. Nayar however shopped the story around for a few weeks, and it was not published until 1 March, after the matter had been resolved. Nonetheless it left a lingering sense of nuclear threat associated with the Brasstacks affair. The potential for even non-hostile actions to create dangerous situations has unfortunately not been a lesson well learned, judging from crises that have followed in 1990, 1998 and 1999.

Crippled by international sanctions imposed after the 1974 nuclear test, India's civilian nuclear power program fell further behind objectives throughout the 80s. One possible avenue for bolstering the program was to import nuclear reactors
from supplier countries (like Russia) which were available on the condition that India will operate them under IAEA safeguards. The weapons establishment, maintaining their obsession with nuclear technology as a symbol of national pride, vigorously opposed taking this step. This obstructionist attitude displeased Rajiv Gandhi, and upon the expiration of Ramanna's term as AEC chairman in 1987 resulted in an occasion of considerable controversy (and horse trading) within the government. Ramanna and his allies insisted that P.K. Iyengar (Head of BARC) be appointed to the position, and Iyengar threatened to resign from BARC if he was passed over. Iyengar was, like Ramanna, a physicist that had had a leading role in the 1974 nuclear test. Rajiv Gandhi preferred M.R. Srinivasan, a nuclear engineer who was in charge of the nuclear power program and thus disposed to place the priorities of that program first. In the end a deal was struck in which Srinivasan was appointed to the position, but Iyengar was promised that he would be Srinivasan's successor.

Ever since China's first nuclear test, the position it held as a threat in the Indian psyche had been on the decline as Pakistan's position had risen. A brief resurgence in the border dispute with China coincided with the Brasstacks debacle, but with a more favorable outcome for India. In late 1986 India's Parliament amended the Indian constitution to make the Northeast Frontier Agency (Arunachal Pradesh) a full state of the Indian union. Since a large parcel of territory claimed by China lies in Arunachal Pradesh, China protested and on 17 December demanded territorial concessions. This led to large deployments of armed forces on both sides of the border over the next several months, reaching 200,000 on each side by May 1987. At the same time Gen. Sundarji began another exercise, "Chequerboard", this time on the Chinese border in the northeast Himalayan region. Sundarji appears to have learned lessons from the just concluded Brasstacks and went to some pains to reassure the Chinese that the operation would not infringe on disputed territory. The vigorous and well executed movements of forces by India appears to have impressed China sufficiently once the deployments wound down, it was willing to resume talks on the border that had been suspended. The contrast of this denouement with that of Khan's bellicose talk at the close of Brasstacks served to further elevate India's apprehension of threat from Pakistan over China.
Two dramatic changes altered the strategic environment for India in 1988. The first was the Soviet decision in February 1988 to withdraw its forces from Afghanistan, a move that removed the geopolitical rationale for the U.S. support for the military regime, and the reluctance to pressure Pakistan on account of its nuclear weapons program. The second change was on 17 August 1988, when President Zia Ul-Haq, the architect of the militarization of the nuclear program, was killed along with thirty other people, when the aircraft in which he was travelling crashed in what is suspected to be an assassination.

In the aftermath of Zia's death, the military stepped aside and permitted the return of Pakistan to democracy three months later. In November 1988 Benazir Bhutto, the daughter of Prime Minister Zulfikar Ali Bhutto who had been overthrown and executed by Zia, became Prime Minister herself. The nuclear weapons complex remained in the hands of the military, who formed an independent center of power not under the control of the civilian government. PM Bhutto was in fact unaware of the status of the nuclear program, and when Pakistan passed the milestone of manufacturing fissile cores for weapons she first learned of it from the U.S. Ambassador to Pakistan.

**The Momentum Builds: 1989-1998**

1989 marked a turning point in the strategic situation in South Asia because it was in this year that Pakistan, and in response India, began creating real nuclear arsenals by stockpiling complete, ready-to-assemble weapons.

Throughout the 80s, due to its strategic importance the U.S. had been loathe to pressure on its nuclear weapons program. To avoid invoking sanctions against Pakistan the Republicans in Congress had passed the Pressler Amendment which stated that as long as the administration could certify that Pakistan had not acquired nuclear weapons no sanctions would be invoked. To avoid triggering the Pressler amendment a series of "red lines" had been drawn for various milestones, such as producing weapon grade uranium, converting it to metal, and fabricating a core. But as Pakistan passed them one by one the Pressler Amendment, passed to avoid sanctions, became an inevitable trigger for them instead. The last certification was
made in 1989, with great difficulty. Bhutto thus faced having to deal with the imposition of sanctions for a program she had done nothing to advance and did not control. Bhutto's knowledge of the Pakistani program was in fact wholly dependent on briefings given her by U.S. officials in February and June 1989.

This maturation of the Pakistani weapons program finally persuaded India to take the step of manufacturing an arsenal of weapons in a decision was made by Rajiv Gandhi on 18 March 1989. The program to finally build a nuclear arsenal was directed secretly by Defence Secretary Naresh Chandra, who cleared each of the acquisition steps personally with Gandhi. The weapons were assembled at TBRL and ARDE. According to Subrahmanyam by 1990 India had stockpiled at least two dozen unassembled weapons.

The Indian missile programs were also reaching fruition. The first test flight of the 150 km Prithvi tactical missile with a 1000 kg payload had occurred on 18 February 1988. The Army was committed to developing and procuring the Prithvi in April 1989 with a budget of 580 million rupees. The Agni MRBM had its first test flight on 22 May 1989, a successful launch in which it carried a 1000 kg payload 800 km. India described the Agni at this stage as a "technology demonstrator" which is precisely what it was. There was no intention to deploy this version of the Agni as a weapon delivery system.

November 1989 saw a change in India's government, with Rajiv Gandhi and the Congress (I) Party being replaced by V.P. Singh and a coalition led by Singh's Janata Dal party. An important member of the coalition government was the Bharatiya Janata Party (Indian People's Party), or BJP which had won 86 seats in the Lok Sabha, second in the coalition only to Janata Dal's 144 seats.

The BJP had been growing as a political force in India since its founding in April 1980. It was the successor to the Jana Sangh, a party that based its appeal on Hindu nationalism and had distinguished itself by its consistent support of an openly nuclear-armed India. In its first electoral content the BJP had won a mere 2 seats in

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20 Burrows and Windrem 1994; pp. 79-81
21 Chengappa 2000; p. 332
the Lok Sabha in the 1984 election. The leader of the BJP was Atal Behari Vajpayee, who had been a rising star in the Jana Sangh and served as foreign minister in the Janata government of 1978-79. The BJP had gained considerable prominence as a result of a rising strain if Hindu nationalist and religious activism which the BJP abetted. In particular an organization aligned with the BJP, known as the Vishwa Hindu Parishad (VHP), had created a cause caliber in arguing that a disused sixteenth century mosque in Ayodhya was the very birthplace of the god-king Ram, and had been built with the ruins of the Ram Temple that had existed at the site. The religious militancy that the Ram Temple campaign inspired was the wave that washed the BJP into a prominent position in the government.

Despite the large bloc of seats that the BJP contributed to V.P. Singh's government, it received no ministerial positions, and had little opportunity to press its pro-nuclear position.

A new crisis involving India and Pakistan developed in the spring of 1990 over Muslim-majority Kashmir. The seeds of this crisis had been sown in April 1987 when Rajiv Gandhi’s Congress (I) Party had contrived with the aid of the local Kashmir National Conference to steal the state election. Intimidation, harassment, and ballot tampering were widespread (and widely reported) but the Congress-National Conference Alliance emerged with slightly less than 50% of the vote, yet obtained 80% of the seats. Widespread protest followed over the next few years, much of it violent, which was met with harsh repression. An armed insurgency developed, and after Gandhi's defeat in November 1989 it escalated further. In January 1990 the new government sent 150,000 troops to restore order and established military rule. At this even the government's Kashmiri allies defected to the opposition. Pakistan had established training bases for Kashmiri insurgents months before, but now the Pakistani support for the insurrection went into high gear, and Pakistan's government began high profile protests of the situation. The rhetoric on both sides escalate rapidly during March and April. On 13 March PM Bhutto traveled to Pakistani controlled Kashmir and promised a "thousand year war"; Indian PM Singh responded on 10 April calling on India to be "psychologically prepared for war with Pakistan".
Both civilian governments appeared to be too weak to be able to back out of the confrontation, and on the Pakistani side events were actually being controlled by the military. The Kashmiri training camps were run by the Pakistani secret intelligence organization, the ISI (Inter-Services Intelligence Directorate), and General Aslam Beg and his close ally Pres. Ghulam Ishaq Khan gave Bhutto little room to maneuver. Rajiv Gandhi used the crisis to needle Singh, stating archly that he knew "what was in the pipeline, and what the capabilities are" in an obvious veiled reference to the nuclear weapons then being manufactured, but were not yet operational.

Then in late spring U.S. intelligence intercepted messages indicating that the Pakistan Atomic Energy Commission (PAEC), the custodian of Pakistan's nuclear arsenal, had assembled at least one nuclear weapon. There was additional evidence of suspicious activity detected, such as convoys traveling from nuclear storage sites, and F-16 aircraft on runway alert suggesting they were already armed. This prompted the George Bush administration to send a high-level team, headed by Deputy National Security Adviser Robert Gates, to meet with leaders of both governments. In Pakistan the team met with Gen. Beg and President Khan on 20 May (PM Bhutto was out of the country at the time); and with PM Singh, Foreign Minister Gujral, and Principal Secretary Deshmukh in India on 21 May. The American team found the two sides concerned about the prospects of war breaking out, but neither seemed much concerned about the prospects of a nuclear war. The American team revealed to the Pakistanis that they were aware of Pakistan's nuclear preparations, preparations that apparently came as a surprise to Pres. Khan, and was the subject of sharp exchanges. The Indians on the other hand knew nothing of Pakistan's preparations, and were not told about it by the Americans. In the end a list of confidence building measures proposed by the Americans served as the basis for a negotiated withdrawal from the crisis over the next six weeks.

