Denver Journal of International Law & Policy

Volume 6
Number 1 *Spring*

Article 10

January 1976

Prospects for Nuclear Proliferation and Its Control

Douglas Triggs

Prospects for Nuclear Proliferation and Its Control

Keywords
States, United Nations, Weapons, Disarmament

Prospects for Nuclear Proliferation and Its Control

The Treaty on the Nonproliferation of Nuclear Weapons (NPT) has been with us now for seven years and has gained the adherence of a substantial number of nations. Yet one nation recently exploded its first nuclear device, and others may do so in the near future. Does nonproliferation remain a realistic goal? What problems exist with the Treaty and its implementation? Under what circumstances is further nuclear weapons proliferation likely? What pressures promote it, and how can these pressures be mitigated? This comment assesses the current problem areas and identifies recent activity in, and prospects for, proliferation control.

I. THE NPT AND THE IAEA

The Treaty on the Nonproliferation of Nuclear Weapons,[1] which was the subject of lengthy U.S.-U.S.S.R. negotiations,[2] was completed and opened for ratification in 1968. As of July 1976, 98 nations had ratified (or acceded to) the NPT, another 12 nations had signed but not ratified, and the remaining nations had neither signed nor ratified. As mandated by Article VIII of the Treaty,[3] the first Review Conference met in May 1975 to make recommendations for the future operation of the Treaty.

Impetus for preventing the spread of nuclear weapons to nations not now possessing such weapons derived from a concern that unchecked nuclear proliferation would seriously enhance the possibility of nuclear war, and from a hope that an

1. Treaty on the Non-Proliferation of Nuclear Weapons, *done* July 1, 1968, [1970] 1 U.S.T. 483, T.I.A.S. No. 6839 [hereinafter cited as NPT].

2. The first nonproliferation proposals were part of a partial disarmament plan submitted to the U.N. Disarmament Subcommittee in 1957; similar proposals became part of the draft agreements for a general disarmament considered by the Ten Nation Disarmament Committee in 1960 and later by the Eighteen Nation Disarmament Committee. U.S. ARMS CONTROL AND DISARMAMENT AGENCY, INTERNATIONAL NEGOTIATIONS ON THE TREATY ON THE NONPROLIFERATION OF NUCLEAR WEAPONS 3-6 (1969).

3. Article VIII:

> (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.

agreement on nonproliferation would reduce international tensions and thereby facilitate an end to the dangerous international arms race.

These goals were to be accomplished by a number of measures. First, the NPT forbids all parties from transferring nuclear technology or nuclear source material (such as uranium or plutonium) to any non-nuclear-weapon nation[4] without international safeguards.[5] These international safeguards are to insure that the transferred nuclear technology or material is not diverted from peaceful uses to use in nuclear weapons or nuclear explosive devices.[6] Second, the Treaty forbids nuclear-weapon nations from transferring nuclear weapons to non-nuclear-weapon nations.[7] Third, the NPT forbids acceptance of nuclear weapons by non-nuclear nations who are parties to the Treaty and prohibits these nations from manufacturing nuclear weapons.[8] Fourth, the Treaty requires each non-nuclear

4. The NPT does not directly define either a nuclear-weapon nation or a non-nuclear-weapon nation. However, since the Treaty forbids nuclear-weapon nations from transferring—and non-nuclear weapon nations from receiving or manufacturing—nuclear weapons or other nuclear explosive devices, a nuclear-weapon nation is one which possesses nuclear weapons or a nuclear explosion capability (or both), and a non-nuclear-weapon nation possesses neither. For convenience, this comment will use nuclear nation to mean nuclear-weapon nation and non-nuclear nation to mean non-nuclear-weapon nation.

5. Article III:

> (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.

6. As will be discussed *infra*, there is little difference in effect between a nation's possession of nuclear weapons and its possession of nuclear explosive devices. This comment will use the words "nuclear weapon" to include any destructive nuclear explosive device, unless a narrower definition is specifically stated.

7. 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.

8. 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

nation which is a party to the Treaty to accept international safeguarding of all its peaceful nuclear facilities.[9] The Treaty also urges the free exchange of information and technology for the peaceful uses of nuclear energy,[10] encourages nuclear nations to make peaceful nuclear explosives available to non-nuclear nations on a favored basis,[11] and directs that "good

---

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.

