COMPREHENSIVE TEST BAN : PROBLEMS AND PROSPECTS

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MANISH

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CERTIFICATE

This is to certify that the dissertation, entitled **"Comprehensive Test Ban : Problems and Prospects"** submitted by **Mr. MANISH**, in partial fulfilment of the requirements for the award of the Degree of **Master of Philosophy**, has not been previously submitted for any degree of this or any other University. This is his own work.

We recommend that this dissertation may be placed before the examiners for evaluation.

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TO MY FATHER

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The responsibility of demerits is mine alone.

MANISH

NEW DELHI
JULY 1995.

CHRONOLOGY OF THE COMPREHENSIVE TEST BAN
(1945-1990)

1945
July 16 The United States conducts the first nuclear test, the "Trinity" explosion, at Alamagordo Air Base, New Mexico (19 kilotons).
August 6 United States drops an atomic bomb on Hiroshima (15 kilotons), causing an estimated 140,000 deaths by the end of 1945.
August 9 The United States drops an atomic bomb on Nagasaki (21 kilotons), resulting in approximately 70,000 deaths by the end of 1945.

1946
June 14, The United States Baruch Plan proposes nuclear disarmament and international control over all nuclear facilities. U.S. bombs would be destroyed after the establishment of international controls and sanctions. The Soviet Union rejects the plan.

1949
August 29 The Soviet Union explodes its first atomic bomb (Joe I: 10-20 kilotons), at or near the Semipalatinsk test site.

1950
January 31 President Harry Truman announced his decision to go ahead with the hydrogen bomb project.

1952
October 3 Britain explodes its first atomic bomb at the Monte Bello Islands off Australia.
October 31 The United States explodes its full-scale thermonuclear device, code named Mike (10 megatons), utilizing cryogenic liquid deuterium, at Enwetok Atoll in the Pacific.
1953
August 12 At Semipalatinsk, the Soviet Union explodes a one-stage fission/fusion bomb (Joe 4 : 200-300 kt). This has often incorrectly been identified as a true thermonuclear device.

1954
February 28 The United States explodes its first full-scale thermonuclear device, utilizing solid lithium deuteride, suitable for weaponization, at Bikini Atoll. This 15 megaton test, code-named Bravo, produces large amounts of radioactive fallout, irradiating the crew of the Japanese fishing boat "Lucky Dragon", contaminating wide areas of the Marshall Islands, and provoking worldwide pressure for a nuclear test ban.

April 2, Indian Price Minister Jawaharlal Nehru proposes a "standstill agreement on nuclear testing, the first Initiative of its kind.

1955
November 22 The Soviet Union detonates its first genuine thermonuclear device (1.6 mt), at the Semipalatinsk test site.

1956
Adlai Stevenson, the Democratic Presidential candidate, makes a nuclear test ban a major campaign issue.
September 11 Soviet Premier Nikolai Bulganin proposes a permanent halt to nuclear testing without on-site inspections.

1957
International protests of unprecedented scale break out against nuclear testing.
March 28 At the United Nations Disarmament Commission Sub-committee in London, the United States announces it would consider stoping or limiting testing if verification issue could be settled.
May 15 Britain conducts its first thermonuclear test at the Christmas islands in the Pacific.
August 21 President Dwight Eisenhower proposes suspension of nuclear testing for up to two years, linked to a cutoff in production of fissionable material for weapons. The Soviet Union rejects this proposal, cirticizing the linkage.
September 19 The United States conducts its first contained underground test, code named Rainier, at the Nevada test site, with a yield of 1.7 kt.

1958
March 31 The Soviet Union accounced a unilateral moratorium on all nuclear test, providing Western nations also stop testing. Due to disagreements, all three nuclear-weapon countries continue to test for another several months.
April 8 Eisenhower proposes a Conference of Experts to examine test ban verification issues.
July 1 The Conference of Experts, bringing together scientists from the United States, Britain, the Soviet Union, France, Canada, Czechoslovakia, Romania and Poland beings in Geneva.
August 21 The report from the Conference of Experts concludes that a comprehensive test ban (CTB) in the atmosphere, underground and underwater can be verified with some 160 monitoring stations spread around the world. The report also contends that nuclear tests in space out to 50 kms could be verified, but that the means to detect deep space tests could not be developed with the technology at that time. The next day, Eisenhower proposes tripartite negotiations to end nuclear tests, and a test moratorium for the first year of the talks.

October 31 in Geneva, the United States, the Soviet Union, and Britain begin CTB talks, formally known as the Geneva Conference on the Discontinuance of Nuclear Weapons Tests. The United States and Britain begin a one-year moratorium; the Soviet Union joins the moratorium a few days later.

1959

April 13 Eisenhower suggest a phased agreement, beginning with a ban on atmospheric tests under the altitude of 50 kms. Soviet General Secretary Nikita Khrushchev rejects this, suggesting instead a CTB with a limited number of one-site inspections, an idea previous proposed by British Prime Minister Harold Macmillian.

June 22 The technical working group on monitoring high altitude explosives convenes. Its July 10 report concludes that a six-satellite system could detect tests in space.

November 25 The technical working group on detecting underground explosions convenes to review new U.S. data on underground tests and evasion techniques, including "big hole" decoupling.

December 18 The working group on underground test verification adjourns without reaching an agreement.

1960

February 13 France tests its first nuclear weapon in the Sahara Desert (60-70 kt).

May 2 After a U.S. U-2 reconnaissance aircraft is shot down over Sverdlovsk, Khrushchev cancels the "Big Four" Paris summit, at which it was hoped there would be progress in CTB.

1961

March 21 Tripartite negotiations reconvene in Geneva after a review of the U.S. position by Kennedy administration, Positions are close on many points, but the United States and Britain call for 20 on-site inspections per year on each nation's territory, while the Soviet Union proposes three. Differences remain on other issues.

June 3 At a summit in Vienna, Khrushchev takes a hard-line on several issues, including the test ban. President John F Kennedy reports that "our hopes for an end to nuclear tests .... have been struck a serious blow".

October 30 The Soviet Union explodes the largest nuclear device in history (58 mt), over Navaya Zemlya.

November 28 Test ban negotiations resume in Geneva. The Soviet Union tables a draft test ban treaty with verification issues to be worked out later. The United States and Britain reject the plan.

1962

January 29 Conference on Discontinuation of Nuclear Weapons Tests adjourns in deadlock.

March 14, The United Nations 18-Nation Committee on Disarmament open in Geneva. The Soviet Union repeats its proposal for a test ban without agreed verification methods. U.S. and British representatives suggest eliminating their previous seismic threshold, calling for a CTB with 20 inspections per year and an extensive seismic network.

1963
June 10 In a commencement speech at American University, Kennedy announces the initiation of special test ban discussions and a U.S. moratorium on atmospheric tests, if the Soviet Union reciprocates.
July 2 Khrushchev announces his acceptance of the idea of a Limited Test Ban Treaty (LTBT), banning nuclear testing in the atmosphere, underwater, and in outer space.
July 15 Negotiations begin for an LTBT.
August 5 The LTBT is signed in Moscow. The treaty prohibits nuclear explosions in the atmosphere, in outer space and underwater and proclaims the parties determination to continue negotiations toward a CTB.

1964
October 16 China conducts its first nuclear test (20 kt), at Lop Nur on the Qinghai Plateau.

1967
June 1 China conducts its first thermonuclear test (three mt), at Lop Nur.

1968
July 1 The Nuclear Nonproliferation Treaty (NPT) is signed. The agreement, the cornerstone of the international nonproliferation regime, obligates non-nuclear-weapons states not to manufacture or acquire nuclear weapons (implicitly prohibiting testing by those states), and requires all parties to pursue negotiations on arms control and disarmament. The preamble refers explicitly to the CTB, which many non-nuclear-weapon states regard as the key criterion for judging the nuclear-weapons states' compliance with the treaty.
August 24 France conducts its first thermonuclear test (2.6 megatons), at Fangatuafa in the Pacific.

1974
May 18 India explodes its first nuclear device, in an underground test in the Rajasthan Desert, claiming it was for peaceful purposes.

July 3 The Threshold Test Ban Treaty (TTBT) is signed, limiting the yield of underground nuclear weapons tests to 150 kt and obligating parties to continue negotiations towards a CTB.

1976
May 28 The Peaceful Nuclear Explosions Treaty (PNET) is singed, limiting any individual nuclear explosion to yield of 150 kt. President Gerald Ford delays ratification of both the PNET and TTBT, reportedly because of the primary election challenge from Ronald Reagan.

1977
March 17 At the United Nations, President Carter announced his intention to pursue a CTB.
October 3 Trilateral CTB negotiations in Geneva.

1981
October 21 At the U.N. General Assembly, the Reagan administration's first Arms Control and Disarmament Agency (ACDA) director, Eugene Rostow, says that the U.S. government supports a CTB as a "long term goal", but that "international conditions.....are not now propitious.

1984
May22 The Five Continent Peace Initiative led by Sweden, India, Mexico, Tanzania, Greece, and Argentina, calls for a complete freeze in testing, production, and deployment of nuclear weapons.

1985
December 19 In response to Gorbachev's December letter, the United States replies, "A comprehensive test ban..... is long term objective of the U.S. in the context of achieving broad, deep and verifiable arms reductions, substantially improved verification capabilities; expanded confidence-building measures; greater balance in conventional forces; and at a time when a nuclear deterrent is no longer essential".

1986
October 12 At the end of the Reykjavik summit, Gorbachev asks for the United States to begin negotiations on limitations of the yield and number of nuclear explosions in order to move toward a CTB, Gorbachev briefly links progress on strategic arms reductions, intermediate range nuclear forces, missile defenses, and testing in a single package.

1987
November 9 In Geneva, the United States and the Soviet Union begin the negotiations on nuclear test limitations agreed to in September (Nuclear Testing Talks), but the talks soon focus exclusively on TTBT and PNET verifications issues, rather than the broader agenda originally announced.
December 9 During the Washington summit, the United States and the Soviet Union agree to conduct the Joint Verification Experiment (JVE), allowing each side to monitor a nuclear test at the other's test site.

1989
May 18 French President Francois Mitterand announced that if the United States, Great Britain, and the Soviet Union stop nuclear testing, France "shall follow suit".
October 19 The Soviet Union conducts its last nuclear test of 1989, beginning an undeclared test pause lasting just over a year.

1990
January 9 Bush approves a policy statement on nuclear testing indicating that the administration "has not identified any further limitations on nuclear testing..... that would be in the U.S. national security interest"; that now new testing negotiations will be undertaken until after a "period of implementation" of the TTBT and PNET verification protocols; and that the administration views a CTB as a "long term objective" possible only "when we do not need to depend on nuclear deterrence".
March 7 A representative of the Soviet Ministry of Defence recommends to the Supreme Soviet that nuclear testing at Semipalatinsk be phased out by 1993, after 27 more tests. All testing would be moved to the Arctic island of Novaya Zemlya.
June 1 The United States and the Soviet Union sign the new verification protocols for the TTBT and PNET.
September 25 The U.S. Senate approves the TTBT and PNET with their new protocols, 98-0 with two attached declarations; one supporting various "safeguards" which would effectively involve continued testing, and the other pointing out U.S. treaty commitments to pursue a CTB.
october 24 The Soviet Union conducts its first test in more than a year, ending an undeclared pause in nuclear testing.

Source : Arms Control Today, vol.20, no. 9, November 1990

PROLOGUE

"If the radiance of thousand suns
were to burst at once into the sky
That would be like the splendor mighty One (Krishna)
I am become Death, the destroyer of worlds."

- Bhagavad Gita

These lines were the reminiscence of Robert J. Oppenheimer, the director of the Los Alamos laboratory, after the success of the first test shot "Trinity' at Alamogordo, New Mexico, on July 16th, 1945. The explosion produced intense light and shock waves which were beyond the imagination of even the scientists involved in the process.[1] This day can be said as a turning point in world history for it marked the beginning of the nuclear age which consequently changed the complexion of the global politics.