As the crisis was winding down in June, Peter Galbraith, South Asia specialist for the Senate Foreign Relations Committee, met with Benazir Bhutto to

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22 Perkovich 1999, p. 308
brief her about her own nation's nuclear activities during the crisis. She was completely surprised by the revelations. The U.S. had by this time determined that Pakistan had converted 125 kg of weapon grade enriched uranium to metal and had fabricated the cores for seven weapons. In a follow-up meeting in July U.S. Ambassador Robert Oakley informed her that the U.S. was not going to be able to certify Pakistan again under the Pressler Amendment. This prompted Bhutto to try and obtain a briefing on the program from her own government. Three times over the next month she contacted President Ayub Khan and requested that he convene the committee that ran the nuclear weapons program, but each time he demurred. Then on 6 August 1990, Pres. Ghulam Ishaq Khan announced Benazir Bhutto had been removed from office, a move Bhutto later described as a "nuclear coup" triggered by her efforts to obtain nuclear accountability.

Although much has been made of the 1990 crisis as the first example of nuclear deterrence in South Asian affairs, Perkovich argues persuasively that nuclear weapons played little or no role in the decisions made by the leadership of the two nations in generating, then resolving the crisis. The only real influence Pakistan's nuclear preparations had to prompt the U.S. to get involved as mediator, a role that proved to be quite valuable in defusing the situation. The incident serves to underscore the independence that Pakistan's military exercised in controlling the nation's nuclear capabilities, even in a period of supposed democratic rule. In October 1990, Pres. Bush informed Congress that he could no longer certify that Pakistan no longer had the bomb, thereby triggering the Pressler Amendment.

The declaration of Pakistan as a non-possessor of nuclear weapons was scarcely a revelation to India, indeed many there felt that it was long overdue. Nonetheless the formal change in U.S. position created new leverage for supporters of an openly nuclear armed India.

Pakistan's decision to manufacture nuclear weapons, and India's earlier decision to do the same (even if they were not fully assembled), prompted PM V.P. Singh to convene a secret study group in September 1990 to wrestle with the thorny

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24 Burrows and Windrem 1994; pp. 60-61
issues of how to establish a National Command Authority, that is, how to formulate procedures so that the nation's nuclear arsenal would remain under effective control and leadership in the event of a surprise "decapitation attack" - a nuclear strike that kills the entire central government. This group was composed of scientific adviser to the ministry of defense V.S. Arunachalam, who proposed and organized the group, Rajagopala Chidambaram of the Indian AEC, Rajiv Gandhi's adviser Arun Singh, Gen. (retired) K. Sundarji, K. Subrahmanyam, and some others. The study group was not able to report its findings before Singh's government collapsed on 7 November amid widespread Hindu-Muslim violence fomented by the VHP and BJP, but was eventually able to hand its conclusions in to PM Narasimha Rao after his election in 1991. Despite this preliminary attempt to address some of the issues resulting from a nuclearized South Asia, no effort had been made yet to formulate an actual nuclear doctrine - policies and strategies defining how India would manage this new capability.

India went through considerable political instability in late 1990 through mid-1991. The Hindu nationalist agitation not only stirred up hostility between Muslims and Hindus, but also between Hindu castes and destabilized many political coalitions and arrangements. On 21 May 1991 Rajiv Gandhi was blown apart by a bomb while campaigning in Tamil Nadu (the suicide bomber who had approached him with the explosives strapped to her body perished with a dozen others). Narasimha Rao was hastily chosen to fill in for Rajiv Gandhi at the top of the ticket. When the delayed elections were held in June the Congress Party took 226 seats, and the BJP increased its share to 119. Even more significantly the BJP nearly doubled its electoral support, garnering 20% of the vote compared to 11% in 1989. Much to nearly everyone's surprise, PM Rao succeeded in completing a full five year term in office.

The BJP made political hay out of its demand that India deploy a nuclear arsenal, but in fact India was already taking that step. Indira Gandhi had committed itself to deploying a nuclear arsenal in 1986 with its first truly serious efforts at integrating nuclear weapons with delivery systems, but its first qualified, operationally ready nuclear weapons and delivery systems only became available in May 1994. India had adopted (temporarily) a policy of "nuclear opacity" similar to
that practiced by Israel - obtaining deterrent effect through an obviously advanced nuclear capability; having a genuine, though secret, nuclear option that could be exercised if needed; while avoiding the political and economic costs by refusing to openly acknowledge that it had progressed to full weaponization.

PM Rao placed a strong emphasis on economic development, closer ties to the West in the aftermath of the Soviet Bloc's collapse, and instituted a strikingly effective economic program based on liberalization of the economy. He was thus strongly against overt declarations of nuclear capability that would incur crippling sanctions. The U.S. accommodated this approach by shifting its emphasis away from pressuring India to a more cooperative and conciliatory arrangement. The shift away from supporting Pakistan made this easier, and it had become clear that efforts to restrain India's nuclear and missile development programs had at best limited success. For better or worse India now had the capability of fielding a nuclear arsenal at will, and there was no chance it would volunteer to relinquish it. Thus the best prospect of influencing India's behavior was one of engagement.

This change in tone can by the first ever joint naval exercise conducted between the U.S. and India in May 1992. During this exercise (29 May 1992) India conducted the second test of the Agni (a failure), but the U.S. had been notified in advance of the test, and issued only a muted and mildly critical note about the test.

The Prithvi program continued to advance. On 18 August 1992 the ninth flight test of the Prithvi system was conducted. This was the second flight test of an extended 250 km version, and the first fully instrumented flight of this version. Rao slowed the program though, to avoid moving into deployment too soon, which risked triggering restrictions on technology imports.

P.K. Iyengar's term as chairman on the Indian AEC expired on 31 January 1993, and he was replaced by Rajagopala Chidambaram, a fellow nuclear weaponry from BARC. Chidambaram had participated in the 1974 test, but had received little recognition at the time. Now as head of India's nuclear establishment he made it his mission to build on all the preparatory work that had gone on since the 80s on thermonuclear weapons, and push ahead with the development and testing of a
hydrogen bomb. Chidambaram at the Indian AEC and A.P.J. Abdul Kalam at the DRDO, which had become a major power center for strategic system development, formed an effective team intent on rapidly advancing India's nuclear capabilities, and making India a recognized nuclear power.

Relations with South Asia during the first two years of the Clinton administration (1993-1994) were marked by an effort to overcome the impasse that existed between India and Pakistan, and achieve some sort of agreement to restrain the nuclear competition between the two states. Efforts at avoiding nuclear weapon deployment had clearly failed, so the emphasis shifted to arms limitation in some form such as a cutoff in fissile material production, and a commitment to forgo nuclear tests. The reelection of Benazir Bhutto as Prime Minister of Pakistan in October seemingly provided a boost to this effort by restoring democratic government. Unfortunately the relations between India and Pakistan proved to be a zero-sum game -- a gain for one nation was perceived as a loss by the other, and what each nation desired to gain proved to be greater than what the others were prepared, or were politically able, to offer. In particular the more favorable position taken by the U.S. toward Pakistan after Bhutto's election was unacceptable to India and caused the Indians to dig in their heels; and Bhutto was too weak domestically to commit to the types of restrictions and inspections that were necessary in light of Pakistan's sense of inferiority with India. So in the end nothing came of considerable diplomatic effort.

India became a nuclear weapon state in reality in May 1994, though most observers thought that this milestone had been passed years before. It was then that India completed its development of a fully combat ready system for delivering nuclear weapons by successfully conducting acceptance tests. The bomb, complete except for its plutonium core, was fuzed for an airburst and released over the ocean. If it been required due to national crisis, no doubt the system could have been pushed into service at an earlier date as a stop gap, but in May the fully mature reliable and safe system entered in service. India now had an arsenal of at least a couple of dozen operational nuclear bombs.
The years 1995-1996 proved to be watershed in the history of South Asia, and in nuclear proliferation efforts world-wide. The Non-Proliferation Treaty (NPT) came up for review and extension in 1995. Since its original drafting in 1968 the NPT had steadily gained adherents until by the mid-90s the vast majority of states in the world had signed it (by 2000 only 4 states out of 191 had not signed it - with India and Pakistan being half of the four). India had endorsed the NPT in principle, but had refrained from signing because it objected to the establishment of "legitimate" nuclear weapons limited to the 5 nuclear armed nations then in existence. The NPT committed these nuclear states to good faith efforts at eliminating their arsenals but in the nearly 30 years since no effort in this direction could be discerned. India refused to sign the NPT unless the nuclear states committed themselves to a specific timetable to accomplish disarmament, an approach they unanimously refused to consider.

As the NPT extension date approached the nuclear states began pressing for making the NPT permanent so that it would never expire again, while the non-nuclear signatories to the treaty began insisting on a firmer commitment to arms limitation from the nuclear powers in return. In lieu of an actual disarmament commitment, the nuclear powers pushed two treaties that provided for restrictions on specific proliferation activities - the Comprehensive Test Ban Treaty (CTBT) to prohibit all nuclear tests, and a treaty to cut-off the production of fissile materials for weapons. Neither of these treaties would cause inconvenience for the states already possessing extensive stockpiles of tested weapons, but they would have serious effects on states with less well developed arsenals - like India.

This situation presented India with the worst of all worlds. It found themselves under intense pressure, particularly from the U.S., to assent to these treaties which would lock them in to a permanent status of a "second tier state", sharply constrain or wholly foreclose their nuclear capabilities developed at great expense and now at a stage of advanced development, while exacting a negligible price from the nuclear weapon states. To add further insult, two of the nuclear states - China and France - embarked on a new round of nuclear tests to add still more sophisticated designs to their arsenals before the CTBT shut down all testing. The
dilemma was strongly reminiscent of the 1980s when developing international restrictions on ballistic missile technology induced India to push ahead with its own missile program before the door could be shut on them. The new international push for limiting the spread of nuclear weapons (but not reducing those already held by the major powers) created pressure in India to breakout of its closet status, test its new weapons, and openly deploy them.