9. Article III:

(1) Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency and the Agency's safeguard system, for the exclusive purpose of verification of the fulfillment 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 facilities within the territory of such state, under its jurisdiction, or carried out under its control anywhere.

10. Article IV:

(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 cooperate 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.

11. Each Party to the 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 States Party to the 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.

faith" measures be taken to end the arms race and achieve complete disarmament.[12] In short, the NPT calls for rigorous control of nuclear weapon proliferation even as it encourages the unhampered proliferation of peaceful nuclear energy and its benefits.

The NPT is implemented through the International Atomic Energy Agency (IAEA).[13] IAEA, acting under its basic statute,[14] and through bilateral agreements between itself and nations party to the NPT,[15] applies the NPT-required safeguards to peaceful nuclear reactors and source material, conducts research to improve safeguards, and provides information and assistance to its member nations. The safeguards which are applied to prevent diversions include periodic physical inspections, tamper-proof technology, and national informational reporting requirements (with subsequent IAEA analysis of the reported data).[16] In addition, IAEA inspects nuclear

---

12. 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.

13. An in-depth look at the organization and functions of IAEA from formation through 1966 is provided in P. SZASZ, THE LAW AND PRACTICE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY (International Atomic Energy Agency Legal Series No. 7, 1970). A similar study through 1969 is A. MCKNIGHT, ATOMIC SAFEGUARDS: A STUDY IN INTERNATIONAL VERIFICATION (1971) [hereinafter cited as MCKNIGHT]. *See also* CONGRESSIONAL RESEARCH SERVICE FOR SENATE COMM. ON GOVERNMENT OPERATIONS, 94TH CONG., 2D SESS., NUCLEAR WEAPONS PROLIFERATION AND THE INTERNATIONAL ATOMIC ENERGY AGENCY (Comm. Print 1976).

14. Statute of the International Atomic Energy Agency, *done* October 26, 1956, [1957] 2 U.S.T. 1093, T.I.A.S. No. 3873, as amended, [1963] 1 U.S.T. 135, T.I.A.S. No. 5284 and [1973] 2 U.S.T. 1637, T.I.A.S. No. 7668.

15. For a concise statement of IAEA's ideal bilateral agreement, see IAEA, THE STRUCTURE AND CONTENT OF AGREEMENTS BETWEEN THE AGENCY AND STATES REQUIRED IN CONNECTION WITH THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS (IAEA Doc. INFCIRC 153, June 1974); reprinted in SENATE COMM. ON GOVERNMENT OPERATIONS, 94TH CONG., 1ST SESS., PEACEFUL NUCLEAR EXPORTS AND WEAPONS PROLIFERATION 757 (Comm. Print 1975) [hereinafter cited as PEACEFUL NUCLEAR EXPORTS]. As of February 1975, the IAEA had concluded safeguards agreements with only 35 non-nuclear parties to the Treaty. STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, WORLD ARMAMENTS AND DISARMAMENT: SIPRI YEARBOOK 1975 495 (1975).

16. An analysis of IAEA safeguards is provided in J. MADDOX, PROSPECTS FOR NUCLEAR PROLIFERATION 22-26 (Adelphi Paper No. 113, 1975) [hereinafter cited as MADDOX]. For a detailed look at the scope and procedures of IAEA inspection, see Szasz, *International Atomic Energy Safeguards*, in INTERNATIONAL SAFEGUARDS AND NUCLEAR INDUSTRY 73 (M. Willrich ed. 1973); reprinted in PEACEFUL NUCLEAR EXPORTS, *supra* note 15, at 884.

material and reactors in nations not party to the NPT when such safeguarding has been agreed to by all parties—IAEA, the nuclear-exporting nation (when appropriate) and the nuclear-importing or host nation.[17] More recently, IAEA has begun to provide its member nations with information and recommended standards for the physical protection of nuclear materials from theft.[18]

II. CURRENT LIMITATIONS IN PROLIFERATION CONTROL

Although the NPT was designed to halt any further proliferation of nuclear weapons, the possibility of proliferation remains. Indeed, certain pressures in the present international environment increase the probability of additions to the number of nuclear nations. The proponents of nonproliferation must now contend with five important problem areas: (1) loopholes in the NPT; (2) limitations in IAEA capabilities; (3) the decisions of nations not parties to the Treaty; (4) the possibility of proliferation through peaceful nuclear explosions; and (5) non-governmental diversions (including terrorist attacks).