Two interrelated developments took place in the forties - the first was the advent of atomic bomb, the destructiveness of which was manifest in Hiroshima and Nagasaki bombing on the sixth and the ninth day of August 1945. Although the casualties inflicted by this bombing were almost equal to the one caused by conventional bombing in Tokyo city five months before this devastation, the significance of this was, that the damage was imposed by a

1. See Edward Teller, The Legacy of Hiroshima (London, 1962) pp. 3-20

single weapon.[2] Thus the advent of nuclear weapons increased the potential human cost to an extent that the 'ultima ratio' in an international war brought sharply into question and a search for new means for peaceful adjustment appeared urgently.[3]

Secondly, the end of world-war-II brought about a radical transformation in the political configuration of the world. At the outbreak of war, the world witnessed approximately seven great powers including Germany and Japan. This number was reduced to three at the end of the war - bringing U.S. and U.K. on the one plank and U.S.S.R. on the other - a shift from multipolarity to bipolarity, a consequence of the ideological rivalry. Thus, while the atomic bombing brought an early end to the war it laid the foundations of the `cold-war'.

While the early thirties marked the successes of James Chadwick Earnest Lawrence, John Cockoft and Walton in the field of quantum physics, politics witnessed the rice of Hilter to Chancellorship of Germany. Subsequently, the Nazi persecution of the Jews led to the exodus of scientists (most of whom were Jews) from Germany.[4] The cultural and academic

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2. ibid

3. Harold Karan Jacobson and Eric Stein, Diplomats Scientists and Politicians : The United States and the Nuclear Test Ban Negotiations (Michigan, 1966), p. 4.

4. M. Zuberi, "Decisions of the Nuclear Age" DEFENSE TODAY, vo. 2, no. 2, May 1994, p. 13

decline in the totalitarian fascism also paved the way of departure of German scientists, most of whom found refuge in the United States.[5] The initial motivation in these scientists to make a bomb was the knowledge that Nazi Germany was also pursuing this goal and at the same time fear that it might succeed in doing so. These scientists clubbed together to warn the U.S. government of the forecoming threats to its security and at the same time convinced about the rationale of the bomb. The famous letter dated August 2, 1939 from Albert Einstein to President Roosevelt was the manifestation of this endeavour. the result was the government sponsored `Manhattan Project' which had its culmination in the atomic bombing of Hiroshima and Nagasaki. Although the bombing brought an early end to second world war it was coupled by another development of historical importance. The latent rivalry between Western capitalism and communism, enhanced by the distrust among the allies, resulted in the cold war which lasted till the end of the 1990's.

The advent of the bomb, brought about a new challenge - the challenge of controlling the bomb. Efforts were made towards controlling the atomic energy through some institutional mechanism. The `Baruch Plan' was proposed by the Americans in 1946 which suggested the transfer of nuclear materials to an international authority for peaceful purposes

5. Gorden A. Craig, GERMANY 1866-1945 (Oxford,1988), p. 639.

and the outlawing of nuclear weapons. The plan was unacceptable to the Soviets, since it would have left the atomic know - how in the sole possession of the U.S. In fact, the Soviets were in a process of making the bomb a fact revealed only in the year 1949.

Comprehensive Test Ban (CTB) has been one of the long debated issues in history of arms-control and disarmament negotiations. The demand for an immediate cessation of nuclear testing was first made by the then Indian Prime Minister Jawaharlal Nehru in response to the radioactive fallout from the first ever thermonuclear explosion 'BRAVO', which caused human casualities. Since then the issue has gone through several cycles of activism and apparent passivity. The issue was linked with nuclear proliferation, stockpile degradation and U.S.-U.S.S.R. asymetrices. The negotiation process can serve as a case study. At the same time, it also serves as a focal point for examing the attitudes of the super powers towards achieving peace. It is also an illustration of interaction between domestic events, national policies and international occurences.

A comprehensive test ban still remains the major objective of nuclear disarmament but the present stratified world in terms of nuclear haves, have nots and 'threshold states' has added complexities to an early conclusion of a treaty.

CHAPTER - 1

THE ORIGIN OF TEST-BAN DEBATE

'A Comprehensive Test Ban (CTB) is perhaps one of the oldest agenda item of nuclear disarmament and arms control. While a concerted discussion of a CTB began on Oct. 31, 1958 with the tripartite test ban negotiation between U.S., U.K., and U.S.S.R.; the public demand for the cessation of nuclear test dates back to early 1954 when the radioactive fall-out from the first U.S. thermonuclear explosion contaminated areas of the Marshall Islands and caused radiation sickness to twenty-three Japanese fisherman abroad the tuna trawler 'Fukuryu Maru'. The incident gave an initial spark for an anti-nuclear activism world-wide.' Nuclear testing was not a new phenomenon. After the atomic bombing on Hiroshima and Nagasaki through 1949, the U.S. Atomic Energy Commission (AEC) conducted five nuclear weapons test at the Bikini and Eniwetok Islands in South Pacific. It is also a fact that the safety measures for the military personnel were inadequate. In the year 1946, Radiological Safety Officers at the Bikini tests complained that the ship's commanders permitted their crews to be exposed to radioactive fallout without protection.[1] But the 1945 'Bravo' explosion, apart from causing public casualities, was significant in a sence that it revealed the secrecy of the U.S. thermonuclear bomb.

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1. Gerald H. Clarfield and William M. Wiecek, Nuclear America : Military and Civilian Nuclear Power in the United States, 1940-1980 (New York, 1948), p. 201

The March 31, 1954 press conference, and the responses of the Lewis Strauss, the then A.E.C. Chairman, on the nature of Hydrogen Bomb further magnified the public scar of nuclear testing and the horrors of Hydrogen-Bomb.[2] Prime Minister Jawaharlal Nehru made the first most eloquent call for the cessation of nuclear tests. In a formal address to the Indian Parliament on April 2, 1954, Nehru called for an immediate "standstill agreement" on nuclear testing between the three powers.[3] His sentiments were shared by influential people like Dr. Albert Schweitzer, famous Europian musian, philosopher and physian and Pope Pius XII.[4] In the British Parliament 104 Labour members signed a petition calling for surrendering control of all nuclear weapons to the U.N. and and immediate ban or the H-bomb tests.[5] The issue also figured before the U.N. Trusteeship Council as the Marshall Islands and other Islands like Caroline and Mariana of Pacific were governed by the U.S. under the trusteeship agreement of 1947.[6] Even within the United States, Lewis Mumford, well known writer on technology, and Arthur Comptom, noted scientist were outraged by `BRAVO'.[7] But all this was

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2. Robert Divine, Blowing on the Wind : The Nuclear Test Ban Debate, 1954-1960 (New York, 1978), p. 13

3. ibid, p. 20

4. ibid, p. 21

5. ibid

6. ibid, p. 27

7. Divine, n.2, p. 18

not enough to deter the U.S. government which did nothing more than a public relations campaign to passify the outraged public opinion.

II

From the initial call for the cessation of nuclear tests until the beginning of serious negotiations in 1958, a variety of problems stood as a formidable barrier. The first was the perceptive difference between the West and the East on the basic approach towards disarmament. After the advent of nuclear bomb, the west fell the need of controlling the bomb. In a meeting of President Harry Truman, British Prime Minister Clement Atlee and Canadian Prime Minister Mckenzie King held on November 1945, they acknowledged the needful international control of atomic energy.[8]

Subsequently, the United States proposed at the U.N. Atomic Energy Commission the so called 'Baruch Plan'.[9] According to this plan; the manufacture of nuclear weapon was to cease; existing weapons were to be destroyed after the successful completion of earlier stages and the nuclear materials were to be transferred to an international authority for use in the peaceful purposes. Rigid controls were contemplated, the punishments for violators not subject

8. A.Y. Yefremov, Nuclear Disarmament (Moscow, 1979), p. 14

9. ibid

to Security Council veto.[10] The plan was unacceptable to the Soviets for they felt that the proposed International Atomic Development Authority would have brought all the sources of nuclear fuel in the world under U.S. control thus leaving the monopoly of nuclear know-how in the hands of the United States. Also article 11 of the Baruch Plan gave priority to 'proven competence' while recruiting the personnel to the Authority. This would have lead to U.S. domination since it was the only country at that time which had the proven competence in atomic matters.[11] In fact the Soviets were engaged in their secret atomic programme and the intrusive inspection procedures suggested by the Baruch Plan would have nipped development of nuclear weapons. Therefore as a response to the American Plan, the Soviet representative Andrei Gromyko on June 1946, at the second meeting of U.N. Atomic Energy Commission introduced a draft convention. It suggested (1) the outlawing of the production and use of atomic weapon, (2) Three months later all existing weapons to be destroyed, (3) Only after another month was a control system to be considered and (4) Any penalties for violators were to be meted out by the Security Council where the great powers had the veto.[12] The major difference between the U.S. and the Soviet approach towards disarmament at this initial

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10. Glenn, T. Seaborg, Kennedy, Khrushchev and the Test Ban (California, 1981), p. 4

11. Yefremov, n. 18, p. 15

12. Seaborg, n. 10, p. 4

stage related to control mechanism. While the Americans wanted the control system to be made effective before taking any stop towards disarmament. the Soviets thought the other way round-disarmament first and then the establishment of control system.[13] Joseph I.Lieberman has opined in his book The Scorpion and the Tarantula, that even if the Soviets had accepted the Baruch Plan it was improbable that the U.S. would have proceeded with its total implementation.[14] Although in the next several years, efforts were made to bridge this gap, but all in vain. The difference in approach towards disarmament persisted for several years. After the fall-out incident in the year 1954, the Soviet union submitted to the sub-committee of the U.N. Disarmament Commission - specially formed for practical discussion on concrete aspects of disarmament problem - proposal concerning the basic provision of an international convention for prohibition of atomic, hydrogen and other types of weapons of mass destruction. The same year on July 6th, it submitted to the 14th session of U.N. Trusteeship Council a resolution stating that the Atomic and H-bomb tests in the Pacific Island trust territory had done harm to the health of the native population and caused material damage. The draft resolution reiterated that the U.S.A. discontinue Atomic and

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13. ibid, p. 5

14. Joseph I. Lieberman, The Scorpian and the Tarantula : The Struggle to Control Atomic Weapons, 1945-1949 (Boston, 1970), p. 406

H-bomb tests in the Trust Territory.[15] Again in a declaration submitted to the Sub-Committee of U.N. Disarmament Commission on May 10,1955, it proposed the discontinuance of atomic and hydrogen weapon tests as a preliminary measure towards disarmament.[16] In the Western view, however the Soviet proposals offered no basis for constructive negotiations. It was felt that the Soviets sought to place their country in the forefront of the movement to prohibit further nuclear testing after BRAVO fallout incident. The Soviet Union had continued its own test programme without interruption. It was only at the London session of the Sub-Committee of the Disarmament Commission from March to September 1957 that both the East and the West revised their earlier stances towards disarmament. While the U.S.S.R. agreed to the establishment of control posts in its own territory the West also altered its position on a test ban.[17] These two developments; the period of which synchronized with worldwide protests against nuclear testing, could be said as prelude to nuclear test ban negotiations, the latter was in certain ways a consequence of the former.