The linkage between U.S. pressure on the NPT and India's decision to move ahead aggressively on its strategic programs seems to have been quite direct. The full pressure for the NPT began in January 1995, PM Rao responded by meeting with Chidambaram and authorized him to prepare to conduct a series of tests, including a hydrogen bomb test device and sub-kiloton devices to provide data for post-CTBT weapon simulations. Rao even specified that the scientists should be ready to conduct a test on 10 days notice, after the Prime Minister's decision to do so. Later, on 13 April 1995, Rao authorized 6 billion rupees for the development of the Agni II. Kalam was directed to intensify work on setting up a sophisticated command and control system for India's nuclear weapons, and to build additional weapon storage sites around the country (up to that point they nuclear components for weapons were all stored at BARC in Trombay).

It was after Rao's meeting with him that Chidambaram authorized Satinder Kumar Sikka at BARC to begin the development and preparation of a thermonuclear test device - a hydrogen bomb. BARC had developed some designs for thermonuclear weapons in the 80s, but these had languished without any serious effort to move forward with device fabrication although important work in the basic physics and in producing many of the essential materials like enriched lithium-6 and tritium provided a sound foundation. Sikka began developing a new design -- a sophisticated one intended for deployment on ballistic missiles (with a weight thus limited to 1000 kg) and using a boosted fission bomb primary.

The NPT extension passed overwhelmingly on 11 May, four days later on 15 May China conducted another nuclear test, and the next day PM Rao announced that India was considering deploying the Prithvi missile in the near future.
But Rao's term in office was drawing to a close. Elections were held in April-May 1996, and the Congress Party was voted out of office. The balance of power in the Lok Sabha was indecisive - the BJP won the largest seats with 186. Congress and its allies won only 138 seats, and the National Front took 113 and remaining 95 split among smaller parties. A governing coalition required 273 seats and it was not clear what part could assemble a sufficiently large coalition. Since the BJP had gained the largest share of seats President Shankar Dayal Sharma asked the BJP led by Atal Behari Vajpayee to form a government on 15 May. Vajpayee was faced with the challenge of marshalling at least another 75 votes within 15 days to win a vote of confidence and remain in power.

Vajpayee had supported open nuclearization of India for 30 years, since the first Chinese nuclear test, as had the BJP for its entire existence, and as had its predecessor, the Janasangh before that. One of the plans in the campaign platform for the BJP had been "to exercise the option to induct nuclear weapons". So it should have been to no one's surprise that one of the first actions taken by Vajpayee upon taking office would be to set in motion the test operations that Rao had ordered to be made ready. That it appears to have actually been the very first issue acted upon by Vajpayee though is notable. 25

According to Chengappa, Vajpayee's attempt to order nuclear tests was delayed until the day after his inauguration due to problems in contacting Abdul Kalam to receive the order. Three test devices were brought to Pokhran and emplaced in the test shafts:

- A lightweight pure fission bomb (12 kt);
- A boosted fission bomb; and
- A sub-kiloton experimental test device.

The site preparations at Pokhran came within about a day of being completed, when it became apparent that Vajpayee's government was not going to be able to win the upcoming vote of confidence. Although he had the authority to order the test,

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25 Chengappa 2000; p. 31
Vajpayee recognized that it would be improper to saddle a successor government with dealing with the consequences of a test with which it had no involvement. So Vajpayee rescinded his authorization until after the vote was held. On 28 May the BJP lost the vote of confidence and Vajpayee's government was dissolved. Vajpayee's aides felt that without the one day delay in locating Kalam the tests would have been conducted in 1996. Within several months information about Vajpayee's initial authorization of nuclear tests leaked out, and although it did not become widely known this was undoubtedly picked up by U.S. intelligence - making the later admission of "surprise" by the U.S. when Vajpayee took office in 1998 and conducted tests soon after difficult to justify.

The delay in testing brought about the hesitance of Rao and Vajpayee was actually a boon to the weapons scientists. The thermonuclear device was not ready yet, and the delay gave them time to prepare additional devices - two sub-kiloton experiments, and a boosted fission device using reactor-grade plutonium to enable India to draw upon its very large inventory of power reactor produced material if desired.

The nuclear establishment (BARC and the DRDO) also spent the rest of 1996 in mating the existing fission weapon to the Prithvi and Agni missile delivery systems and preparing the necessary command, control and security measures for the warhead (arming codes, security inter-locks, and an authentication and authorization system for use by the Prime Minister)\textsuperscript{26}. On 1 April 1996, Anil Kakodkar became the new Director of BARC.

The BJP government was succeeded by a coalition of 13 parties supported by the Congress Party from the outside. A regional politician named H.D. Deve Gowda became Prime Minister. Soon after taking office Gowda was also faced with the decision to proceed with nuclear tests (the devices that had been placed in the test shafts had not been removed). The same economic considerations that had concerned Rao militated against it. While the matter was under consideration the U.S. detected additional activity around Pokhran and Warren Christopher questioned Foreign

\textsuperscript{26} Chengappa 2000; p. 418
Minister Inder Kumar Gujral about it. Finally at the end of July or early August the devices were removed from the shafts and sent back to BARC.

The summer of 1996 was the "summer of the CTBT" for India's foreign policy. The negotiations on the Comprehensive Test Ban Treaty were drawing to a close, and although India had supported the treaty in principle for many years, as the debate on the final draft moved toward a conclusion India became increasingly critical of it. The treaty conference had been structured to require unanimous consent and on 14 August India announced that it opposed to treaty, blocking its adoption. A parliamentary maneuver subsequently side-stepped India's obstruction when the draft treaty was introduced directly into the UN General Assembly on 9 September 1996 by Australia and approved by voice vote the next day. It was adopted by a vote of 158 to 3, only India, Bhutan and Libya voted against it. Pakistan, which had said that it would sign the CTBT only if India did, abstained from voting. As one of the 44 nations possessing nuclear reactors, the CTBT cannot go into effect without India's signature however.

Many observers had concluded by this time that it had become inevitable that India would resume testing in the near future and inevitably declare itself a nuclear power. U.S. Defense Secretary William Perry later reported coming to this conclusion after visiting India in January 1995 and finding virtually no receptivity to avoiding nuclear development. Curiously enough, two strong long-time advocates of a nuclear armed India - Raja Ramanna and K. Subrahmanyam - argued in the fall of 1996 that testing was not necessary for India, that India's existing fission weapons were an adequate deterrent without it.

During Gowda's term in office Foreign Minister Gujral conducted a very active and successful foreign policy under Gowda - improving Indian relations with China, Pakistan, the minor states bordering India, and last but not least the United States. In part Gujral's success was due to taking advantage of the possibilities created by the end of the Cold War, which had tended to isolate India from China, Pakistan, and the United States as a quasi-client of the USSR. Also India's growing
strength commanded greater attention by all parties, and there was a synergistic effect - improving ties with one party tended to raise India's status with others.

But also important factors with regard to Pakistan's interest in improving ties with India were the fact that it was again (temporarily) under the civilian rule of Prime Minister Nawaz Sharif, and Pakistan's both relative and absolute decline. Since the end of the Cold War, and the Afghanistan War, Pakistan had lost its strategic importance to both the U.S. and China and with it some or all of their financial and technical support. While India's economy had been growing robustly since 1992 and had a positive trade balance, Pakistan's economy had deteriorated seriously and was running massive deficits both in trade and in government spending. Pakistan had also failed to establish a stable social order - the military existed outside of civilian control (when civilian control even existed), the bulk of the Pakistani economy was under the control of a small number of wealthy families that exercised near feudal control over large areas of Pakistan, and radical Islamic fundamentalist sects formed yet another independent state-within-the-state. This last independent power arose as a result of the Afghanistan War, when the increasing Islamicized Pakistani military granted considerable autonomy and funding to Mujahedeen training camps in Pakistan. After the end of the war, these Islamic factions increasingly turned their attention to radicalizing Muslim ethnic groups inside China, quickly alienating Pakistan's erst-while patrons. China's disenchantment with Pakistan accordingly raised its interest in a rapprochement with India.

In the spring of 1997 PM Gowda authorized two operations that brought India closer to an open declaration of its nuclear status. The first was deploying Prithvi missiles (numbering less than a dozen), which had by this time gone into series production, at Jalandhar about 200 km from the Pakistani border. The second was to authorize the construction of two additional test shafts 50 m deep at Pokhran to accommodate the sub-kiloton test devices in March. It appears that Gowda may have decided to conduct nuclear tests at this point, a question that remains unresolved at this writing. Construction on the shafts began on 1 April and were completed on 11 April. Anil Kakodkar, BARC's director, traveled to the site from on
15 April to inspect the shafts and possibly to prepare for moving the devices. But two days later Gowda was forced by a vote of no confidence to resign.

August marked the 50th anniversary of India's independence. Widespread celebrations were held, but the occasion found the nation in an uncertain and reflective mood. Certainly much of the promise of the new nation had yet to be realized, and many were anxious for India to emerge as a major player on the world stage.

A most telling (and often quoted) exchange between Prime Minister Gujral and President Clinton occurred on 22 September 1997 at the occasion of the U.N. General Assembly session in New York. Gujral later recounted telling Clinton that an old Indian saying holds that Indians have a third eye. "I told President Clinton that when my third eye looks at the door of the Security Council chamber it sees a little sign that says 'only those with economic power or nuclear weapons are allowed.' I said to him, 'it is very difficult to achieve economic wealth'."

According to then Defense Minister Mulayam Singh Yadav in October 1997 the BARC scientists had completed assembly of the test devices ("[they] had even tightened the last screw"). Whether or not Yadav was correct about the devices' basic assembly, the plutonium cores were kept separate from the devices and were only inserted in the devices at Pokhran just before the tests.

Gujral decided to make a statement by awarding India's highest civilian award - the Bharat Ratna - to A.P.J. Abdul Kalam. The last time this award had been granted to a scientist was 1952 when it was posthumously awarded to Nobel laureate C.V. Raman. He made the proposal to President K.R. Narayanan on 3 November 1997, who readily agreed. This was also an award that had been rarely received by a Muslim like Kalam. The Bharat Ratna was actually awarded to Kalam on 1 March 1998.

**Operation Shakti: 1998**

"India is now a nuclear weapons state."
"We have the capacity for a big bomb now. Ours will never be weapons of aggression."