The NPT and the IAEA safeguards contain loopholes through which a non-nuclear party to the NPT could acquire the technology and materials to manufacture nuclear weapons.[19] Under the NPT, a nuclear-seeking nation has a number of options which may be more attractive than a simple clandestine diversion of nuclear material from safeguarded nuclear facilities. Two are of particular importance today:

> 1. A nation may purchase nuclear facilities, study these facilities, and then replicate them. By proclaiming the replications not peaceful, NPT-required safeguards would be effectively blocked.[20]

---

17. A list of agreements (current through 1974) providing for IAEA safeguards other than in connection with the NPT is in STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, THE NUCLEAR AGE 129 (1974) [hereinafter cited as NUCLEAR AGE].

18. CONGRESSIONAL RESEARCH SERVICE FOR THE SENATE COMM. ON GOVERNMENT OPERATIONS, 94TH CONG., 1ST SESS., FACTS ON NUCLEAR PROLIFERATION: A HANDBOOK 229 (Comm. Print 1975) [hereinafter cited as FACTS ON NUCLEAR PROLIFERATION].

19. Willrich, *The Treaty on Non-Proliferation of Nuclear Weapons: Nuclear Technology Confronts World Politics*, 77 YALE L.J. 1463 (1968) provides a comprehensive treatment of possible loopholes in the NPT, although later events have closed some of these loopholes.

20. Proliferation by replication has become a real danger. Brazil, a non-party nation, recently purchased the technology for a complete nuclear cycle from the Federal Republic of Germany. This technology, although safeguarded, will provide an ideal learning tool for Brazil's nuclear establishment. 19 ORBIS 319 (1975). Similar fears

> 2. While the NPT prohibits non-nuclear parties from manufacturing nuclear weapons, it does not specifically prohibit a country from manufacturing the component parts of a nuclear weapon. The advantage of such research and development is that it can be easily disguised as peaceful research, and it enables a country to "go nuclear" in a short time should the need arise.[21]

IAEA enforcement practices provide other loopholes which may permit illegal transfers of nuclear weapons, technology or assistance. For example, a non-nuclear party to the NPT may persuade a nuclear nation to provide nuclear weapons. Such a transfer, although prohibited by Article II of the Treaty, is not monitored by IAEA. Illegal transfers of this type are made more probable by the fact that nations not parties to the NPT include countries with nuclear weapons (France and China), highly-developed nuclear technology (for example, India and South Africa), and extensive uranium reserves (South Africa and Brazil, among others). These nations are under no legal obligation not to transfer nuclear weapons, nuclear technology, and source materials to any nation requesting or willing to buy them.[22]

---

have been expressed regarding the French contract for the sale of fuel reprocessing facilities to Pakistan, N.Y. Times, Mar. 10, 1976, at 6, col. 4, and Germany's discussion with Iran for the sale of full nuclear technology, N.Y. Times, Apr. 18, 1976, § 1, at 1, col. 6.

21. Israel, a non-party to the NPT, is reported to have constructed ten to twenty atomic bombs without conducting test explosions. N.Y. Times, Mar. 16, 1976, at 1, col. 2; *cf.* TIME, Apr. 12, 1976, at 39. If these nuclear explosive devices, although untested, prove to be an important factor in the politics of the Middle East, Israel's example may spur NPT parties in other potential conflict areas, such as South Korea and Taiwan, to test the limits of IAEA safeguards by beginning research and preliminary manufacturing for nuclear explosives.

22. Of the non-party nuclear powers, France has repeatedly declared that it will act toward non-nuclear nations as if France were an NPT member. N.Y. Times, June 1, 1976, at 7, col. 1. However, France has not complied fully with current IAEA procedures. MADDOX, *supra* note 16, at 27. China's attitude is that no country should be precluded from establishing a nuclear capability for use in self-defense. H. GELBER, NUCLEAR WEAPONS AND CHINESE POLICY 28 (Adelphi Paper No. 99, 1973). To date, no Chinese exports of nuclear weapons, technology or source material have been reported. India has declared it would use its nuclear energy "solely for peaceful purposes" and has remained publicly opposed to the development of nuclear weapons. N.Y. Times, Sept. 19, 1974, at 11, col. 1. India has recently entered into an agreement to exchange nuclear technology with Argentina and has initiated discussions for the same purpose with Iran; the application of safeguards, if any, in each project has not been revealed. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, LDC NUCLEAR POWER PROSPECTS, 1975-1990: COMMERCIAL, ECONOMIC & SECURITY IMPLICATIONS, App. C at 23-24 (1975) [hereinafter cited as LDC NUCLEAR POWER PROSPECTS].