Secondly the domestic and international pressure,

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15. Yefremov, n. 8, p. 78

16. ibid, p. 79

17. Harold Karan Jacobson and Eric Stein, Diplomats, Scientists and Politicians : The United States and the Nuclear Test Ban Negotiations (Michigan, 1966), p. 15

exerted upon the policymakers by individuals and groups, within and outside the government had a relative influence on the test ban policy. The bureaucratic process of decision making and the particular style of democratic politics specific to U.S.A. had its impact at a number of levels. It should be noted that the 1954 `CASTLE' test series of the United States had contaminated large areas the pacific and brought illness and death to Japanese fisherman. The Soviet hydrogen bomb tests, begun in 1954 and continued through the decade further contaminated the atmosphere. In 1955, radioactive rain fell in Chicago and in the year 1959, deadly strontium 90 began to show up in milk. Scientists like Linus Pauling, Barry Commoner and others warned of leukamia, bone cancer and genetic damage from nuclear testing. All this had fuelled the anti-nuclear activism worldwide. While there were wide protests within and outside the United States against continued nuclear testing, it hardly had any effect on the Eisenhower administration. Within the administration, the Atomic Energy Chairman Lewis Strauss, Scientists Edward Teller and Mark Mill were the ardent supporters of nuclear testing apart from pressure groups like the Pentagon. These scientists stated that with continued testing U.S. laboratories could develop "clean" (fallout-free) weapons. It was also emphasized by them that clean nuclear weapons were vital to national interests of the Western block. Even Washington was under strong pressure from the U.K., which sought to develop nuclear weapons of its own when at the end

of May 1957 the U.S. representative Harold Stassen, the Eisenhower's consent, handed the Soviet representative in the Sub-Committee of the U.N. Disarmament Commission a memorandum containing certain proposals that could prove acceptable to the U.S.S.R., London sounded the alarm. The upshot was that Eisenhower in response to a protest from British Prime Minister had to ask Stassen to tender his resignation.[18]

But by the year 1956 people had become more aware about the dangers of the fall-out. This period also synchronised with the U.S. Presidential election. During the campaign the democratic nominee Adlai E. Stevenson made test ban an issue and suggested that the United States might unilaterally stop testing as a first step towards obtaining an Agreement. Also by this time, the Soviets had gained the propaganda advantage by consistently demanding a test-ban. With the growing pressure - both national and international the Eisenhower administration was left with no option than to review its earlier position on the subject. As a first step, in the month of November 1957, the Eisenhower administration brought into the government scientists including James Killian of M.I.T., George Kistiakosky of Harvard, Hans Bethe of Cornell who began to counter the strong antitest ban view of the officials. They stressed the value of test ban as an initial measure to control U.S. - Soviet arms race. All

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18. Yefremov, n. 8, p. 80

these developments led to the calling of the "Conference of Experts" for a technical discussion on the feasibility of a test ban.

III

By the end of the year 1957, the Soviet Union had gained the propaganda advantage in its favour. Its declaration of unilateral suspension of nuclear tests for a period of three years would have brought to it an added advantage. In an attempt to minimize the propaganda advantages which the Soviet Union had won by that time, President Eisenhower pressed to the new Soviet Premier Khrushchev calling of a "Conference of Experts" to study the possibility of detecting and identifying the underground explosions, as a preliminary condition for any political decision on a test ban.

The conference met in the summer of 1958. The Western delegation included two British delegates, one Frenchmen and one Canadian apart from the U.S. delegates. Led by James Fisk, Vice President of the Bell Telephone Laboratories, the delegation had Professors Robert F. Bacher and Ernest O Lawrence. On the other hand, the Soviet experts were joined by colleagues from Poland and Czechslovakia and received political guidance from a senior diplomat, Semyon Tsarapkin, head of the section for international organisation in Foreign Ministry and a veteran of disarmament negotiations. In fact,

the presence of the leading diplomat marked a difference from the U.S. led delegation, which had only technical experts and even among advisors only junior diplomats. Dr. Yevgeni K. Fedorov, a corresponding member of the Academy of Science of U.S.S.R. served as Chairman and thus was Dr. Fisk's counterpart. The Western delegation was very much clear on the objectives of the conference. While it conceded that the conference should recommend a single system of inspection, it was careful not to give any commitment in principle to a test ban.[19] This situation was, probably a logical consequence of the respective political positions of both sides. In course of the conference the West seemed to be more quantitative, thus arguing for extensive control system. The Soviets appeared to be more optimistic on the methods of inspection. They asserted that with the maturation of technology, inspection would become rather easier. The experts prominently examined the method which included recording acoustic and hydroacoustic waves, recording radio signals, collecting radioactive debris and recording seismic signals. And on 21 August, 1958, in the final communique, it was stated that it was technically feasible to set up, with certain capabilities and limitations, a workable and effective control system for the detection and violations of a possible agreement on worldwide cessation of nuclear

19. April Carter, Success and Failure in Arms Control Negotiations (Oxford, 1989), p. 45

weapons tests.[20] In the final report of the conference issued on 30 August, 1958 the proposed system was spelt out. Known as the 'Geneva System', it suggested to establish 160-170 land based control posts, each containing scientific detection apparatus, manned by 30-40 person, several of which had to scientists. In addition, ten similarly manned and instrumented ships and regular flights were to be used to patrol the oceans.

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20. Jacobson and Stein, n. 17, p. 80.

CHAPTER-2

THE TEST BAN DEBATE

Engaged by the optimistic findings of the `Conference of Experts' and at the same time placed on the defensive by domestic and international pressures, the United States proposed that the then three nuclear powers meet to negotiate a permanent end to nuclear test. The talk which began on October 31, 1958 in Geneva known as the `Conference on the Discontinuance of Nuclear Weapon Tests' could be called as the starting point of a concerted discussion towards banning of nuclear tests. While this initial effort could not result in a comprehensive nuclear test ban, it did succeed in achieving partial objectives. The negotiations in 1963 by the United States, the Soviet Union and Great Britain led to the conclusion of Limited Test Ban Treaty (LTBT), banning testing in the atmosphere, in outer space and under water. The immediate gain of the treaty was that it minimised the possibilities of `radioactive fall out' and thus helped to pacify the anti-nuclear activism of the sixties. Subsequently the 1968 Non-Proliferation Treaty, the 1974 negotiations by the United States and Soviet Union leading towards a bilateral treaty limiting underground nuclear tests to a size equivalent to not more than 150 Kiloton of conventional explosive force (the Threshold Test Ban Treaty or TTBT) and in 1976, a complementary bilateral treaty controlling underground nuclear explosions for peaceful purposes (the Peaceful Nuclear

Explosions Treaty or PNET) did help to contain nuclear dangers although it did not eliminate it.

I

The Geneva Conference of 1958 on the `Discontinuance of Nuclear Weapon Tests' opened somewhat inauspiciously. In the early November, after the start of the conference, the Soviet Union conducted two nuclear tests. In fact, all the three states -U.S.A., U.K. and U.S.S.R. - had rushed to complete their test series before the start of the conference. The U.S. `HARDTACK' series comprised fiftyfour tests, eight of which were underground.[1] The Soviet Union invoked the escape clause in the moratorium dating from 31 March 1958 and began a major series of tests. The tone of public statements also was hostile. In a Pravda interview, Khrushchev attacked the U.S.A. for limiting its promised moratorium to one year, for attempting to link a suspension of tests to major measures of disarmament and for placing emphasis on control system.[2]

Not only that, the period between the issuance of President Eisenower's statement of August 22, 1958 and the opening of the Geneva test ban negotiation witnessed relevant events, prominent of which was the bombardment of the off-shore island groups of Quemoy and Matsu by Communist China. On

1. Glenn T. Seaborg Kennedy, Khruschev and the Test Ban (California,1981), p.15

2. April Carter Success and Failure in Arms Control Negotiations (Oxford, 1989) p.47

August 23, the islands were hit by some fifty thousand shells within a period of two hours. The crisis which this action touched off continued until late October.[3] While it has not been established whether this action was somewhat linked to the developments concerning a test ban, it cannot be denied that test ban would affect Communist China's ability to develop an independent nuclear capability.[4] At this juncture, it is worth remembering that the 'Conference of Experts' had suggested a global system of control posts, some of which were to be installed in China. Also Communist China and USSR had discussed the question of the former's obtaining a nuclear capability.[5] Thus any conclusion of a test ban would not only had nipped China's nuclear ambitions but also would have left China facing nuclear- equipped American forces in Eastern Asia without having such weapons of its own.[6]

Despite all odds, the conference began on the scheduled date. Although the conference was held outside the framework of United Nations, it was serviced by the U.N. Secretariat. All the three delegations were led by senior and experienced diplomats. While the leader of U.S. delegation was Ambassador James Wadsworth, who had the experience of arms control

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3. Harold Karan Jacobson and Eric Stein, Diplomats Scientists and Politicians : The United States and the Nuclear Test Ban Negotiations (Michagan, 1966), p. 95

4. ibid

5. ibid

6. ibid

negotiations at the United Nations, the Soviets had Tsarapkin as their head. The British delegation was headed by David Ormsby Gore from the British Foreign Office. At the outset of the conference, the Soviets tabled on the agenda, a draft treaty.[7] The one liner draft treaty proposed to stop all nuclear tests, to set up control system based on 'Geneva System' and to dissuade others from testing. According to Glenn T Seaborg, in speaking of 'others', the Soviets surely had France in mind.[8] It was objectionable to the Western delegates who considered it nothing more than the continuation of the old Soviet sequence in which the treaty relating to test ban was to precede the 'control system'. It was only on November 29, in reaction to the criticism in the American press, that the Soviets agreed to incorporate basic provision of 'control system' in the treaty test. The other issues on which the two sides were at odd were regarding the 'composition of the control posts' and the 'right to veto' in the control system. Also, the new technical findings by the U.S. during its 'HARDTACK' series became a challenge to the negotiators. The Soviets wanted the 'control posts' to be staffed by the nationals of the country in which they were locate except one or two observors. They also wanted a 'veto' right to be given to the original parties in voting by control commission that would supervise a test ban. The Western view was diametrically

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7. Seaborg, n.1, p.15

8. ibid

opposite to that of the Soviet view and eventually frustrated the test ban cause.[9]

While negotiations were gradually progressing in the Geneva Conference, opposition within the Eisenhower administration to a test ban remained strong. Following the 'Conference of Experts', scientist Edward Teller had asked the Livermore and the Rand Corporation scientists to consider ways in which the 'Geneva System' might be evaded.[10] The revelation of these scientists while the conference was in progress gave a new dimension to the test ban talks. These scientists opined that the conclusions of the 'Conferences of Expert' were based on an overestimation of seismic detection of underground tests. They put forward the new theory of 'decoupling' that is muffling of the seismic signal by firing an explosion in a very large underground cavity. A necessary corollary of these findings was that it was almost necessary to establish control posts, internationally controlled (according to western model) with an inspection quota, as suggested by British Prime Minister Macmillan. Knowing the fact that the Soviets would never accept it, the West adhered to its stand during the conference and in a letter to Khrushchev dated May 5, 1959, President Eisenhower went on to state that the Soviet Union would have to modify its position in order to continue the

9. ibid, p.16

10. ibid, p.18

negotiations, thus jeopardising all hopes of comprehensive test ban.[11] It was following this that the U.S. decided against a total ban, turning instead to either a ban on atmospheric tests alone or a threshold ban.

Despite the divergence between both sides on the issue of verification, the Geneva Negotiation continued. Even both the sides observed a voluntary moratorium after the end of official moratorium in the last month of 1958. In the sixties a proposal of 'phased disarmament' was presented by the West and at a stage in the 'Big Four Summit' held in Paris, a treaty of some partial nature seemed imminent . The momentum seemed so strong that France and China which were opposed to test ban came forward in haste to make their positions clear. While France which had detonated its first and second nuclear devices in Sahara on February 13, and April 1960 respectively by stated the it could abondon its nuclear programme only after the three nuclear haves had destroyed all their nuclear weapons, China took a different position. It stated that it would be bound by no accord which it would not sign.[12] But then the U-2 spy plane incident undermined the summit and put and end to any expectation to achieve a negotiated ban.

Significant events occurred in the early sixties. While John F. Kennedy, who entered the White House as the President

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11. ibid, p.18

12. Seaborg, p.23

in January 1961, embarked upon a more activist policy of seeking an agreement, the Soviet Premier Khrushchev - under pressure from constituencies within the Soviet bureaucracy, especially military elite - began to downplay the importance of a test ban altogether. On several occasions, he suggested that nuclear weapon tests by the French might compel the Soviet Union to resume testing.[13] And it did resume in September 1961, thus paring way to extensive test series, including the largest soil nuclear explosion equivalent to 50 megatons.

Another significant event was the entry of the non-nuclear non-aligned states in the test ban discussions. With the U.S.-Soviet test negotiations entering the new forum the Eighteen Nation Disarmament Conference (ENDC) the non-aligned states which were concerned primarily about nuclear testing actively involved in arms control and disarmament process. These states even took the initiative and produced a memorandum which sought a compromise between the Western and Soviet positions. Their proposal abandoned the vast and elaborate control system envisaged by the West, and advocated the use of national monitoring facilities instead.[14] But even the ENDC discussions resulted in stalemate.