Prime Minister Atal Behari Vajpayee, Thursday 14 May 1998

Despite the U.S. government's self-declared "surprise" at India's multiple tests in May 1998, India's march towards an openly declared nuclear capability underscored by new tests was clear for a number of years.

During the last several years the Hindu nationalist Bharatiya Janata Party (Indian People's Party, or BJP) has emerged as the dominant power in domestic politics. One of its key platform issues has been its desire to make India an openly declared nuclear power. The BJP created a short-lived government for 13 days in May 1996, and it is now known that Vajpayee actually authorized nuclear tests at that time, and the devices got as far as being placed in the test shafts, before he called them off when it became evident that his government was unlikely to survive long enough to deal with the aftermath.

Two years later however, on 10 March 1998, the BJP achieved a strong electoral victory and finally succeeded in putting together a governing coalition of 13 (later 20) parties. The BJP wasted no time in making clear its intention to deploy nuclear weapons. On 18 March 1998, the day before he was sworn in as Prime Minister, PM-designate Vajpayee declared "There is no compromise on national security. We will exercise all options including nuclear options to protect security and sovereignty". An official planning report further stated directly that the new BJP government intended to "re-evaluate the nuclear policy and exercise the option to induct nuclear weapons".

Considering the numerous test preparations that had been detected over the past three years, and Vajpayee's 1996 actual test authorization which was undoubtedly known to U.S. intelligence by that time, and after such announcements there would seem to be little excuse for being "surprised" by subsequent events. The underlying reason seems to have been a very ill advised cut-back in the analysis of imagery of the Pokhran site, combined with greater stealth on the part of the Indians. Given the considerable activity at the site over the previous three years, and the
intelligence that the CIA undoubtedly had by then that Vajpayee had actually ordered tests during his previous short-lived government, it was not a difficult assessment to realize that Pokhran should be watched more carefully after Vajpayee took office, rather than less. It appears that the one NIMA (National Imagery and Mapping Agency) assigned to the site actually did detect suspicious activity on the morning of May 11, 6 hours before the tests (and about the time they were originally scheduled for detonation) and was waiting for further review of his findings when the tests were announced.

Prime Minister Vajpayee consulted with A.P.J. Abdul Kalam the day before he was sworn in to office and asked him to join the cabinet. Kalam declined, indicating that he was needed at his current post to support the nuclear program. It is possible that at this meeting Vajpayee indicated his intention to prepare for and conduct nuclear tests. Certainly Kalam, keenly aware of Vajpayee's previous near brush with testing anticipated that tests would be imminent, and would likely have brought the subject up. Vajpayee consulted again with both Kalam and AEC Chairman R. Chidambaram on 20 March. Chidambaram had declared in an interview only days before that nuclear tests were needed. Chidambaram briefed Vajpayee extensively on the nuclear program, and the devices that had been prepared; Kalam presented the status of the missile program. At the conclusion of the meeting Vajpayee told them to be ready to test, but made no commitment to conduct tests. Accordingly, the test preparations began immediately after the meeting even though the tests had not yet been approved.

On 28 March the BJP-led coalition passed a vote of confidence, 275 to 260. This was the milestone that had prevented tests from being conducted by the BJP in 1996. The way was now clear to go forward. On 9 April Vajpayee met again with Kalam and Chidambaram and asked how long it would take to conduct tests, Kalam indicated that tests could be conducted within 30 days from the decision to go ahead, Vajpayee told them to fix a date and coordinate it with Brajesh Mishra, Principal Secretary to PM Vajpayee (and an ardent advocate of nuclear armament for India). The next day, the scientists reviewed preparations at Pokhran. Thirty days from 10 April was 10 May, but President Narayanan was scheduled to be touring Latin
America from 26 April and 10 May. Narayanan was not in the loop on nuclear tests, and it would have been diplomatically awkward to have him surprised by the tests, and the inevitable controversy while abroad. Further, attempting to accelerate the tests by testing before 26 April would not work since Chidambaram's daughter was getting married on 27 April. Chidambaram's absence at his own daughter's wedding and preparations would have been a red flag that something was afoot. Kalam and Chidambaram provided Mishra with the date 11 May as the earliest practical date. Mishra checked the date with Vajpayee who then gave the authorization for the tests.

The "stick" side of the Pakistani equation was reemphasized on 6 April when Pakistan tested a new missile, named Ghauri, with a range of 1500 km (900 miles) and a payload of 700 kg (though it flew only 800 km in this test). This missile program had been known since 1997, and Pakistan had hinted about the imminent test on 23 March, but the test came as a shock to India which had felt itself far ahead of Pakistan with the Agni program although this program had been dormant for four years now. This escalation of the strategic challenge for Pakistan could only have strengthened Vajpayee's to conduct the tests.

The next day, the Richardson delegation visited Pakistan. During the visit Dr. Abdul Qader Khan, the self-proclaimed father of Pakistan's nuclear weapons program, always ready to take the spotlight with inflammatory rhetoric, told the Urdu daily Ausaf on 15 April "We are ready to carry out nuclear explosion anytime and the day this political decision will be made, we will show the world," during an informal chat with journalists. "We have achieved uranium enrichment capability way back in 1978 and after that several times we asked different governments to grant us permission to carry out a nuclear test, but we did not got the permission," The daily quoted him as saying and asked when Pakistan would carry out a nuclear test, Dr. Khan was quoted as having said, " When we got permission from the government." Khan was not a spokesman for the government at the time, but he remained extremely influential and was still closely connected with the corridors of power in Pakistan.
And throughout the 52 days period between Vajpayees swearing-in and the tests, occasional artillery and small arms fire was exchanged between the two nations, as it has been for years, on the Siachen glacier, the world's highest and coldest battlefield.

On 4 May the colorful and controversial Indian Defense Minister George Fernandes reemphasized his views on nuclear arms, saying that "My views have not changed after I became defense minister, ... I agree with our decision not to sign the CTBT or NPT (Nuclear Non-Proliferation Treaty). We should not only keep the nuclear option open, but also think about exercising this option to make nuclear weapons". Only two days later Fernandes set off an international tiff with China when he declared China to be India's "potential enemy number one" and claimed that many tactical nuclear weapons were stationed on the Indian border. In retrospect these remarks by Fernandes seemed part of a deliberate strategy to prepare the ground for India's tests -- illustrating that India regards itself as acting on the world stage and facing threats from a recognized world power, rather than needing defenses against a regional state like Pakistan. In fact Fernandes, like the other Defense Minister's who preceded him, was not in the loop regarding nuclear decisions. He was not on the very short list of government leaders who knew what was up.

The Announcement

On Monday, 11 May 1998, at 10:13:44.2 UCT (+/-0.32 sec; 6:13:44.2 a.m. EDT; 3:43:44.2 p.m. local) as measured by international seismic monitors, India declared itself a full fledged nuclear armed state. This was accomplished by the detonation of a thermonuclear weapon design, one of three nuclear devices with kiloton-range yields detonated simultaneously under the surface of the Thar desert of Rajasthan near the Indo-Pakistani border. This de facto declaration was followed shortly thereafter by an official one. In a hurriedly convened press conference Indian Prime Minister Atal Behari Vajpayee said:

"I have an announcement to make: today at 3:45 p.m., India conducted three underground nuclear tests in the Pokhran range (in Rajasthan state). These were contained explosions like the experiment conducted in May 1974."
Vajpayee said Monday in a brief statement, referring to the 1974 underground 12 kiloton test known as Smiling Buddha also conducted at Pokhran. Vaypayee further stated that like the 1974 test, none of the three tests resulted in venting into the atmosphere (which was not entirely true - some venting had occurred).

He went on to say that the devices tested were a thermonuclear device, a fission device, and a low-yield device.

"I warmly congratulate the scientists and engineers who have carried out these successful tests," Vajpayee added.

In contrast to the 1974 explosion no claims that these were 'peaceful tests' were made. Indeed, government officials quickly emphasized the military nature of the explosions. "These tests have established that India has a proven capability for a weaponized nuclear program," Brajesh Mishra, Principal Secretary to PM Vajpayee, told reporters.

Just two days later on 13 May, at 6:51 UCT (2:51 a.m. EST, 12.21 p.m. local Indian time) India detonated two more sub-kiloton nuclear devices underground before declaring that the test series was completed.

The test series was dubbed as Operation Shakti-98 (Power-98) and the five tests are designated Shakti I through V. Like the 1974 test's moniker "Smiling Buddha", this name seems to have been stuck on the test series after the fact. The test operation itself apparently did not have a formal name. More recently it has been common to refer to the five shot test series as Pokhran II, the 1974 shot being Pokhran I.

Mouth of a test shaft after the 11 May 1998 detonation. Either the White House or Kumbhkaran shaft.
Table 2.2 Shakti I

<table>
<thead>
<tr>
<th>Test:</th>
<th>Shakti I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Height and Type:</td>
<td>Underground, more than -200 m</td>
</tr>
<tr>
<td>Location:</td>
<td>Pokhran, Thar Desert, Rajasthan, India 27.0716 deg N, 71.7612 deg E</td>
</tr>
<tr>
<td>Yield:</td>
<td>30 kt est. (22-30 kt possible range; 43-45 kt claimed)</td>
</tr>
</tbody>
</table>

This was a test of reduced yield two-stage thermonuclear bomb using a fusion boosted fission primary, apparently a 43-45 kt design test yield for a ~300 kt weapon. The available evidence indicates that the boosted primary performed correctly, but that the secondary stage failed partially.

The Indian government held a triumphal press conference with the entire scientific and engineering leadership three days after the second group of tests. This conference was notable, even unprecedented, in the level of detail about the tests that was released - discussing yields and the general characteristics of the devices. By comparison the US and USSR/Russia has kept the exact yields and purpose the vast number underground shots dating back to the early 1960s classified up to the present day. In fact most of the information about the nature and intent of the test available almost three years after the tests were released at this press conference or in the few days following it. Most of the information was conveyed by two top officials -- Drs. Avil (Abdul) Pakir Jainulabdeen Kalam, Scientific Adviser to the Defence Minister and head of the DRDO (Defence Research and Development Organization), and Rajagopala Chidambaram, chairman of India's Atomic Energy Commission (AEC) and Department of Atomic energy (DAE).