Under its basic statute, the IAEA is charged with verifying that nuclear material in NPT-party nations is not diverted from peaceful uses, such as nuclear power reactors, and used "to further any military purpose." IAEA's small staff for monitoring—40 active inspectors for 289 nuclear facilities (38 nuclear power stations, 104 other reactors, 14 fuel conversion facilities, and 133 other projects)[23]—as well as its limited budget prohibit constant monitoring of all nuclear facilities subject to its inspection. Instead, IAEA requires periodic reports from those in charge of nuclear facilities and depends on statistical evaluations of those reports and periodic inspections to identify possible diversions of nuclear material.[24] The reports include measurements of nuclear material made at strategic points in the nuclear cycle. Although in theory these reports should show any diversion of material, in practice the accuracy of the system is significantly degraded by instrument measurement error, operational fuel losses, and the inadequacies of national reporting systems. As a result, IAEA's statements of nuclear material accountability are necessarily probability statements rather than statements of certainty.[25] Thus, the possibility persists that a diversion of nuclear material will not be detected, a possibility likely to increase in probability under present procedures as peaceful nuclear facilities proliferate in number and size.[26] Although IAEA must constantly balance the need for credibility in its inspection statements with the incremental costs of increasing the accuracy of its monitoring system, its limited budget precludes significant increases in certainty using present verification methods.

It is well to remember, however, that the NPT is a political document and exists as much to promote deterrence through early detection and warning as it does to physically prevent non-nuclear nations from acquiring discretionary nuclear material.[27] For this reason, any realistic critique of NPT loopholes

23. N.Y. Times, May 15, 1976, at 5, col. 7.

24. See MCKNIGHT, *supra* note 13, at 97-150. The basic inspection documents are IAEA Doc. INFCIRC/66/Rev. 2 and IAEA Doc. GC(V) INF/39.

25. LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at V-52; R. IMAI, NUCLEAR SAFEGUARDS 11-14 (Adelphi Paper No. 86, 1972) [hereinafter cited as IMAI].

26. Bomb production potential figures are provided for certain less-developed countries in LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at V-6 to V-10. World plutonium production to 1990 is estimated in FACTS ON NUCLEAR PROLIFERATION, *supra* note 18, at 121.

27. IMAI, *supra* note 25, at 11-14.

and IAEA inspection inadequacies must consider the economic and political costs of a more rigorous prevention system, the probabilities that these loopholes will be used, and the consequences of such use.[28]

The third problem area for proliferation is the nations that have not ratified the NPT. Among these nations are the two nuclear powers mentioned above and a number of nations with the relatively developed economic and industrial capability necessary to become nuclear powers.[29] Many of these nuclear-capable non-party nations are in regions with severe security problems and rivalries, such as Israel and Egypt, India and Pakistan, Brazil and Argentina, and South Africa. These security pressures and other factors that might influence these nations to acquire nuclear weapons are discussed in detail below.

A likely route for these potential nuclear nations to follow in acquiring nuclear weapons will be that of peaceful nuclear explosions (PNEs), following the example of India. India's nuclear explosion capability, developed by utilizing indigenous nuclear experts and the by-products from inadequately safeguarded imported nuclear technology,[30] demonstrated that further proliferation in the number of nuclear nations is likely to bring no immediate international disaster and will probably not trigger significant retaliation by other nations.[31]

For nations contemplating nuclear weapons, the advantage of the PNE route is its ambiguous nature. Since a PNE is indistinguishable from an explosion specifically for testing nuclear weapons and requires similar technology and research, a PNE advertises that a nation has the tested capability to be a nuclear weapons power, even while allowing the nation to claim only peaceful intentions. This very ambiguity contributes to the proliferation problem. Because the testing of a nuclear ex-

28. *Id.* at 15-20.