It was only after the Cuban Missile Crisis of October

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13. G.Allen Greb and Warren Heckrotte, "The long history: the test ban debate", Bulletin of Atomic Scientists, August/September 1983, p.38

14. Carter, n.2, p.54

1962, that substantial progress was made. Realizing the necessity to avoid any future accidental crisis, technical talks concerning a `hot-line' between the two capitals started in April 1963 with agreement in the month of June. The month also witnessed conciliatory public gestures and private contacts. In a speech at the American University Kennedy talked of the "mutually deep interest in a just and genuine peace and in halting arms race". It was before the commencement of the Moscow Conference that the focus shifted to limited test ban as it was realized that the Soviets would never accept on-site inspections. And it was in the Moscow Conference which began on July 15, 1963 and lasted for ten days, that both the Western and the Soviet side settled for a partial test ban. Signed by the U.S.A, the U.K., and the U.S.S.R. formally on 5 August, the treaty banned atmospheric, underwater and outer space tests. While the treaty was widely hailed, France and China denounced it as an attempt to preserve ` nuclear-hegemony'.

II

The 1963 Partial Test Ban Treaty (PTBT) generated an euphoria. While the treaty won enthusiastic public and journalistic support, it was felt that it laid the foundation of a process that would ultimately free the world of nuclear menace. Writing in January 1964 issue of the Bulletin editor Rabinowitch observed that the "signs of rapprochement between

Soviet Union and United States encouraged public attention to turn in other directions".[15]

The next major treaty to follow was the 'Non-Profileration Treaty'. President Johnson who followed Kennedy, did not share his enthusiasm for a comprehensive test ban. Although he urged the Eighteen Nation Disarmament Committee (ENDC) formed in 1962 to promote the comprehensive test ban goal, it did not receive any priority by the ENDC.[16] It was only in 1965, that the issue was taken up. By that time it was more and more linked to the debate on Non-Proliferation Recognizing the fact that it was in the mutual interests of both the powers to check proliferation of nuclear weapons, both the United State and the Soviet Union pushed through the Non-Proliferation Treaty in 1968. The treaty was termed discriminatory by the non-nuclear developing countries including India . While it prevents 'horizontal proliferation' of nuclear weapons, it allows the five declared nuclear powers to maintain and even augment their nuclear arsenals. The treaty thus is inherently discriminatory. Also Article VI of the treaty calls the parties to the treaty to pursue negotiations in good faith for effective measures relating to cessation of nuclear arms race at an early date and to nuclear

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15. See Paul Boyer, "From Activism to Apathy : America and the nuclear issue 1853-1980, The Bulletin of the Atomic Scientists, vol. 40, August/Septmber 1984, p. 15

16. Carter, n. 2, p. 80

disarmament, and on a Treaty on General and Complete disarmament' - a goal which still remains unfinished. Lack of progress towards a CTB was a bone of contention at NPT review conferences held in 1975, 1980,1985 and 1990.

After 1968, the shift of the discussion was towards offensive and defensive strategic systems resulting in SALT-I in 1972. This is not to say that the issue of test ban faded from the agenda. Back in the ENDC efforts continued for a total test ban. In the year 1969 Sweden took a major initiative and presented a draft treaty banning underground tests. The draft tackled the verification issue by proposing an exchange of seismic information[17]. Even Canada pressed for measures to ensure an exchange of seismic data in the "Conference of the Committee on Disarmament" which was the new name of the older ENDC, enlarged to include 26 states. Both Canada and Sweden, later joined by Japan, continued to work on improving seismic techniques and agreed to promote cooperation to identify underground tests by such techniques[18]. But the fact is that despite the serious and sincere efforts taken by certain members of the CD, the great powers showed little interest. It was the gradual maturation of the verification technology by the year 1972, synchronizing with the conclusion of SALT-I and the growing Senate pressure for the US initiative

17. ibid

18. SIPRI, World Armaments and Disarmaments: SIPRI Yearbook 1973 (Stockholm,1973),p.392

to conclude a CTBT, that one witnesses the resumption of a next active phase of test ban negotiations.

The Nixon Administration emphasized strategic arms limitation over a test ban. Despite the fact that in 1973, Senator Edward Kennedy tabled a resolution in the U.S. Senate which was signed by 33 other senators and recommended a moratorium on underground nuclear tests, the U.S. went ahead with conducting high yield nuclear tests. Not only that, it also became sympathetic to French and even Chinese nuclear sensitivities.[19] It should be recalled that France and China by this time had became nuclear weapon powers. Although public protest within African countries compelled France to stop testing in the Sahara, China was not deterred by these protests. Even the official protests by the Governments of Japan, Australia and New Zealand against the Chinese thermo-nuclear tests of June 1973 were ignored by the Chinese Government.[20] A western observor pointed out that the purpose of that test was to reinforce the claims of Peking leaders to hegemony in developing countries.[21]

The continued testing by these states had brought further complications to conclusion of a comprehensive test ban treaty. While the Soviets persistently proposed a CTB, the

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19. Carter, n.2, p.82

20. A.Y. Yefremov, Nuclear Disarmament (Moscow 1979),pp.216-17

21. ibid

U.S. rejected it. At this stage one of the reasons, apart from the traditional concern with verification, was that the Soviet proposals called for a ban on testing by all countries and gave the original signatories the right to withdraw if some country refused to sign the treaty.[22] The year of 1974 faced the prospect of a Summit meeting between Nixon and Brezhnev with no new strategic arms agreement ready for signing. It was in this context that Gromyko introduced to Kissenger the idea of a Threshold Test Ban Treaty (TTB). Since it did not require intrusive verification measures, Kissenger responded favourably. One reason was also that the USSR was more reliant on high-yield nuclear weapons and that the TTBT would favour the United States. And after brief negotiation TTBT was formulated, not in terms of seismic magnitude, but in terms of explosive yield which was set at 150 Kt. Finally in the June 1974 'Summit Meeting' the treaty was signed. It is not difficult to trace the reversal in the previous positions of the US and USSR by the conclusion of TTBT. Both these states had from 1971 until 1973 opposed proposals for limits either on magnitude or on the number of nuclear tests at the Geneva Conference and the U.N. General Assembly.[23] It was only the desire of both states to bring about 'detente' that acted as a major political incentive to both parties. In his memoirs, Nixon writes "we both understood that if the process of detente

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22. Carter, n.2, p.82

23. SIPRI, World Armaments and Disarmament: SIPRI Yearbook 1975 (Stockholm, 1975), pp.406-407.

could be maintained through a holding-pattern summit, we might be able to make a breakthrough at the next meeting".[24] Even Henry Kissenger writes : "The Soviet conciliationess with respect to it (the TTBT) must have been to maintain some momentum in the flagging detente".[25]

A rapid conclusion of the treaty by the two powers was also subject to criticism. There were apprehensions that TTBT might actually result in indefinite postponement of serious talks concerning a CTBT. It was also felt that the treaty did not address the issue of the peaceful nuclear explosions. As a response to this problem, a companion treaty was signed by both powers - the PNET - on 28th May 1976. While this treaty limits individual explosions to 150 kilotons, it permits group explosions in which the aggregate yield is less than 1.5 megaton and where the individual yield can be determined to be no greater than 150 Kiloton. Both the TTBT and PNET were submitted to the US Senate for ratification but due to US Presidential election the ratification was postponed. New President Jimmy Carter was critical to both these treaties and as result he did not seek ratification. Instead he wished "to proceed quickly and agressively" to the achievement of a CTB.

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24. Richard Nixon, RN:The Memoirs of Richard Nixon (New York 1978),pp 1036-37

25. Henry Kissenger, Years of Upheaval (Boston, 1982), p. 1167.

III

With Jimmy Carter assuming power in 1977, a good start was made in terms of positive approaches towards achieving a CTBT. Six days after assuming power, the President in a letter to Soviet Premier Brezhnev urged the need of a CTBT. Furthermore, he publically stated that all nuclear tests be banned. This strong personal commitment stimulated the bureaucracy to initiate studies to seek flexible solutions to problems of verification. Paul Warnke, a capable negotiator, was authorised to explore the issues with the Soviets which would pave the way towards progress. Even Secretary of State Cyrus Vance visited Moscow with a proposal for establishment of a working group to consider the CTB, in the month of March, 1977. Preliminary consultations between U.S.A. and U.S.S.R were held in the month of June and in this meeting it was finally decided to hold further private negotiations.

Finally a trilateral talks on CTBT began in July in Geneva. Peaceful Nuclear Explosions and Verification became the points of controversy. The U.S.A. and U.K. wanted a ban on all nuclear tests, the Soviets wanted exemption of tests for peaceful purposes. In fact the western position was based on the assumption that "PNE technology" is indistinguishable from that required for weapons tests and that a state undertaking PNE's inevitably derives weapons-related information. The accession of France and China to a CTBT also figured in the

agenda of the talks. Gradual progress in the talks was made by March 1978. Both Soviet Union and U.S.A had come close on the 'verification' issue by agreeing in principle to permit the location of automatic seismic stations (black boxes) on their territories. It was also accepted that the parties would not be bound by on site inspections. The possibility of a CTBT received such scrutiny in Washington that it proved counter-productive. Opposition came from the Department of Energy, Joint Chiefs of Staff (JCS) and also from the Nuclear Weapon Laboratories. Their contention was that, without testing 'reliability of nuclear weapons stockpile would inexorably erode. This issue had simmered over the years and with the possibility of CTBT at the doorsteps it became central.[26] The critics also challenged the contention that whatever stockpile degradation occured would affect both sides equally. Their view was that because of the U.S.-U.S.S.R "asymmetries", there could be no assurance that the reliability of Soviet weapon stockpile would decrease as the U.S. stockpile did.[27] Initially the Carter administration remained committed to its position, but with the growing internal opposition the administration changed its position from signing the CTBT from an indefinite duration to a finite one. With growing complications Carter's principal arms control item, SALT-II also ran into troubles. The Soviet intervention in Afganistan put to rest any hope of successfully concluding a CTBT.

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26. Greb and Heckrotte, n. 14, p. 40

27. ibid

The subsequent U.S. Presidents Ronald Reagan and George Bush relegated a CTBT to the status of an `ultimate goal' and a `long term objective' respectively. Both these Presidents concentrated on the `TTBT', and `PNET' verification issues. In the year 1991 - the year beginning with the changed political configuration of the world with the collapse of Soviet Union and a shift in the power hierarchy - a widely supported initiative to amend PTBT so as to make it a CTBT was blocked by United States and U.K.'s veto. This was despite the fact that the Soviet Russia (later joined by France) had unilatarally declared a moratorium on tests. Clinton's own inclination towards bringing testing towards close had generated some hope. In the `Vancover Summit' held in April 1993, Bill Clinton and Russian President Boris Yelstin agreed that "negotiations on a multilateral nuclear tests should commence at an early date".[28] In fact the five nuclear powers began informal talks in July 1993 to lay groundwork for formal CTB talk. Although the Chinese test of 5 October 1993 perturbed momentarily, nevertheless the talks resumed. Even the "United Nations Committee on disarmament and International security" adopted by consensus a resolution calling for negotiation of a CTBT on 19 November 1993. The conference of Disarmament also held discussions in Geneva in the last month of 1993.[29]

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28. Glenn T Seaborg and Benjamin S Loeb, "Approaching a Comprehensive Test Ban : A United States Historical Perspective", DISARMAMENT, Vol. XV1, No. 3, 1993, p.42

29. ibid.

Despite progress made towards a conclusion of CTBT, certain events have even given rise to uncertainities. The indication that Ukraine (a former Soviet Republic) might seek to retain some 46 modern SS-24 strategic missiles, all targetted at USA; North Korea's reluctance to accept inspection procedures and the future course in international affairs of China might prove fatal to future CTB talk. But despite uncertainities, euphoria has been generated for the early conclusion of a CTB. Even France has pledged to sign a CTB at the close of the recently held European Union Summit in Cannes; which was hailed worldwide.