The largest device tested, Shakti I, was a two-stage thermonuclear design using a boosted fission primary which Chidambaram claimed had a yield of 43 kt (also described as 43 kt +/- 3 kt). Shakti II, the next largest device, was a refined lightweight pure fission device with a yield of 12 kt. Shakti III the third device tested on 11 May was a 0.3 kt fission device using less-than-weapon grade plutonium. Both
of the devices in the second test group, with yields of 0.5 and 0.3 kilotons, were experimental devices detonated to generate additional data for improved computer simulation of weapon designs.

On the other hand, there continues to be considerable controversy about the accuracy of this information, particularly regarding the yields of the thermonuclear device, and the second series of sub-kiloton shots. In summary the balance of the evidence indicates that the claimed yields are significantly overstated - particularly regarding the thermonuclear device, and the total yields of both test groups. The available information indicates that Shakti I could not have had a yield larger than 25 kt, but was at least 22 kt (based on Indian drilling data). The evidence offered by the Indian government to date to support the 43 kt yield claim is weak, in fact a plain reading of their own seismic evidence puts the yield at or below 25 kt. Accepting the radiological and photographic evidence for this second group of tests offered by BARC as valid, the complete absence of a seismic signal for these shots defies explanation at the present time if the stated test time and yields are even is even remotely correct. BARC does not appear to have offered an explanation for this anomaly.

Based on this evidence the most plausible interpretation of the 11 May tests is that the fission bomb was successful and yielded 12 kt. The straightforward nature of this technology and the lengthy time India had to master it makes doubts about its performance difficult to support. The yield of the thermonuclear device was apparently 22-25 kt. This is at or above the expected yield range of a thermonuclear primary, so it appears that the fusion boosted device used for the primary was successful. The plausible yield for the secondary stage is from 10 to 15 kt, well below the 30 kt or so apparently expected by India. The 0.3 kt yield for the third device is appropriate for the unboosted yield of a boosted fission design - that is, a device that is fired without the deuterium-tritium boost gas. It suggests that India now as the ability to employ full yield fusion boosted weapons using less-than-weapon grade plutonium. This could be fuel grade plutonium as is produced by India's power reactors or perhaps an intermediate grade. In the first case all of India's considerable holdings of plutonium could be used for weapon manufacture, in the
second case the stock of weapon grade material could be extended by mixing it with fuel grade plutonium.

The reasons given for the second group of tests are entirely credible and are consistent with the objectives of other nuclear weapons nations in recent testing activities (either nuclear tests prior to the CTBT signing, or sub-critical tests afterward). India's stated interest in gathering high quality physical data for use in simulations is quite consistent with a well planned weapon development effort.

The use of simultaneous detonations of multiple nuclear devices has been a routine practice by other nuclear weapons states. The principal purposes of this technique are to minimize the ability of other nations to collect intelligence data about the tests (ironically too successful, given India's subsequent and not entirely convincing efforts to publicize its test results), and to reduce the cost and difficulty of test preparations. In India's case the desire to minimize political repercussions and outside pressure also motivated a compressed schedule of simultaneous tests.

Corroboration of a sort for India's explanations for the different tests on 11 May was given immediately after they were fired, and four days before the official AEC/DRDO announcements, by commentary on their military significance offered by P.K. Iyengar, the former chairman of India's AEC. On 12 May he told Reuters in Mumbai (Bombay) that their differing sizes corresponded to three ways in which nuclear bombs might be used.

According to Iyengar, the smallest was the size that might be fired as an artillery shell or dropped from a combat support aircraft. The mid-size blast was from a standard fission device equivalent to about 12 kilotons -- the size that might be dropped from a bomber plane. The largest of the three warheads tests on Monday was not a full hydrogen bomb. Most of its 50 to 100 kiloton explosive force came from the primary, a fission device which serves as a trigger for the H-bomb's big fusion explosion. Iyengar said the device contained only a token amount of the hydrogen variant tritium. It showed that India's thermonuclear technology worked, but did not produce the megaton explosion typical of a full H-bomb.
"We need not go for a megaton explosion while testing an H-bomb," said Iyengar, one of the scientists involved in India's only other nuclear test, in 1974. "Such tests are required only if we are planning for a total destruction of the opposite side. They don't have relevance in our strategy."

One technical issue that affects all three of the low yield tests, with yields of 0.2, 0.3, and 0.5 kilotons, is that the yields of low yield fission tests are very sensitive to physical parameters like the amount of fissile material present, the degree and uniformity of compression, and the nuclear properties of the materials. Even if the Indian designers have achieved very accurate control over the implosion process, without test data in this yield range to calibrate their models they would have difficulty predicting the exact yield of their devices. This of course is one reason for conducting these tests in the first place, but it also means that there is a good chance of overshooting or undershooting the target yields. Thus the intended yields of these devices may be significantly different than the yields produced, on the other hand if the advertised yields are the expected ones, then the actual ones may be significantly different.

Initial Reactions

After the Indian tests were reported Pakistani Foreign Minister Ayub initially stopped saying that Pakistan would conduct a nuclear test of its own, but said "We in Pakistan will maintain a balance with India in all fields... We are in a headlong arms race on the subcontinent."

"The responsibility for dealing a death blow to the global efforts at nuclear non-proliferation rests squarely with India," he told the Senate in the Pakistani capital of Islamabad.

Others in Pakistan were not so cautious. "We have now to show that we have a counter regional bomb," Hamid Gul, the former head of Pakistan's secret service, said Monday. "All the Muslim countries are vulnerable to India's ambitions that are driving it toward the Gulf and central Asia."
Former Prime Minister Benazir Bhutto said in a BBC interview in London that her government had a contingency plan in 1996 to carry out a nuclear test if India did. She said the capability still existed, and should be used. "If we don't, India will go ahead and adopt aggressive designs on us," she said. She further indicated that the test should be conducted within the month.

Popular reaction in India was overwhelmingly positive. A *Times of India* poll registered a 91 percent approval rating for the tests.

After a day of silence China's initial reaction was muted. Beijing warned that India's nuclear tests would harm peace and stability in South Asia. China is "seriously concerned" about the tests, the state-run Xinhua News Agency said in a brief report quoting Foreign Ministry spokesman Zhu Bangzao.

In general world reaction was strongly disapproving. "The United States is deeply disappointed by the decision of the government of India to conduct three nuclear tests," President Clinton's spokesman Mike McCurry said. "This runs counter to the effort the international community is making to promulgate a comprehensive ban on such testing."

"The United States intends to address its concern directly to New Delhi," McCurry said. "We will continue to spare no effort in encouraging countries to both promulgate and ratify the comprehensive test ban. If anything, these tests underscore the importance of that international regime."

Praful Bidwai, an independent Indian weapons policy analyst who had urged India to abandon its pursuit of nuclear weapons, said a thermonuclear device was a sign India's program has progressed considerably since it tested a simpler fission device in 1974. "We have dropped the ambiguity completely," he said. "China and Pakistan will regard us as a full-fledged nuclear adversary and so we will have two nuclear arms races -- a small one with Pakistan and a big one with China."

If the first group of tests evoked disapproval, the second group of tests created a flurry of consternation.
"Today? Two?," Chinese foreign ministry spokesman Zhu Bangzao exclaimed upon hearing of the second set of shots. "We have no immediate comment," he said, adding that China would study the matter.

"The Indian leadership has gone berserk," Pakistan's Foreign Minister Gohar Ayub Khan told Reuters when asked about the latest tests, and said its actions had been encouraged by a weak Western response to India's weapons program.

**International Responses**

In keeping with its preferred approach to foreign policy in recent decades, the US imposed economic sanctions on India as punishment. In fact a 1994 anti-proliferation law made such action virtually automatic.

Most other nations refrained from joining the US in imposing an economic embargo. Since most nations are not imposing similar sanctions, and India's exports and imports together constitute only 4% of its GDP, with US trade being only 10% of this total, the overall effect on India's economy from a direct trade embargo was small. Far more significant were the restrictions on lending imposed by the United States and its representatives on international finance bodies.

The day after the first tests Ayub Khan said the Asian subcontinent has been thrust into a nuclear arms race and indicated that Pakistan was ready to conduct a nuclear test of its own. "We are prepared to match India, we have the capability ... We in Pakistan will maintain a balance with India in all fields," he said in an interview. "We are in a headlong arms race on the subcontinent."

Prime Minister Mohammad Nawaz Sharif was much more subdued, refusing to say whether a test would be conducted in response: "We are watching the situation and we will take appropriate action with regard to our security," he said.

After returning to the country from a trip to Central Asia on 13 May Sharif met for several hours with senior military officials and senior members of his government to discuss India's action, which appeared to have taken Pakistan's security establishment by surprise. "We didn't have any advance information on these explosions," said a member of Sharif's cabinet.

Another cabinet member said, "Not surprisingly, many ministers thought it was the ideal moment for Pakistan to test its nuclear device," and Pakistan's army informed Sharif that it will be ready "within a week" to conduct an underground
nuclear test on 24 hours' notice. But officials familiar the deliberations spoke of a division within the cabinet over an appropriate Pakistani response.

According to an aide, Sharif appeared to favor "a balanced and moderate response" and ordered a report on the cost the country would have to bear if a Pakistani nuclear test brought international sanctions.

The same day President Clinton telephone Sharif and urged him not to go ahead with a test, asking him "not to respond to an irresponsible act in kind."

But by week's end American spy satellites had detected an influx of equipment at a previously prepared test site in the Chagai Hills in the desert of southwestern Baluchistan province, barely 50 km from the border with Iran, and the CIA was predicting that a test could occur as early as Sunday 17 May.

Over the weekend Sharif consulted with various parties and factions, and remained under enormous pressure to test. Meanwhile public reaction continued to favor an immediate response. Former PM Benazir Bhutto advocated not only an immediate nuclear test by Pakistan, but also asserted that India should be disarmed by a preemptive attack.