CHAPTER-3

SCIENCE, TECHNOLOGY AND THE TEST-BAN DEBATE

The scientific and technological developments have been a predominant factor in shaping man's physical and social environment. While it is visibly true in all walks of life it is much more evident in the realm of international affairs where the scientific and technological developments have sharply altered the complexion of global politics, brought about new relationships among the nations and made the future politics bondage of its discoveries. This influence of science and technology on international affairs is a result of the evolution of nuclear weapon of enormous destructive power the spectre of which was manifest in the Hiroshima and Nagasaki bombing. These developments brought the world on the brink of a typical situation where the question of relative power, uses of power and the limitations of power had to be considered in the light of existing scientific and technological base. Even the efforts to control the nuclear weapons was influenced by it. The nuclear test ban talks too witnessed the impact of the rapidly changing technological environment. During the course of the test-ban talks beginning in the late fifties till date, we witness that the issues of 'verification', 'stockpile degration' and weapons safety clouded the test ban debate. The present chapter is an attempt to discern the relative influence of this scientific and technological factor on the comprehensive test ban talks.

I

From the initial phase itself when the `Conference of Experts' was convened to discuss the technical feasibility of a test ban till date, `verification' of compliance with the testing limitation has become the core of the test-ban discussions. While the scientists at the conference concluded that with some exceptions, it was technically feasible to set up a control system for verification purposes, nevertheless, the delegates at the following "Geneva Conference on the Discontinuance of Nuclear Weapons" could not reach any conclusion regarding the establishment of a workable control system. This probably could be the result of mutual suspicion among the then nuclear powers but latent in these suspicions was the fact that the existing technology had its own limitations. It should be remembered that the `Conference of Experts' had considered four key methods of detecting nuclear tests - the recording of acoustic and hydroacoustic waves for atmospheric and under water tests respectively, the collection of radioactive debris for low altitude atmospheric explosion and seismic waves for the underground tests. Apart from that radio signals and atmospheric signals could also be used for the atmospheric explosions and the high altitude phenomenon. The findings of scientists were rather optimistic. Scientists had based the detection of underground explosions on the seismological means. The assumption was that when a nuclear detonation takes place underground vibrations are generated.

These vibrations travel on different paths, at different speeds, have different frequencies and wave lengths and are absorbed and scattered with different strengths. They can be detected by the seismometer, instrument which responds to extremely small displacements of the earth at their point of location. But the problem was the difficulty in determining whether a seismic signal was caused by a nuclear explosion or by a natural earthquake or a chemical explosion carried out in a mine. Therefore, while it was easy to 'detect' explosion, it was rather difficult to 'identify' them at this early phase of test-ban talks. These unidentified seismic signals would be the primary reason for requiring on-site inspections, which was unacceptable to the Soviets. In fact, the Soviets felt that the U.S. insistence for on-the-site inspection was more motivated by military intelligence rather than some genuine compliance with an agreement on test ban.

Furthermore, based on the findings of the Rand Corporation scientists, the Western delegates felts in the 1961 conference that even the effectiveness of a test-ban monitoring system can be degraded by deliberately engineered evasive measure.[1] They had earlier put forward the theory of 'decoupling' - that is muffling of a seismic signal by firing an explosion in an underground cavity. This finding further

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1. April Carter, Success and Failure in Arms Control Negotiations (Oxford, 1989), p. 50

reinforced the idea of establishment of an elaborate control system, with on-the site inspection by internationally manned monitoring organisation, obviously not acceptable to the Soviets. Thus the limited knowledge about 'detections' and 'identification' of seismic data at this early stage was one of the major handicaps in the conclusion of a test ban treaty of a comprehensive nature. Subsequently the United State convened a panel of scientists - later known as the Berkner Panel - after its Chairman, Lloyd Berkner- to develop recommendations on improving seismic capabilities.[2] It was on the basis of the report submitted by this panel that a vigorous new programme of research was started in nuclear verification technology sponsored by Department of Defence, and known as the 'Vela Programme'. The programme started in 1959 and included the U.S. research efforts for on-the-site inspection technology, alongwith other nuclear monitoring technologies.[3] In parallel to the on-site inspection, research,efforts were made to improve detection technique. In fact from the point of on-site inspection also, it was necessary to improve seismic research concerned with development of identification and detection techniques and that seismic event location capability must precede.

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2. Carl F Romney, "On-Site Inspection for Nuclear Test Verification : Past Research and Continuing Limits" in Lewis A Dunn and Amy E Gordon (eds), Arms control Verification and New Role of On-Site Inspection : Challenges, Issues and Realities (Toronto, 1990), p. 59.

3. ibid

The 'Vela Programme' research regarding discrimination of seismic event has been impressive. Prior to it that is at the time of 'Conference of Exports',identification of earthquake relied on the determination of focal depth and direction of first motion. Consequently determination that a selected seismic event originated at a depth inaccessible by drilling provided proof of natural origin. At this juncture it needs to be stated that an earthquake typically involves rock sliding against each other over a much wider area for a longer time and may send different seismic signals in different directions. On the other hand explosion happens instantly, in one spot sending out compressional waves of approximately same strength in all directions. It was on this principle that under the Vela Programme methods for discrimination between earthquake and nuclear explosion were developed which remain effective even today. It has been estimated that by these methods almost all events as small as magnitude of 4.5 (equivalent to 5-25 kiloton) can be discriminated.[4] As far as research in location accuracy was concerned, results were not encouraging and in fact the research faded in importance when the PTBT was signed. The conclusion of report that visual inspection and radiochemical analysis are the only useful on-site inspection technique also was not encouraging. Lack of precision in on the site inspection technology for nuclear test verification was one of the principal areas of contention among the negotiating parties in subsequent CTB negotiation.

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4. ibid, p. 64

To fill in these verification gaps, non-seismic methods have provided supplementary techniques.[5] The photographic reconnaissance may be useful in detecting activities which are usually connected with preparations of nuclear explosions. Even the attempts to evade detection of an underground nuclear explosion by decoupling could be spotted by satellites, if large amount of material were removed to excavate a cavity of required dimension, but even this technology has its limits.

Verification with hundred percent of accuracy can never be achieved. Realizing this fact and knowing the limits of available technology, the super-powers adopted a step by step approach. While it was easy to verify the atmospheric and underwater explosion, a treaty of partial nature was signed in 1963. With the maturation of technology of underground identification of nuclear test up to certain limits, the TTBT and PNET were signed in 1974, and 1976 respectively. The 1977-80 phase witnessed a more cooperative attitude between the powers on the issue of 'verification'. But then the issue of stock-pile reliability became central. Since then, the technology has improved a lot. At the same time the global environment is more conducive for a conclusion of CTBT. With the advent of 'glasnost' and with the initiative taken by private U.S. organizations, establishment of seismic stations within Soviet Union became possible in 1986. In the April of

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5. For details see Gregory E Vander Vink, "Verifying a Comprehensive Test Ban" Arms Control Today vol. 20, p.9, November 1990, p. 19

1988, the US/USSR joint seismic programme established, with IRIS consortium and U.S. Geological Survey representing the United States and Soviet Academy of Sciences.[6] With technological advances a practical seismic station can be established world-wide which could identify ordinary explosions down to a small fraction of a kiloton, and therefore 'verification' can no longer be a convincing argument against a test ban.

II

The possibility of signing a comprehensive test ban seemed imminent with Jimmy Carter assuming power in 1977. This phase marked the beginning of an era which witnessed a relative convergence of the U.S. and the Soviet views regarding test-ban verification. At a point of time, a test-ban treaty almost seemed inevitable. But then, due to pressure from the U.S. Nuclear Weapons Laboratories, the efforts were bogged down. The contention was that, the 'reliability' of nuclear weapon stockpile would erode without testing.

The issue of 'stockpile degradation' and the 'U.S.-U.S.S.R. asymmetries' was raised by Roger Batzel, the then director of the Livermore Laboratory In a letter to a U.S. Congressmen Charles Wilson, dated September 25, 1978, Batzel wrote: "We cannot assume that stockpile-degradation will be

6. ibid, p. 20

symmetrical with respect to U.S. and Soviet weapons. We just do not know how Soviet weapons are made..... or what their remanufacturing problems are".[7] Furthermore, in a testimony to Senate Armed Services Committee, in February 1987 he stated - "Approximately one third of all modern weapon design placed in U.S. stockpile have required and received post-deployment nuclear tests for resolution of problems. In three-fourth of these cases the problems were discovered only by ongoing nuclear testing.[8] The conclusion of the remarks would be that 'reliability' cannot be established without nuclear testing.

For a meaningful understanding of the problems for which Batzel argued for nuclear testing, one requires to know the actual course of events. It is true that the checking for some 14 weapon models out of a (then) total of 41 involved post deployment nuclear tests. Nine of these involved weapons which were deployed or scheduled for deployment, during the 1958-61 testing moratorium and simply had not been adequately tested in their final configuration before being put in stockpile. Some had not been tested for the conditions of 'corrosion' that might develop over time. After the moratorium, it was decided to fill in these gaps in test

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7. See G. Allen Greb and Warren Heckrotte, "The Long History : The Test Ban Debate", The Bulletin of the Atomic Scientists, vol. 39, no. 7, August/Spetember 1983, p. 42

8. For details See J. Carson Mark, "Do We need Nuclear Testing?", Arms Control Today, vol. 20, no. 9, November 1990, p. 13

coverage and it was found that several of the weapons failed to meet the expectations. Also some poor results were obtained when tests were conducted. A clear message of this experience was that a weapon should not be deployed before all necessary tests have been performed.[9] Lessons have been learned. It has nothing to do with the need for continued testing to maintain reliability of existing U.S. stockpile. In fact testing for reliability of those U.S. stockpile models with 'incomplete predeployment testing during moratorium is not required, since the gaps in testing coverage had been attended as early as in sixties.[10]

Also United States has maintained a 'surveillance programme' to check for potential problems. A random sample of weapons of each model are taken from the stockpile at regular intervals and returned to weapon builders for examination. Also checking is conducted through non-nuclear testing to ascertain if any deterioration has occured and if no changes are found, it can be easily assumed that item will perform as the model tested did. It was through this programme that the remaining one quarter of Batzel's one third weapons were identified, not by nuclear testing. These involved some problems with mechanical system used to assure war-head safety. And since the option of testing was available, a number of

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9. ibid

10. ibid

nuclear tests were conducted to address them. But it should be remembered that these tests were in no way necessary to address these problems. The problem was not unsurmountable and, therefore, could not be an excuse for nuclear testing.[11]

Secondly, the possibility of U.S. - U.S.S.R. asymmetry as pointed by Batzel was also somewhat disingenuous. Logically it can be agreed that the details of Soviet weapon design may not be known, the principles upon which they are based and whatever resulting problem may follow is certainly well known. While an estimate of physical degradation of a weapon can well be made by the weapon laboratories and can be corrected, the asymmetries arising as a result of design changes too can well be controlled.[12] It can, therefore, be well concluded that Batzel's opposition to ban nuclear testing was not based on a rational premise. It was rather a classic case of "answer first - reasons afterward". The available technology was effective enough to maintain 'reliability' without nuclear tests.

III

With the end of the cold war, when the ideological rivalries between the two powers U.S. and U.S.S.R. came to an end with the collapse of the U.S.S.R., the prospects of a CTB increased. But this time the U.S. weapon laboratories' leading

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11. ibid

12. Greb and Heckrotte, n. 7, p. 43

argument against a comprehensive test ban (CTB) was the 'nuclear warhead safety'. The laboratories said that testing must continue to make nuclear warhead "optimally safe". In fact the issue surfaced in public in 1990 as a result of recommendations from U.S. nuclear weapon laboratories that the SRAM (Short Range Attack Missile) -not be loaded onto bombers on runway alert and that urgently safety-related modifications be made in nuclear artillery shells deployed in Europe.[13] In response, Sidney D Drell of Stanford University was asked to advice on warhead safety. His report suggested that completely new safety optimised designs should be studied aggresively.[14] Developing such a design as Kidder point out "would be a major and protacted undertaking requiring a large number of tests and that the cost benefit aspect of such an undertaking is questionable in view of both performance penalties that would be paid and its adverse implications for nuclear arms control".[15] The Drell report appears to be driven by the political consequences of a possible nuclear warhead accident that would result in plutonium contamination.

While it is a fact that the safety record of nuclear weapons has been remarkably good (except for the 1966 accident in Palomares, Spain and the 1968 accident in Thule, Greenland)

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13. See Frank Von Hippel, "Test Ban Debate, Round Three : Warhead Safety", The Bulletin of the Atomic Scienctists, vol 47, no. 3, April 1991, p. 29

14. ibid

15. ibid

the possibility that some warhead may scatter deadly plutonium cannot be ruled out. As is known, the safety concerns raised for the three artillery-fired atomic projectiles (AFAPs); the W48, W79 and W82 and the safety of SRAM-A, the short range attack missile, are genuine.[16] But it is also a fact that there exist options other than nuclear testing that would satisfy the safety concerns. Most of the nuclear weapons were designed 20 years ago or more and do not have the important electrical, nuclear and plutonium dispersal safety features according to modern standards.[17] The warheads lack the features like the Enhanced Nuclear Detonation Safety (ENDS), which reduced to less than one in a million the chance that a warhead's detonators will fire electronically in an accident, Insensitive High Explosive (IHE), a non-nuclear high explosive that is less easily detonated by impact of fire than are conventional explosives; and Fire Resistant Pits (FRP's), plutonium pits covered, with high melting point metal shells. This is not to say, that these warheads are unsafe, but clearly their safety is not in harmony with modern standards.

But it is to be realized that majority of these old-timers are due for retirement without replacement. According to Energy Department congressional testimony : "We now have a commitment with Department of Defence to retire weapons without

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16. Ray E. Kidder, "Safety No Barrier to Test Ban", The Bulletin of the Atomic Scientists, vol. 47, no. 3, April 1991, p. 32

17. ibid

having to replace them. As such we are confident that we can achieve modern safety in stockpile by the year 2000".[18]

The majority of other weapons will be replaced by modern warheads already in stockpile and no significant increase beyond a number of nuclear tests will be required by weapons currently under development. Also there are a number of ways to deal with warhead safety other than nuclear testing which includes improvement in the conditions and operating procedure associated with the storage, transport and deployment of the weapons.

The chart shows (see next page), all the eight warhead types expected to remain in stockpile beyond 2000 have ENDS, IHE and FRPs.

The principal rationale for developing new weapons and thus for nuclear testing - has been to counter Soviet nuclear threat. That threat has almost disappeared. The main test-site at Semipalatinsk in Kazkhstan has been permanently closed and Boris Yelstin has expressed opposition to more tests at the secondary site on Russia's Arctic island of Novaya Zemlya. Nuclear testing for development of sophisticated weapons cannot serve as a rationale of testing. On the other hand, the existing technology can well be exploited for the improvement in weapon safety without nuclear testing.

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18. Tom A. Zomara, "Put A Safety Cap on Testing", The Bulletin of Atomic Scientists, vol. 48, no. 2, March 1992, p. 27

U.S. NUCLEAR WEAPONS IN THE YEAR 2000

Warhead	Weapons System	Stockpile entry date	Safety features
W 89	?	?	ENDS, IHE, FRP
B 61	Strategic and tactical bombs	1980 present	ENDS, IHE
W 88	Trident II	1990	ENDS
W 87	MX?	1986	ENDS, IHE, FRP
W 80	ALCM, SLCM	1982, 1984	ENDS, IHE
B 83	Strategic Bomb	1983	ENDS, IHE, FRP
W 78	Minuteman III	1980	ENDS
W 76	Trident I, II	1979	ENDS

ALCM - Air launched cruise missile

ENDS - Enhanced nuclear detonation safety

FRP - Fire resistant pit

IHE - Insensitive high explosions

SLCM - Submarine - launched cruise missile.

Source : Cited from Tom A. Zamora "Put A Safety Cap On Testing" The Bulletin of the Atomic Scientists, vol. 48, no. 2, March 1992

Recently Bill Clinton's "Stockpile Stewardship" programme present an opportunity to build new facilities necessary to help the laboratories maintain the arsenals - and the necessary expertise - without nuclear tests.[19] The programme which

19. Tom Zomara Collina and Ray E Kidder, "Shopping Spree Softens Test-Ban Sorrows", The Bulletin of the Atomic Scientists, vol.50, no. 4, July/August 1994, p. 23.

includes building new facilities for above ground experiments (AGEX) such as the 'Advanced Hydrotest Facility' will definitely enhance the U.S. ability to design new nuclear weapons with non-nuclear testing. Thus even after a CTB, the U.S. can maintain confidence in nuclear arsenal safety, reliability and performance of the weapons.

CHAPTER-4

EPILOGUE

The history of test ban debate is a saga of contrasts. More than forty years have elapsed, since the call for the cessation of test-ban was made, yet no treaty regarding a complete ban, on tests has been signed till date. The efforts were rather shelved in favour of some limited objective like the PTBT of 1963, NPT of 1968, the TTBT of 1974 and it companion treaty PNET of 1976. Initially the public outcry was in response to radioactive fallout. After the signing of PTBT in 1963, this fear seemed reduced. The subsequent era witnessed a quiescence on issues related to nuclear fallout. Rather `proliferation' became the central theme of discussion. After signing the NPT in 1968, it was felt by the great powers that the treaty would bring about a public complacency by reducing the threats of war and the focus shifted towards offensive and defensive strategic weapons limitation resulting in signing of SALT-I in 1972 to reinforce `detente' the TTBT and PNET were signed in 1974 and 1976 respectively.

During these talks we witness that the cold war provided the conditions as a result of which extreme hostility and divergence in views of the negotiating parties was manifest. These talks reflected tension and consequently fluctuated between attempts to reach an understanding and bitter polemics relating to number of issues. These included

the verification problems, such as validity and relevance of technical data about conceivable scenarios for cheating, the number of procedures for on site inspections, the number and location of seismic monitoring stations and the organisation and composition of an international control commission. The mutual distrust among the negotiating parties was visible from the beginning of the test ban negotiation itself. Jacobson and Stein note that when the Geneva Conference opened on 31 October 1958, it did so in a cold war atmosphere of profound suspicion of motives of other sides.[1] James Wadsworth, one of the negotiators of test ban expressed "It seems to me that suspicion is engrained in Russian make up".[2] Daniel Lang, a journalist who visited the conference noted "Time and again suspicion has supplied some new snag just when matters were rolling smoothly.[3] This suspicion of motives persists in the course of future negotiations too. These talks suffered from several political linkages. Both sides related their position in the talks to their stance in other negotiations or on other issues. The West continued to insist upon an elaborate and expensive control organisation because of a commitment to the principles of international

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1. Harold Karan Jacobson and Eric Stein, Diplomats, Scientists and Politicians : The United States and Nuclear Test Ban Negotiations (Michigan, 1966), p.112.

2. J, Wadsworth, The Price of Peace (New York, 1962), p. 15.

3. D, Lang, An Inquiry into Enoughness : Of Bomb and Men and Staying Alive (London 1966), p. 43

inspection. The Soviets pursued its quest for parity in representation on the international bodies within the context of discussions concerning the composition of a control commission.

The negotiations were also visibly influenced by wider international events, both positively and negatively. The U-2 spy plane incident, bogged down the 'Big Four Summit' in 1962. In fact, Khrushchev chose to make it a major issue. He writes in his memoirs that the Soviet aircraft could not overfly U.S.A. and that the U-2 affair was a unilateral, unprovoked demonstration of their supposed superiority and outrageous treachery.[4] Similarly the Cuban Missile crisis of October 1962 reiterated the need for some political accommodation, the result was the PTBT of 1963.

The test-ban debate also reflects the asymmetry that existed between the United States and the Soviet Union. The constraints contained in the Partial Test Ban Treaty (PTBT) and the Threshold Test Ban Treaty are evidence of this phenomenon. During the course of negotiations, one witnesses that the great powers were ready to accept the area of test-ban which they felt would preserve their advantage and had the effect of freezing the adversaries advantage. With respect to PTBT of 1963, it is clear that Soviet Union was at a relatively technological disadvantage. The U.S.A. had

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4. S. Talbott (ed), Khrushchev Remembers : Vol. 2, The Last Testament (Harmondsworth, 1977), p. 510.

tested underground for several years while the Soviets had not tested underground at all (See Appendix I). The situation with respect to TTBT of 1974 is more in favour of United States. The U.S.S.R at that time was more reliant on high-yield nuclear weapons for perfecting its warheads and putting a threshold to 150 kt was definitely not favourable to them. The Americans, therefore, showed no reluctance to accept the treaty.

Domestic pressure has its own impact on policy formulation. This phenomenon is visible in the test-ban negotiation. The Eisenhower administration had to initiate the test ban negotiations under the impact of growing public demand for cessation of nuclear weapons due to its hazardous impact on health. This pressure was further accentuated when the democratic nominee for Presidential Election Adlai E Stevenson made test ban an issue during its electoral campaign. Subsequently the Eisenhower administration had to reverse its earlier opposition to test ban and initiate the 'Conference of Experts'. We also witness the phenomenon where domestic pressure became the major obstacle to test ban negotiations. A group of scientist within United States was from the very beginning opposed to the idea of a test ban. These scientists, including Edward Teller and Ernest O Lawrence, were the ardent advocates of nuclear tests for development of so-called 'clean' bombs with minimal fallout. Their sentiment was shared by Lewis Strauss Chairman of the

Atomic Energy Commission. Even John McCone who replaced Strauss was opposed to test-ban because of vested interests in promoting military applications of nuclear energy. The JCS also displayed hostility towards a test ban because of its proprietary interest in continued testing of nuclear weapons and in August 1962 when it appeared that the test ban might be possible, it initiated public attacks against the U.S. draft treaty and made clear their resistance to test ban.[5] It again played a decisive role in obstructing agreement in 1978. Even the views of some U.S. Congressmen were also not responsive to test ban talks.

The influence of science and technology on the test-ban debate is visibly clear. Between 1958 and 1963, the technology for monitoring nuclear tests had increased. The result of this progress in scientific knowledge was the readiness of both sides to pursue negotiations seriously which later paved the way for the conclusion of the PTBT. As a result of technolgical advances only the U.S.A. finally came to the conclusion that testing in the atmosphere, outer space and underwater could be adequately monitored by national means which was a reversal of its earlier view. Also the scientific thinking of the U.S. and the "theory of decoupling" resulted in greatly increased Soviet suspicion. At the same time the scientific uncertainties associated with detecting and identifying nuclear tests did exacerbate the

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5. Jacobson and Stein, n. 1, p. 451.

problems of agreement. During the 1977-1980 CTBT negotiations, the need to continue testing for maintaining reliability of weapons was espoused which had the support of several distinguished scientists.

With this dependence of test-ban negotiation on science and technology we witness scientists playing a key role as policy advisors in the decision making process. Their judgements on scientific issues played a crucial role. Although these scientists did their new job with conviction their lack in political expertise fell into a number of regrettable errors. Robert Gilpin, in his book **American Scientists and Nuclear Weapons Policy** is quite critical of the performance of the American Scientists as negotiators in the 1958 'Conference of Experts'.[6]

II

The end of ideological rivalry after the collapse of Soviet Union has brought about an end to the deep mistrust that marked the entire cold war period that provided conditions for test ban talks. This has resulted in several conciliatory gestures. While Kazakhstan has closed down its famous Semipalatinsk nuclear site, Boris Yelstin has expressed opposition to more tests at the secondary site on Russias' arctic island of Novaya Zemlya. Thus with

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6. Robert Gilpin, American Scientists and Nuclear Weapons Policy (Princeton, 1962), p. 219.

Russian effort to end testing, the U.S. is left with no reason to continue it. There hardly will be any `asymmetry'. `Verification', weapons `reliability' and `safety' are no convincing arguments. Technological sophistication has reached the stage when reliability, effectiveness, safety and security of nuclear arsenal can be maintained without nuclear tests.