Meanwhile the US worked on putting together an incentive package to Pakistan to persuade it not to test. The repeal of the Pressler amendment that cut off military aid was offered, as was delivery of $600 million dollars worth of F-16 fighter-bombers that Pakistan had ordered and paid for but never received. Discussions also began on how much aid to offer Pakistan on top of these concessions. The automatic imposition of a nearly complete embargo like that imposed on India, but which much smaller Pakistan could hardly afford, provided the penalty side of the equation.

The tension was ratcheted up on Saturday by Ayub Khan, known to be a hard-liner with close ties to the military, when he remarked to reporters that a nuclear test by Pakistan "Is just a matter of timing and the government of Pakistan will choose as to when to conduct the test." "A nuclear test by Pakistan is certain," he added.

He repeated the remarks the next day, telling The Associated Press that Pakistan has decided to go ahead with a test of a nuclear device. "It's a matter of when, not if, Pakistan will test," he said. "The decision has already been taken by Cabinet," he said in a telephone interview from his rural home in northwestern Pakistan.
The frenzy reached a peak on Sunday when the nuclear device was believed to be in place for a test. There was even a brief flurry of excitement caused by a false alarm on Sunday when German President Helmut Kohl said he had "reliable information" saying Pakistan had exploded a bomb, a report that was quickly denied and discredited.

But PM Sharif did not confirm the comments by Ayub, and by the beginning of the next week, Pakistan appeared to have backed off any immediate decision to test, and was content to see how much in aid the US might offer in return.

On 25 May it was reported by the Associated Press and Reuters that U.S. intelligence officials had said that Pakistani preparations had accelerated in recent days at a site called Raskoh in the Chagai Hills (it later transpired that Ras Koh was indeed the test area, but Ras Koh is a separate mountain range over 40 km from the Chagai Hills area). Tunneling activities and the setup of explosive monitoring equipment had been observed. "At this point, they could conduct a nuclear test at any time," said one official.

At the same time it had become increasingly likely that any U.S. aid package would fall short of Pakistani expectations. The major inducements suggested at this point - the delivery of 28 F-16s that Pakistan has already paid for and was promised by Pres. Clinton two years ago anyway, and the rescheduling of loans - was not very tempting. Pakistan seemed to be after explicit U.S. security guarantees, something that was unlikely to be offered.

Late in the day on 27 May the U.S. government reported that Pakistan had been observed pouring cement in a test shaft in the Chagai Hills. This indicated that nuclear test devices were being sealed in, which is the final necessary step before conducting nuclear tests. Officials then predicted that tests could occur within hours.

On 28 May at 15:00 UCT: PM Sharif announced that Pakistan has detonated six nuclear devices.

Map 2.1: India Nuclear Facilities
Nuclear Capabilities at Present

Prime Minister Atal Behari Vajpayee's statement in the wake of Operation Shakti, the five shot nuclear test series held on 11 and 13 May 1998, dispels any reasonable doubt or ambiguity regarding the reality of India's nuclear arsenal and its ongoing weapons programs. A considerable quantity of information, once closely held, has come out since those tests that not only confirms these capabilities but recounts their development in some detail.

Although India first tested a nuclear explosive in 1974 (euphemistically called the PNE, for "peaceful nuclear explosive") it did not become a nuclear weapons state - in the sense of having the ability to deliver nuclear weapons until 1986-88 when, according to Dr. Sanjay Badri-Maharaj author of The Armageddon Factor, a rudimentary delivery system was in place. This presumably refers to a developmental delivery system based on the Mirage 2000 that began development in 1986, after an attempt to integrate a DRDO developed nuclear bomb with the Jaguar fighter-bomber failed. This system provided India with a usable but limited nuclear weapons capability, but the weapon system did not actually enter service until it passed a full field drop test in May 1994 at Balasore, though most observers thought that this milestone had been passed years before.

The US CIA testified before congress in 1993 that it did not believe that India maintains assembled or deployed nuclear weapons, although it believed India was producing weapon components. The CIA's HUMINT (human intelligence, as opposed to electronic intelligence) regarding India's nuclear program is famously poor however (witness the U.S. intelligence communities surprise about the 1998 tests) so it cannot be accorded great weight; nonetheless it could be true that in 1993 India still had not taken the step of maintaining weapons in a ready-to-use state. There is a vague report though27 of "a few" weapons existing as early as the early 1980s. Chengappa relates that hardened concrete bunkers were built in the early 1980s at Mumbai to house India's weapons plutonium stocks, a few weapons. Gen Sundarji was shown these weapons in the mid-80s, an unusual step since the military

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27 Chengappa 2000; pg. 418
chiefs of staff had not been briefed on India's nuclear capability even as late as 1990. These weapons may not have been kept fully assembled, but there is little doubt that India could have made them ready in a matter of hours (or days at the most).

India has several aircraft that are nominally considered "nuclear capable", the Mirage 2000, Mig-27, and the Jaguar. Due to the cost of integrating and qualifying an aircraft for nuclear delivery, and maintaining a cadre of specially trained pilots, it is unlikely that India would choose to deploy nuclear weapons on more than one or two aircraft types. Only the Mirage 2000 is known to have been qualified as a nuclear delivery platform, and the Jaguar is known to have been abandoned for nuclear weapons delivery due to technical problems. Thus it may be that the Mirage 2000 remains the sole air breathing nuclear weapon delivery system.

India has developed short and medium-range nuclear-capable missiles. These are the Prithvi (range 250 km, payload 500 kg), and the Agni-II (range 2500 km, payload 1000 kg).

The first operational capability of a missile deliverable nuclear warhead was probably soon after the official deployment of the Prithvi SS-250 missiles in September 1997, which occurred after the successful completion of integration and testing of the warhead and missile during 1996-97. Reportedly four nuclear armed Prithvis were deployed during the Kargil War in June 1999. Also during this war was the first deployment of the medium range Agni-II, apparently consisting of a single preproduction model. The Agni-II was not qualified for full production and deployment until after the second Agni-II test occurred on 17 January 2001 at 10:01 a.m. IST (Indian Standard Time) when it was tested in its final deployment configuration.

India reportedly is investigating development of an ICBM-class missile called Suriya.

Current Arsenal

There are no official figures for weapon stockpiles at any stage of development of India's arsenal. The only figures that can be offered are either
explicit estimates made from considerations of India's probable ability to produce critical raw materials and considerations of likely production plans; or are unofficial statements of uncertain provenance and authenticity. To show the problems with figures of the latter sort we have only to look at the statement by K. Subrahmanyam, a leading strategic theorist, that by 1990 India had stockpiled at least two dozen unassembled weapons, versus the May 1998 estimate by G. Balachandran, an Indian nuclear researcher, that India had fewer than 10 weapons ready to be assembled and mounted on warplanes or missiles.

The types of weapons India is believed to have available for its arsenal include:

- A pure fission plutonium bomb with a yield of 12 kt;
- A fusion boosted fission bomb with a yield of 15-20 kt, made with weapon-grade plutonium;
- A fusion boosted fission bomb design, made with reactor-grade plutonium;
- Low yield pure fission plutonium bomb designs with yields from 0.1 kt to 1 kt;
- A thermonuclear bomb design with a yield of 200-300 kt.

All of these types should be available based on the tests conducted during Operation Shakti (Pokhran-II). It may be possible to extrapolate significantly from these device classes however without further testing. There is reasonable doubt about whether the thermonuclear device actually performed as designed. Even if this so, it does not rule out the possiblity that sufficient test data was collected to field a successful design with reasonable confidence of good performance. Interest has been expressed in the development of a neutron bomb (a very low yield tactical thermonuclear device), but this would probably require additional testing to perfect.

The most widely accepted estimates of India's plutonium production have been made by David Albright. His most recent estimate (October 2000) was that by the end of 1999 India had available between 240 and 395 kg of weapon grade
plutonium for weapons production, with a median value of 310 kg. He suggests that this is sufficient for 45 - 95 weapons (median estimate 65). The production of weapon grade plutonium has actually been greater, but about 130 kg of plutonium has been consumed - principally in fueling two plutonium reactors, but also in weapons tests. His estimate for India's holdings of less-than-weapons-grade plutonium (reactor or fuel grade plutonium) are 4200 kg of unsafeguarded plutonium (800 kg of this already separated) and 4100 kg of IAEA safeguarded plutonium (25 kg of this separated). This unsafeguarded quantity could be used to manufacture roughly 1000 nuclear weapons, if India so chose (which would give it the third largest arsenal in the world, behind only the U.S. and Russia).

**Nuclear Force Planning**

Nothing is publicly known about official Indian nuclear force planning, but assessments made by opinion leaders provide a context for judging the prevailing attitude in Indian government circles.

India's first effort to formulate a nuclear policy and the determine the means needed to implement it was an informal but authoritative study group that was set up in November 1985 to answer queries by Rajiv Gandhi regarding defense planning. It encompassed the three services (Navy Chief of Staff Adm. Tahliani, Army Vice Chief of Staff Gen. K. Sundarji, Deputy Cheif of Air Staff John Greene), leaders of BARC (Ramanna), the DRDO (Abdul Kalam), and the AEC (Chidambaram), and India's most prominent strategic analyst K. Subrahmanyam. The outcome of the group's deliberations was to recommend building a minimum deterrent force with a strict no first use policy. The arsenal envisioned was 70 to 100 warheads at a cost of about $5.6 billion.

In 1994 K. Subrahmanyam suggested that a force of 60 warheads carried on 20 Agnis, 20 Prithvis and the rest on aircraft would cost about Rs 10 billion over 10 years. In 1996 Sundarji suggested a cost of some Rs 27.5 billion -- Rs 6 billion for 150 warheads, Rs 3.6 billion for 45 Prithvis and Rs 18 billion for 90 Agni missiles.
Delivery Systems

Map 2.2: India Missile Facilities
India is not a signatory to either the Nuclear Non-Proliferation Treaty (NPT) or the Comprehensive Test Ban Treaty (CTBT), but did accede to the Partial Test Ban Treaty in October 1963. India is a member of the International Atomic Energy Agency (IAEA), and four of its 13 nuclear reactors are subject to IAEA safeguards.

India announced its lack of intention to accede to the NPT as late as 1997 by voting against the paragraph of a General Assembly Resolution which urged all non-signatories of the treaty to accede to it at the earliest possible date.