As far as the nuclear weapon powers are concerned, they have sufficient expertise and data for building the present generation of nuclear weapons. A CTBT can have an impact in the production of third generation of nuclear weapons. France and China need a few more tests because they do not have sufficient sophisticated equipment to simulate tests in their countries. Without testing it would also be difficult for non-nuclear weapon states to build nuclear weapons. CTBT would be an important cap on their capabilities.

But, there still remain several complications. Scholars have raised doubts about the comprehensiveness of a CTBT. Their contention is that how will control and check be kept on the form of laboratory testing, be it hydrodynamic, computer simulation and so on. This in fact will defeat the very purpose of instituting a comprehensive test ban. There will be sufficient scope for circumvention of CTBT by the nuclear weapon states, two of whom have this technological sophistication. Also it would help

institutionalising the discriminatory regime. Any treaty of the above nature will provide rationale to the threshold states to refuse signing it. Thus while there has been euphoria regarding the CTBT, its prospects still are remote.

APPENDIX-I

KNOWN NUCLEAR TESTS WORLDWIDE, 1948-1993

	U.S.		S.U.		Britain		France		China		
Year	A	U	A	U	A	U	A	U	A	U	Total
1945	1	0	0	0	0	0	0	0	0	0	1
1946	2	0	0	0	0	0	0	0	0	0	2
1947	0	0	0	0	0	0	0	0	0	0	0
1948	3	0	0	0	0	0	0	0	0	0	3
1949	0	0	1	0	0	0	0	0	0	0	1
1950	0	0	0	0	0	0	0	0	0	0	0
1951	15	1	2	0	0	0	0	0	0	0	18
1952	10	0	0	0	1	0	0	0	0	0	11
1953	11	0	5	0	2	0	0	0	0	0	18
1954	6	0	9	0	0	0	0	0	0	0	15
1955	17	1	6	0	0	0	0	0	0	0	24
1956	18	0	8	0	6	0	0	0	0	0	32
1957	27	5	18	0	7	0	0	0	0	0	57
1958	62	15	35	0	5	0	0	0	0	0	117
1959	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	3	0	0	0	3
1961	0	10	52	1	0	0	1	2	0	0	66
1962	39	57	71	1	0	2**	0	1	0	0	171
1963	4	43	0	0	0	0	0	0	0	0	50
1964	0	45	0	10	0	2	0	3	1	0	61
1965	0	38	0	10/4*	0	1	0	4	1	0	58
1966	0	48	0	16/2	0	0	5	0	3	0	74
1967	0	42	0	16/1	0	0	3	0	2	0	64
1968	0	55	0	14/4	0	0	5	0	1	0	79
1969	0	46	0	14/4	0	0	0	0	1	1	66
1970	0	38	0	11/3	0	0	8	0	1	0	61
1971	0	24	0	16/7	0	0	5	0	1	0	53
1972	0	26	0	17/8	0	0	3	0	2	0	56
1973	0	24	0	12/5	0	0	5	0	1	0	47
1974	0	22	0	17/4	0	1	7	0	1	0	53+
1975	0	22	0	17/2	0	0	0	2	0	1	44
1976	0	20	0	18/3	0	1	0	4	3	1	50
1977	0	20	0	18/5	0	0	0	8	1	0	52
1978	0	19	0	22/7	0	2	0	8	2	1	61
1979	0	15	0	24/8	0	1	0	9	1	0	58
1980	0	14	0	20/5	0	3	0	13	1	0	56
1981	0	16	0	16/5	0	1	0	12	0	0	50
1982	0	18	0	12/9	0	1	0	9	0	1	50
1983	0	18	0	19/9	0	1	0	9	0	2	58
1984	0	18	0	18/11	0	2	0	8	0	2	59
1985	0	17	0	10/2	0	1	0	8	0	0	38
1986	0	14	0	0	0	1	0	8	0	0	23
1987	0	14	0	20/6	0	1	0	8	0	1	50
1988	0	15	0	14/2	0	0	0	8	0	1	40
1989	0	11	0	8	0	1	0	8	0	0	28
1990	0	8	0	1	0	1	0	6	0	2	18
1991	0	7	0	0	0	1	0	6	0	0	14
1992	0	6	0	0	0	0	0	0	0	2	8
1993	0	0	0	0	0	0	0	0	0	1	1
Total	215	812	207	508	21	24	45	147@	23	16	2031+

A=Atmospheric; U=Underground, ** All British underground tests were conducted in the United States, * Number after the "/" represents Soviet peaceful nuclear explosions, @ 12 French safety tests not identified by date are not included here; however, they have been added to the grand total, + Includes one underground explosion by India on May 17, 1974.

Source : The Bulletin of the Atomic Scientists, vol. 50, no. 3, May/June, 1994

APPENDIX-II

TREATY BANNING NUCLEAR WEAPON TESTS IN THE ATMOSPHERE, IN OUTER SPACE AND UNDER WATER

Text of treaty done at Moscow
on August 5, 1963.
U.S. ratification deposited October 10, 1963.
Entered into force October 10, 1963.

The Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland, and the Union of Soviet Socialist Republics, hereinafter referred to as the "Original Parties".

Proclaiming as their principal aim the speediest possible achievement of an agreement on general and complete disarmament under strict international control in accordance with the objectives of the United Nations which would put an end to the armaments race and eliminate the incentive to the production and testing of all kinds of weapons, including nuclear weapons,

Seeking achieve the discontinuance of all test explosions of nuclear weapons for all time, determined to continue negotiations to this end, and desiring to put an end to the contamination of man's environment by radioactive substances,

Have agreed as follows:

Article I

1. Each of the Parties to this Treaty undertakes to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control:

a) in the atmosphere; beyond its limits, including our space; or underwater, including territorial water or high seas; or

b) in any other environment of such explosion causes radioactive debris to be present outside the territorial limits of the state under whose jurisdiction or control such explosion is conducted. It is understood in this connection that the provisions of this subparagraph are without

prejudice to the conclusion of a treaty resulting in the permanent banning of all nuclear test explosions, including all such explosions underground, the conclusion of which, as the Parties have stated in the Preamble to this Treaty, they seek to achieve.

2. Each of the Parties to this Treaty undertakes furthermore to refrain from causing, encouraging, or in any way participating in, the carrying out of any nuclear weapon test explosion, or any other nuclear explosion, anywhere which would take place in any of the environments described, or have the effect referred to, in paragraph 1 of this Article.

Article II

1. Any Party may propose amendments to this Treaty. The text of any proposed amendment shall be submitted to the Depository Governments which shall circulate it to all Parties to this Treaty. Thereafter, if requested to do so by one-third or more of the Parties, the Depository Governments shall convene a conference, to which they shall invite all the Parties, to consider such amendment.

2. Any amendment to this Treaty must be approved by a majority of the votes of all the Parties to this Treaty, including the votes of all of the Original Parties. The amendment shall enter into force for all Parties upon the deposit of instruments of ratification by a majority of all the Parties, including the instruments of ratification of all of the Original Parties.

Article-III

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this Article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Original Parties - the United States of America, the United Kingdom of Great Britain and Northern Ireland, and the Union of Soviet Socialist Republics-which are hereby designated the Depository Governments.

3. This Treaty shall enter into force after its ratification by all the Original Parties and the deposit of their instruments of ratification.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depository Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of an accession to this Treaty, the date of its entry into force, and the date of receipt of any requests for conferences or other notices.

6. This Treaty shall be registered by the Depository Governments pursuant to Article 102 of the Charter of the United Nations.

Article IV

This Treaty shall be of unlimited duration.

Each Party shall in excercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interest of its country. It shall give notice of such withdrawal to all other Parties to the Treaty three months in advance.

Article V

This Treaty, of which the English and Russian texts are equally authentic, shall be deposited in the archives of the Depository Governments. Duly certified copies of this Treaty shall be transmitted by the Depository Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Treaty.

DONE in triplicate at the city of Moscow the fifth day of August, one thousand nine hundred and sixty-three.

For the Government of the United States of America	For the Government of the United Kingdom of Great Britain and Northern Ireland	For the Government of the Union of Soviet Socialist Republics
Dean Rusk	Home.	A. Gromyko

Source- Jozef Goldblat, Arms Control Agreements: A Hand Book, SIPRI (Praeger, New York, NY, 1983).

APPENDIX-III

TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS

The States concluding this Treaty, herein after referred to as the "Parties to the Treaty".

Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war and to take measures to safeguard the security of peoples,

Believing that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war,

In conformity with resolutions of the United Nations General Assembly calling for the conclusion of an agreement on the prevention of wider dissemination of nuclear weapons,

Undertaking to cooperate in facilitating the application of International Atomic Energy Agency safeguards on peaceful nuclear activities,

Expressing their support for research, development and other efforts to further the application, within the framework of the International Atomic Energy Agency safeguards system, of the principle of safeguarding effectively the flow of source and special fissionable materials by use of instruments and other techniques at certain strategic points,

Affirming the principle that benefits of peaceful applications of nuclear technology, including any technological by-products which may be derived by nuclear-weapon States from the development of nuclear explosive devices, should be available for peaceful purposes to all Parties to the Treaty, whether nuclear weapon or non-nuclear-weapon States,

Convinced that, in furtherance of this principle, all Parties to the Treaty are entitled to participate in the fullest possible exchange of scientific information for, and to contribute alone or in cooperation with other States to, the further development of the applications of atomic energy for peaceful purposes,

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to undertake effective measures in the direction of nuclear disarmament,

Urging the co-operation of all States in the attainment of this objective,

Recalling the determination expressed by the Parties to the 1963 Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water in its preamble to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time and to continue negotiations to this end,

Desiring to further the easing of international tension and the strengthening of trust between States in order to facilitate the cessation of the manufacture of nuclear weapons, the liquidation of all their existing stockpiles, and the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a Treaty on general and complete disarmament under strict and effective international control,

Recalling that, in accordance with the Charter of the United Nations, States must refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the purposes of the United Nations, and that the establishment and maintenance of international peace and security are to be promoted with the least diversion for armaments of the world's human and economic resources,

Have agreed as follows:

Article I

Each nuclear-weapon State Party to the Treaty undertakes not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.

Article II

Each non-nuclear-weapon State Party to the Treaty undertakes not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices; and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices.

Article III

1. Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to the negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. Procedures for the safeguards required by this article shall be followed with respect to source or special fissionable material whether it is being produced, processed or used in any principal nuclear facility or is outside any such facility. The safeguards required by this article shall be applied on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere.

2. Each State Party to the Treaty undertakes not to provide: (a) source or special fissionable material, or (b) equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards required by this article.

3. The safeguards required by this article shall be implemented in a manner designed to comply with article IV of this Treaty, and to avoid hampering the economic or technological development of the parties or international co-operation in the field of peaceful nuclear activities, including the international exchange of nuclear material and equipment for the processing, use or production of nuclear material for peaceful purposes in accordance with the provisions of this article and the principle of safeguarding set forth in the preamble.

4. Non-nuclear-weapon States Party to the Treaty shall conclude agreements with the International Atomic Energy Agency to meet the requirements of this article either individually or together with other States in accordance with the Statute of the International Atomic Energy Agency. Negotiation of such agreements shall commence within 180 days from the original entry into force of this Treaty. For States depositing their instruments of ratification or accession after the 180 day period, negotiation of such agreements shall commence not later than the date of such deposit. Such agreements shall enter into force not later than eighteen months after the date of initiation of negotiations.

Article IV

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this Treaty.

2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

Article V

Each Party to this Treaty undertakes to take appropriate measures to ensure that, in accordance with this Treaty, under appropriate international observation and through appropriate international procedures, potential benefits from any peaceful applications of nuclear explosions will be made available to non-nuclear-weapon State Party to this Treaty on a non-discriminatory basis and that the charge to such Parties for the explosive devices used will be as low as possible and exclude any charge for research and development Non-nuclear-weapon States Party to the Treaty shall be able to obtain such benefits, pursuant to a special international agreement or agreements, through an appropriate international body with adequate representation of non-nuclear-weapon States. Negotiations on this subject shall commence as soon as possible after the Treaty enters into force. Non-nuclear-weapon States Party to the Treaty so desiring may also obtain such benefits pursuant to bilateral agreements.

Article VI

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control.

Article VII

Nothing in this Treaty affects the right of any group of States to conclude regional treaties in order to assure the total absence of nuclear weapons in their respective territories.

Article VIII

1. Any Party to the Treaty may propose amendments to this Treaty. The next of any proposed amendment shall be submitted to the Depository Governments which shall circulate it to all Parties to the Treaty. Thereupon, if requested to do so by one third or more of the Parties to the Treaty, the Depository Governments shall convene a conference, to which they shall invite all the Parties to the Treaty, to consider such an amendment.

2. Any amendment to this Treaty must be approved by a majority of the votes of all the Parties to the Treaty, including the votes of all nuclear-weapon States Party to the Treaty and all other Parties which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. The amendment shall enter into force for each Party that deposits its instrument of ratification of the amendment upon the deposit of such instruments of ratification by a majority of all the Parties, including the instruments of ratification of all nuclear-weapon States Party to the Treaty and all other Parties which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. Thereafter, it shall enter into force for any other Party upon the deposit of its instrument of ratification of the amendment.

3. Five years after the entry into force of this Treaty, a conference of Parties to the Treaty shall be held in Geneva, Switzerland, in order to review the operation of this Treaty with a view to assuring that the purposes of the Preamble and the provisions of the Treaty are being realized. At intervals of five years thereafter, a majority of the Parties to the Treaty may obtain, by submitting a proposal to this effect to the Depository Governments, the convening of further conferences with the same objective of reviewing the operation of the Treaty.

Article IX

1. This Treaty shall be open to all States for signature. Any State which does not sign the Treaty before its entry into force in accordance with paragraph 3 of this Article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which are hereby designated the Depository Governments.

3. This Treaty shall enter into force after its ratification by the States, the Governments of which are designated Depositories of the Treaty, and forty other States signatory to this Treaty and the deposit of their instruments of ratification. For the purposes of this Treaty, a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depository Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or of accession , the date of the entry into force of this Treaty, and the date of receipt of any requests for convening a conference or other notices.

6. This Treaty shall be registered by the Depository Governments pursuant to Article 102 of the Charter of the United Nations.

Article X

1. Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject-matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

2. Twenty-five years after the entry into force of the Treaty, a Conference shall be convened to decide whether the Treaty shall continue in force indefinitely, or shall be extended for an additional fixed period or periods. This decision shall be taken by a majority of the Parties to the Treaty.

Article XI

This Treaty, the English, Russian, French, Spanish and Chinese texts of which are equally authentic, shall be deposited in the archives of the Depository Governments. duly certified copies of this Treaty shall be transmitted by the Depository Governments to the Governments of the signatory and acceding States.

In witness whereof the undersigned, duly authorized, have signed this Treaty.

Done in triplicate, at the cities of Washington, London and Moscow this first day of July one thousand nine hundred sixty eight.

Source- Jozef Goldblat, Arms Control Agreements: A Hand Book, SIPRI (Praeger, New York, NY, 1983).

APPENDIX-IV

TREATY BETWEEN USA AND THE USSR ON THE LIMITATION OF UNDERGROUND NUCLEAR WEAPON TESTS (THRESHHOLD TEST BAN TREATY)

Signed at Moscow on 3 July 1974 Not in force by 1 October 1981

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties.

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to take effective measures towards reductions in strategic arms, nuclear disarmament, and general and complete disarmament under strict and effective international control.

Recalling the determination expressed by the Parties to the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water in its preamble to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time, and to continue negotiations to this end.

Noting that the adoption of measures for the further limitation of underground nuclear weapon tests would contribute to the achievement of these objectives and would meet the further relaxation of international tension.

Reaffirming their adherence to the objectives and principles of the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water and of the Treaty on the the Non-Proliferation of Nuclear Weapons.
Have agreed as follows:

Article I

1. Each Party undertakes to prohibit, to prevent, and not to carry out any underground nuclear weapon test having a yield exceeding 150 kilotons at anyplace under its jurisdiction or control, beginning 31 March 1976.

2. Each Party shall limit the number of its underground nuclear weapon tests to a minimum.

3. The Parties shall continue their negotiations with a view towards achieving a solution to the problem of the cessation of all underground nuclear weapon tests.

Article II

1. For the purpose of providing assurance of compliance with the provisions of this Treaty, each Party shall use national technical means of verification at its disposal in a manner consistent with the generally recognized principles of international law.

2. Each Party undertakes not to interfere with the national technical means of verification of the other party operating in accordance with paragraph 1 of this article.

3. To promote the objectives and implementation of the provisions of this Treaty the Parties shall, as necessary, consult with each other, make inquiries and furnish information in response to such inquiries.

Article III

The provisions of this Treaty do not extend to underground nuclear explosions carried out by the Parties for peaceful purposes. Underground nuclear explosions for peaceful purposes shall be governed by an agreement which is to be negotiated and concluded by the parties at the earliest possible time.

Article IV

This Treaty shall be subject to ratification in accordance with the constitutional procedures of each Party. This Treaty shall enter into force on the day of the exchange of instrument of ratification.

Article V

1. This Treaty shall remain in force for a period of five years. Unless replaced earlier by an agreement in implementation of the objectives specified in paragraph 3 of article I of this Treaty, it shall be extended for successive five-year periods unless either Party notifies the other of its termination on later than six months prior to the expiration of the Treaty. Before the expiration of this period the Parties may, as necessary, hold consultations to consider the situation relevant to the substance of this Treaty and to introduce possible amendments to the text of the Treaty.

2. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decide that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests.

It shall give notice of its decision to the other Party six months prior to withdrawal from this Treaty. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests.

3. This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations.

Source: Jozef Goldblat, Arms Control Agreements : A Hand Book, SIPRI (Praeger, New York, NY, 1983)

APPENDIX-V

TREATY BETWEEN THE USA AND THE USSR ON UNDERGROUND NUCLEAR EXPLOSIONS FOR PEACEFUL PURPOSES.

Signed at Moscow and Washington on 28 May 1976
Not in force by 1 October 1981.

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties.

Proceeding from a desire to implement Article III of the Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Underground Nuclear Weapon Tests, which calls for the earliest possible conclusion of an agreement on underground nuclear explosions for peaceful purposes.

Reaffirming their adherence to the objectives and principles of the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, the Treaty on the Non-Proliferation of Nuclear Weapons, and the Treaty on the Limitation of Underground Nuclear Weapon Tests, and their determination to observe strictly the provisions of these international agreements.

Desiring to assure that underground nuclear explosions for peaceful purposes shall not be used for purposes related to nuclear weapons.

Desiring that utilization of nuclear energy be directed only toward peaceful purposes.

Desiring to develop appropriately cooperation in the field of underground nuclear explosions for peaceful purposes.

Have agreed as follows :

Article I

1. The Parties enter into this Treaty to satisfy the obligations in Article III of the Treaty on the Limitation of Underground Nuclear Weapon Tests, and assume additional obligations in accordance with the provisions of this Treaty/

2. This Treaty shall govern all underground nuclear explosions for peaceful purposes conducted by the Parties after 31 March 1976.

Article II

For the purposes of this Treaty :

(a) "explosion" means any individual or group underground nuclear explosion for peaceful purposes;

(b) "explosive" means any device, mechanism or system for producing an individual explosion;

(c) "group explosion" means two or more individual explosions for which the time interval between successive individual explosions does not exceeed five seconds and for which the emplacement points of all explosives can be interconected by straight line segments, each of which joints two emplacement points and each of which does not exceed 40 kilometers.

Article III

1. Each Party, subject to the obligations assumed under this Treaty and other international agreements, reserves the right to :

(a) carry out explosions at any place under its jurisdiction or control outside the geographical boundaries of test sites specified under the provisions of the Treaty on the Limitation of Underground Nuclear Weapons Tests; and

(b) carry out, participate or assist in carrying out explosions in the territory of another State at the request of such other State.

2. Each Party undertakes to prohibit, to prevent and not to carry out at any place under its jurisdiction or control, and further undertakes not to carry out, participate or assist in carrying out anywhere:

(a) any individual explosion having a yield exceeding 150 kilotons;

(b) any group explosion:

(1) having an aggregate yield exceeding 150 kilotons except in ways that will permit identification of each individual explosion and determination of the yield of each individual explosion in the group in accordance with the provisions of Article IV of and the Protocol to this Treaty;

(2) having an aggregate yield exceeding one and one-half megatons;

(c) any explosion which does not carry out a peaceful application;

(d) any explosion except in compliance with the provisions of the Treaty Banning Nuclear Weapon Test in the Atmosphere, in Outer Space and Under Water, the Treaty on Non-Proliferation of Nuclear Weapons, and other international agreements entered into by that Party.

3. The question of carrying out any individual explosion having a yeild exceeding the yield specified in paragraph 2(a) of this article will be considered by Parties at an appropriate time to be agreed.

Article IV

1. For the purpose of providing assurance of compliance with the provisions of this Treaty, each Party shall :

(a) use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law; and

(b) provide to the other Party information and access to sites of explosions and furnish assistance in accordance with the provisions set forth in the Protocol to this Treaty.

2. Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1(a) of this articles, or with the implementation of the provisions of paragraph 1(b) of this article.

Article V

1. To promote the objectives and implementation of the provisions of this Treaty, the Parties shall establish promptly a Joint Consultative Commission within the framework of which they will.

(a) consult with each other, make inquries and furnish information in response to such inquiries, to assure confidence in compliance with the obligations assumed;

(b) consider questions concerning compliance with the obligations assumed and related situations which may be considered ambiguous;

(c) consider questions involving unintended interference with the means for assuring compliance with the provisions of this Treaty;

(d) consider changes in technology or other new circumstances which have a bearing on the provisions of this Treaty; and

(e) consider possible amendments to provisions governing underground nuclear explosions for peaceful purposes.

2. The Parties through consultation shall establish, and may amend as appropriate, regulations for the Joint Consultative Commission governing procedures, composition and other relevant matters.

Article VI

1. The Parties will develop co-operation on the basis of mutual benefit, equality, and reciprocity in various areas related to carrying out underground nuclear explosions for peaceful purposes.

2. The Joint Consultative Commission will facilitate this co-operation by considering specific areas and forms of co-operation which shall be determined by agreement between the Parties in accordance with their constitutional procedures.

3. The parties will appropriately inform the International Atomic Energy of results of their co-operation in the field of underground nuclear explosions for peaceful purposes.

Article VII

1. Each Party shall continue to promote the development of the international agreement or agreements and procedures provided for in Article V of the Treaty on the Non-Proliferation of Nuclear Weapons, and shall provide appropriate assistance to the International Atomic Energy Agency in this regard.

2. Each Party undertakes not to carry out, participate or assist in the carrying out of any explosion in the territory of another State unless that State agrees to the implementation in its territory of the international observation and procedures contemplated by Article V of the Treaty on the Non-Proliferation of Nuclear Weapons and the provisions of Article IV of and the protocol to this Treaty, including the provision by that State of the assistance necessary for such implementation and of the privileges and immunities specified in the Protocol.

Article VIII

1. This Treaty shall remain in force for a period of five years, and it shall be extended for successive five-year periods unless either Party notifies the other of its termination no later than six months prior to its expiration. before the expiration of this period the Parties may, as necessary, hold consultations to consider the situation relevant to the substance of this Treaty. However, under no circumstances shall either Party be entitled to terminate this Treaty while the Treaty on the Limitation of Underground Nuclear Weapon Tests remains in force.

2. Termination of the Treaty on the Limitation of Underground Nuclear Weapon Tests shall entitle either Party to withdraw from this Treaty at any time.

3. Each Party may propose amendments to this Treaty. Amendments shall enter into force on the day of the exchange of instruments of ratification of such amendments.

Article IX

1. This Treaty including the Protocol which forms an integral part hereof, shall be subject to ratification in accordance with the constitutional procedure of each Party. This Treaty shall enter into force on the day of the exchange of instruments of ratification which exchange shall take place simultaneously with the exchange of instruments of ratification of the Treaty on the Limitation of Underground Nuclear Weapon Tests.

2. This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations.

Source: Jozef Goldblat, Arms Control Agreements : A Hand Book, SIPRI (Praeger, New York, NY, 1983)

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