India voted against the UN General Assembly resolution endorsing the CTBT, which was adopted on September 10, 1996. India objected to the lack of provision for universal nuclear disarmament "within a time-bound framework." India also demanded that the treaty also ban laboratory simulations. In addition, India opposed the provision in Article XIV of the CTBT that requires India's ratification for the treaty to enter into force, which India argued was a violation of its sovereign right to choose whether it would sign the treaty. In early February 1997, Foreign Minister Gujral reiterated India's opposition to the treaty, saying that "India favors any step aimed at destroying nuclear weapons, but considers that the treaty in its current form is not comprehensive and bans only certain types of tests."

Controversially the United States is now willing to provide India access to civilian nuclear technology through the 2006 United States-India Peaceful Atomic Energy Cooperation Act, despite India not being a member of the NPT which normally precludes such international cooperation. This is the direct result of the fact that India is recognized by the US and many other developed regions of the world as an important ally in the war on terror and further testifies to the fact that the West believes that the nuclear technology is intended for peaceful purposes.
Ballistic Missiles

India is only the fourth country that has Anti Ballistic capability called in India as the Indian Ballistic Missile Defense Program or the AAD. The Integrated Guided Missile Development Program (IGMDP) was an Indian Ministry of Defence program for the development of a comprehensive range of missiles, including the intermediate range Agni missile (Surface to Surface), and short range missiles such as the Prithvi ballistic missile (Surface to Surface), Akash missile (Surface to Air), Trishul missile (Surface to Air) and Nag Missile (Anti Tank). The program was headed by Defense Research and Development Organization (DRDO), with former President of India, Dr. Abdul Kalam, being one of the chief engineers involved in the project.

India has methodically built an indigenous missile production capability, using its commercial space-launch program to develop the skills and infrastructure needed to support an offensive ballistic missile program. For example, during the 1980s, India conducted a series of space launches using the solid-fueled SLV-3 booster. Most of these launches put light satellites into near-earth orbit. Elements of the SLV-3 were subsequently incorporated into two new programs. In the first, the new polar-space launch vehicle (PSLV) was equipped with six SLV-3 motors strapped to the PSLV’s first stage. The Agni IRBM technology demonstrator uses the SLV-3 booster as its first stage.

The key missile applications and types are given below:

Prithvi

The Prithvi I is mobile liquid-fueled 150 kilometer tactical missile currently deployed with army units. It is claimed that this missile is equipped only with various conventional warheads (which stay attached to the missile over the entire flight path). The missile is of particular interest to the United States (and potential buyers) in that has the capability of maneuvering in flight so as to follow one of several different preprogrammed trajectories. Based on the same design, a modified Prithvi, the Prithvi II, is essentially a longer-ranged version of the Prithvi I except that it has a 250-kilometer range and a lighter payload. It is suspected that any
nuclear missions will be executed by the Prithvi II. Currently, the Prithvi II has completed development and is now in production. When fielded, it will be deployed with air force units for the purpose of deep target attacking manoeuvres against objectives such as air fields. For the Indian Navy, a 350-kilometer version of the Prithvi is under development. The new system is being called the Dhanush, testing is planned to begin in December 1998. It is unclear whether or not this system will be deployed on India's new nuclear missile submarine (under construction).

The Prithvi missile project encompassed developing 3 variants for use by the Indian Army, Indian Air Force and the Indian Navy. The initial project framework of the Integrated Guided Missile Development Program outlines the variants in the following manner.

- Prithvi I - Army Version (150 km range with a payload of 1,000kg)
- Prithvi II - Air Force Version (250 km range with a payload of 500kg)
- Prithvi III - Naval Version (350 km range with a payload of 500kg)
- Dhanush - Dhanush is reportedly a naval version of Prithvi which can be launched from Ships. Some sources claim that Dhanush is
- A System consisting of stabilization platform and missiles, which has the capability to launch both Prithvi II and Prithvi III from Ships[1] while others report that Dhanush is a variant of Prithvi-II Ballistic Missile.

Over the years these specifications underwent a number of changes. While the codename Prithvi stands for any missile inducted by India into its armed forces in this category, the later developmental versions are codenamed as Prithvi II and Prithvi III.

Agni

The 1500-kilometer Agni I technology demonstrator uses the SLV-3 booster for its first stage and a liquid-fueled Prithvi for its second stage. Three test shots were conducted before the U.S. successfully pressured India into suspending testing (1994). Of particular interest, the Agni tests demonstrated that India can develop a
maneuvering warhead that incorporates endo-atmospheric evasive maneuvers and terminal guidance in the reentry vehicle. India has also developed the carbon-carbon composite materials needed for long-range missile components and reentry vehicle ablative coatings. India has also inducted Agni II missiles that have a range of the 2500 to 3500-kilometers. Unlike the Agni I, the Agni II will have a solid-fueled second stage. It is believed that the Agni can only be equipped with a conventional warhead. India recently tested the Agni III IRBM with a range between 5000 and 18000 kilometers which has two stages. Though this range only depends on the load. With a load of 1800Kg the Agni can travel 5000km but with 400kg load it can travel 18000. With a usual 1000kg it can travel 8000km. It is clear that one of the major constraints for this program is the lack of a proven nuclear warhead. Nuclear testing is a key related issue. India developed its own thermonuclear design which was tested in the 1998 Pokhran nuclear tests and yielded 45 KT. DRDO is working on a Submarine Launched Version of the Agni-III missile, which will provide India with a credible sea based second strike capability. The SLBM version is a miniaturized version of the Agni-III which is expected to be test fired shortly.

Surya

The Surya ICBM is an ICBM program that has been discussed repeatedly in the Indian press. Surya (meaning The Sun in Sanskrit and Many Indian Languages) is the codename for the first Intercontinental Ballistic Missile that India is reported to be developing. The DRDO is believed to have begun the project in 1994. Officials of the Indian government have repeatedly denied the existence of the project. According to news reports, the Surya-1 is an intercontinental-range, surface-based, solid and liquid propellant ballistic missile. The Surya-1 and -2 will be classified as strategic weapons, extending the Indian nuclear deterrent force to targets around the world. India currently is limited by the range of the Agni-3 missile. The development of a true ICBM would make strikes against almost any strategic target around the world possible and reduce India’s relative weakness. This would develop a credible global deterrent for India. The Surya-1 will have an expected range of 10,000 km. It reportedly has a length of 40 m and a launch weight of 80,000 kg (some reports indicate as much as 275,000 kg. As the missile has yet to be developed, the payload
and warhead are as yet unknown. It is believed to be a three-stage design, with the first two stages using solid propellants and the third-stage using liquid. The Surya-2 is a longer-ranged variant of the Surya-1. It has a reported range of 20,000 km. The first test flight is expected in 2008, and it is expected to be operationally ready by 2015.

**Sagarika**

The defence scientists are also near breakthrough in test firing the Sagarika, the country's first underwater launch ballistic missile. Sagarika has already been test-fired from a pontoon, but now DRDO is planning a full-fledged test of the missile from a sub-marine and for this purpose may use the services of a Russian Amur class sub-marine which is expected to happen in September, which is in the same period as the Anti Ballistic Missile test which is jointly developed by Israel and India.

Sagarika is a nuclear capable submarine-launched ballistic missile with a range of 750 km. This missile has a length of 8.5 meters, weighs seven tonnes and can carry a pay load of up to 500 kg. The development of this missile started in 1991. The first confirmation about the missile came in 1998. The development of the underwater missile launcher know as the Project 78 (P78) was completed in 2001. This was handed over to the Indian Navy for trials. The missile was successfully test fired thrice. The Indian Navy plans to induct the missile into service soon. The missile is likely to arm the nuclear submarine which is expected to be launched in 2008. Sagarika will form part of the 3 in India's nuclear deterrence and will provide with retaliatory nuclear strike capability.

**CRUISE MISSILES**

**BrahMos**

BrahMos is a supersonic cruise missile that can be launched from submarines, ships, aircraft or land. The acronym BrahMos is perceived as the confluence of the two nations represented by two great rivers, the Brahmaputra of India and the Moskva of Russia. It is a joint venture between India's Defense Research and Development Organization and Russia's NPO Mashinostroeyenia who
have together formed the BrahMos Corp. Propulsion is based on the Russian Yakhont missile, and guidance has been developed by BrahMos Corp. At speeds of Mach 2.5 to 2.8, is the world's fastest cruise missile. At about three and a half times faster than the American subsonic Harpoon cruise missile.

**Nuclear Submarines**

According to some accounts India plans to have as many as five nuclear submarines capable of carrying missiles with nuclear warheads. Currently, India is building 3 nuclear submarines under the Advanced Technology Vessel plan. The Indian nuclear powered attack submarine design is said to have a 6,000-ton displacement and a single-shaft nuclear power plant of Indian origin. Once the vessel is completed, it may be equipped with nuclear capable Dhanush or Sagarika missiles and an advanced sonar system. However, according to some analysts the most probable missile for the Indian submarine would be the nuclear capable Brahmos anti-ship cruise missile designed jointly by India and Russia, based on the Yakhont missile by NPO Mashinostroyeniya.

**Advanced Technology Vessel**

The Advanced Technology Vessel (ATV) is a nuclear-powered ballistic missile submarine being constructed for the Indian Navy at Visakhapatnam, India. The ATV is an SSBN and will be armed with the ballistic missiles like the Sagarika missile, or the submarine variant of the 5000 km range Agni-III missile. As of July 2007, the Sagarika/K-15 missile was reported to have undergone three successful tests.

**Leasing of Soviet/Russian Submarines**

In 1988 INS Chakra, a Charlie-class submarine was leased by the Indian Navy for three years from the Soviet Union, until 1991. From 2000, negotiations between India and Russia were conducted into the leasing of two uncomplete Akula class. The Akulas are to be delivered to the Indian Navy in 2008 on a lease of at least seven years, and up to ten years. The acquisition is to help the Indian Navy prepare for the induction of the ATV. The cost to India of acquiring two Akula submarines
and their support infrastructure along with training of the crews had been estimated at $2 billion.

**INS Sindhuvijay**

The INS Sindhuvijay diesel-electric submarine capable of launching Klub-S missile tests and the nuclear capable BrahMos missile is being refit by the Russian Navy. The Russian 3M-54 Klub is a multi-role missile system developed by the Novator Design Bureau (OKB-8). Its NATO reporting name is SS-N-27. Both submarine and surface ship launched versions exist. The system is designed to accept various warheads, allowing its use against surface and subsurface naval combatants along with static land targets. In one variant, the 3M-54E (Sizzler), the final stage makes a supersonic 'sprint' to its target, reducing the time the target's defense systems have to react. The 3M-54E1 subsonic missile is roughly comparable to both the American Tomahawk cruise missile and the ASROC missile but is smaller and has a shorter range.

**The Akula Class Submarines**

India is reportedly paying two billion dollars for the completion of two Akula-II class submarines which were 40-60% completed. Three hundred Indian Navy personnel are being trained in Russia for the operation of these submarines. India has finalized a deal with Russia, in which at the end of the lease of these submarines, it has an option to buy them. The first submarine will be named INS Chakra.

Whereas the Russian Navy's Akula-II submarine is equipped with 28 nuclear-capable cruise missiles with a striking range of 3,000 kilometers, the Indian version was reportedly expected to be armed with the 300 km range 3M-54 Klub nuclear-capable missiles. Missiles with ranges greater than 300 kilometers cannot be exported due to arms control restrictions, since Russia is a signatory to the MTCR treaty but the Russian Indian nuclear cruise missile - BrahMos missile will feature this. This will also be fitted with Indian developed nuclear SLBM sagarika with 750km range.
Nuclear Aircraft

In 2003, India and Russia signed a 1.9 billion pound deal in which 4 Tupolev Tu-22 M3 long-range aircraft, which are capable of delivering nuclear bombs, were leased to India. They currently serve the Indian Navy and are used regularly for test flights in the Indian Ocean. The Sukhoi Su-30MKI serves in the Indian Air Force and is also seen as a means to deliver nuclear weapons.

Nuclear Facilities

The center piece of India's nuclear weapons program is the Bhabha Atomic Research Center (BARC) in Trombay near Mumbai (Bombay) which is the center for nuclear weapons associated work. BARC was founded as the Atomic Energy Establishment, Trombay (AEET) on 3 January 1954 by Dr. Homi Jehangir Bhabha. Bhabha was the also the founder India's entire nuclear industry and infrastructure, and India's first Secretary of the Department of Atomic Energy (DAE) when it was created on 3 August 1954. In its early years BARC was already a very large, but primarily civilian-oriented nuclear research laboratory. When India's first nuclear device was designed and fabricated at there, the work was conducted surreptitiously (often at night) to hide it from the rest of the laboratory. But in May 2000 a watershed was reached in this tension between civilian and military work when the civilian Atomic Energy Regulatory Board (AERB) which had been exercising regulatory oversight was split off from BARC. As S. Rajagopal oberved, an expert on nuclear affairs and a professor of the Bangalore-based National Institute of Advanced Studies, this decision effectively reclassified BARC as a nuclear weapons laboratory - a laboratory with a primarily military function though also conducting civilian oriented work in a model similar to the U.S. weapons labs. But without much of the civilian oversight and management that the U.S. labs have.

BARC is the site of the two reactors used for weapons-grade plutonium production: the 40 MW CIRUS (Canadian-Indian-U.S.) reactor, and the 100 MW reactor named R-5, but usually called "Dhruva". Both of these are heavy water moderated and cooled natural uranium reactors.
CIRUS was supplied by Canada in 1954, but uses heavy water supplied by the U.S. (hence its name). The reactor is not under IAEA safeguards (which did not exist when the reactor was sold), although Canada stipulated, and the U.S. supply contract for the heavy water explicitly specified, that it only be used for peaceful purposes. Nonetheless CIRUS has produced much of India's weapon plutonium stockpile, as well as the plutonium for India's 1974 Pokhran-I nuclear test. India argued in 1974 that the contract allows its use in producing peaceful nuclear explosives, which is how it characterized this explosion, though in recent years the project director Raja Ramanna has conceded that this was a sham. CIRUS reactor achieved criticality on 10 July 1960. It can produce 6.6-10.5 kg of plutonium a year (at a capacity factor of 50-80%).

In 1977 work began on the larger Dhruva plutonium production reactor, which was developed indigenous but based on the Canadian supplied technology. It was commissioned on 8 August 1985 but startup problems caused by resonance vibrations from the cooling system damaged fuel assemblies soon required shutdown. After modifications were made (spring clips to damp fuel rod vibration) it began operating at one-quarter power in December 1986 and reached full operation in mid-January 1988. It operates at 100 MW and is capable of producing 16-26 kg of plutonium annually (at a capacity factor of 50-80%).

An additional possible source of plutonium are a number of unsafeguarded CANDU power reactors, including Madras Atomic Power Stations (MAPS, known as Madras I and II, or MAPS-I and MAPS-II); the Narora Atomic Power Stations (NAPS, known as NAPS-I and NAPS-II), and the Kakrapar Atomic Power Station (KAPS). Like CIRUS and Dhruva, the CANDU reactors are heavy-water moderated natural uranium reactors that can be used effectively for weapon-grade plutonium production. The possible production by MAPS is much larger than CIR and Dhruva combined, although the fuel burnup in power reactors of this type normally produces lower grade plutonium that is less desirable for weapons. Each power station reactor could produce up to 160 kg/yr (at a 60% capacity factor). It is uncertain how practical it is to operate MAPS for weapons grade plutonium production, although even the reactor-grade output has weapons potential. If supergrade plutonium were
produced at BARC by short irradiation periods, it could be mixed with MAPS plutonium to extend the plutonium supply. As of November 1998 India had a total of 10 small power reactors operating, with 4 under construction and due to begin operation in 1999, but with 12 more planned or under construction that would boost electrical output by another 5100 MW.

Nuclear power supplied 2.65 percent of India's electricity in 1999 and this is expected to reach 10 per cent by 2005. Expectations for nuclear power growth have consistently fallen far short of goals for over 30 years, so this percentage is likely to continue to grow slowly. India's nuclear power program proceeds almost entirely without fuel or technological assistance from other countries. Partly as a result its power reactors have been among the worst-performing in the world (with regard to capacity factors), reflecting the technical difficulties of the country's isolation, but are apparently now improving significantly. Its industry is largely without IAEA safeguards, though a few plants are under facility-specific safeguards.

In February 2001 India had 14 small nuclear power reactors in commercial operation, two larger ones under construction and ten more planned. The 14 operating ones comprise:

- Two 150 MWe BWRs from USA, started up in 1969, now using locally-enriched uranium and are under safeguards,
- Two small Canadian PHWRs (1972 & 1980), also under safeguards; and
- Ten local PHWRs based on Canadian designs, two of 150 and eight 200 MWe.

The separated plutonium for the 1974 test was produced at the separation plant in Trombay, near to Bombay, capable of processing 50 tonnes of heavy metal fuel/yr. Construction on the first facility there began in the 1950s, and began operating in 1964. In 1974 it was shut down for repair and expansion and reopened in 1983 or 1984. Trombay handles the fuel from both the Cirus and Dhruva reactors.

India also can separate plutonium in the Power Reactor Fuel Reprocessing (PREFRE) facility. This plutonium separation plant was built at Tarapur, north of
Bombay, and began operating in 1979. The plant has encountered operating problems, but India reports having overcome these by 1990. The nominal annual capacity is given as 100-150 tonnes of CANDU fuel. A much larger plant is now under construction at Kalpakkam sufficient to handle all existing reactors.

Given its immense thorium resources, India is actively interested in developing the thorium/U-233 fuel cycle. India is known to have produced kilogram quantities of U-233 by irradiating thorium in CIR, Dhruva, and MAPS reactors. Substantial production of U-233 is not practical though with natural uranium fueled reactors. The thorium cycle requires more highly enriched fuel to have an acceptable breeding ratio with the non-fissile thorium blanket. Reactor-grade plutonium from MAPS could serve as start-up fuel for U-233 plants in the future. If available U-233 is as effective a weapon material as plutonium.

India has been developing the capability to produce heavy water domestically to provide the moderator load for future reactors. The heavy water for almost all existing reactors was imported however. The 110 tonnes of unsafeguarded moderator for Dhruva and Madras I and II were ironically provided by China.

India has acquired and developed centrifuge technology and built centrifuge enrichment plants in Trombay and Mysore in the 1980s. The larger Rare Metals Plant (RMP), as it is called, at Mysore has a cascade capable of producing 30% enriched uranium in kilogram quantities, beginning in 1992-93, although reliability has been a problem. These enrichment plants appear to have no role in India's power reactor development plans, so they may be intended to offset the prestige of Pakistan's enrichment capability, or to provide additional standby weapons production capability. India has reported that it plans to build an enriched uranium reactor, and a domestically fueled nuclear submarine.

India's interest in light weight weapon design can be surmised from BARC's acquisition in the 1980s of a vacuum hot pressing machine, suitable for forming large high-quality beryllium forgings, as well as large amounts of high purity beryllium metal. India is known to manufacture tritium, and may have developed designs for fusion-boosted weapons.
India is not a signatory to NPT and has opposed the treaty as discriminatory to non-weapons states. India has previously taken the position that a world-wide ban on nuclear testing, and the production of fissionable material for weapons is called for. Except for China, which continues testing, there is now a de facto halt to testing worldwide, as well as the production of weapons grade plutonium and uranium by the US and Russia. India has shown no interest so far in restricting its own activities despite these changes in the world situation. India has also rejected offers at bilateral negotiation with Pakistan, but in December 1988 the two nations signed an agreement prohibiting attacks on each other's nuclear installations and informing each other of their locations.

Development continued on India’s nuclear delivery systems. On 11th April, 1999 Lohen India conducted a successful 14 minute test flight of the 2,500 kilometer Agni-II missile. “The entire process of achieving a minimum deterrent has been completed. Then Atal Bihari Vajpayee announced following the test. “We are satisfied that we are now fully capable of defending our borders,” he added. And India also abide by no-first-use doctrine. And this deterrence policy India make balance with other countries also.