29. MADDOX, *supra* note 16, at 35, lists eleven nuclear-capable non-party nations. *See also* STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, THE NEAR-NUCLEAR COUNTRIES AND THE NPT (1972) for an in-depth analysis of the nuclear capabilities of certain of these nations and of their attitudes toward the NPT and their interest in acquiring nuclear weapons.

30. MADDOX, *supra* note 16, at 15-16. *See also* N.Y. Times, June 11, 1976, at A9, col. 1.

31. Although Canada has permanently suspended its nuclear aid to India, India's second Canadian-aided reactor, which was close to completion, can probably be made operative using indigenous Indian expertise. N.Y. Times, May 19, 1976, at 8, col. 5.

plosive is the last "firebreak" before actual deployment of nuclear weapons which other nations can readily use to measure the intentions of the testing nation, these other nations must consider the possibility—and difficulty in detecting—the covert manufacture of nuclear weapons by a nation with a proven capability for nuclear explosions. One nation's PNE will strongly motivate adversary nations to begin their own nuclear weapons program to guard against this contingency.[32] It is for this reason that the NPT made a nuclear explosion of any kind the equivalent of a nuclear weapons explosion.

Development of a PNE capability via the Indian pattern, however, requires both domestic sources of nuclear expertise and a supply of fissionable material. Since only those nations with a relatively developed technological base and advanced economy are likely to have the ability to support an indigenous nuclear program, the number of nations that can realistically be expected to develop PNEs is limited. Further, necessary nuclear experts can be trained only with actual reactor experience, and reactors are currently the most probable source of explosion-grade material.[33] Thus, the best candidates for a national PNE program will be relatively developed nations that either are not party to the NPT (and have non-safeguarded reactors) or are party to the NPT (and have nuclear reactors of sufficient size so that slight diversions of nuclear material will escape detection). One recent study estimates that only 13 less-developed-nations will account for 90 percent of all nuclear power generated by all less-developed countries by the year 2000.[34] Those of the 13 nations that have not signed the NPT,

32. For an analysis of the effect of India's "peaceful" explosion on other nations in the region, see Chandrasekhara Rao, *Proliferation and the Indian Test: A View from India*, 16 SURVIVAL 210, 210-212 (1974); *cf.* Dougherty, *Nuclear Proliferation in Asia*, 19 ORBIS 932-39 (1975).

33. Recent technological breakthroughs in laser enrichment technology may provide efficient and readily available alternatives to reactors as sources of explosion-grade material in the future. N.Y. Times, Apr. 24, 1975, at 1, col. 1; *see also* N.Y. Times, May 30, 1975, at 50, col. 1. In addition, centrifuge enrichment plants, now at the pilot testing stage, are projected to be economical at less than one-third the minimum size of presently-used gaseous diffusion enrichment plants. This will encourage the purchase of enrichment technology by medium-power nations. N.Y. Times, July 5, 1976, at 24, col. 5.

34. LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at II-44. These nations are Mexico, Iran, Taiwan, South Korea, the Phillipines, Thailand, India, Brazil, Argentina, Pakistan, Singapore, Egypt, and Turkey; the latter seven are not parties to the

plus the more developed non-party nations, comprise the likely future nuclear nations and should be the focus of concern for future PNE proliferation.

The possibility of nuclear diversions by non-governmental personnel[35] has received much attention in recent years.[36] Such diversions, whether thefts by terrorists, criminals or political factions, or simple diversions by nuclear reactor personnel for personal use, would permit these persons or groups to fashion crude atomic bombs.[37] These bombs could be used for economic or political blackmail and outright destruction. While the potential for theft or sabotage is difficult to estimate in all situations,[38] the Rosenbaum Report, prepared for the U.S. Atomic Energy Commission, estimated that the maximum threat of non-governmental diversion in the United States could be achieved by 15 highly trained persons and the threat to the public of such illicit diversions is greater than any plausible nuclear power plant accident.[39]

NPT. Nuclear power plants in operation, under order or under construction worldwide are provided in FACTS ON NUCLEAR PROLIFERATION, *supra* note 18, at 144-56. A listing of research reactors in operation is in NUCLEAR AGE, *supra* note 17, at 82.

35. Willrich, *Non-Governmental Nuclear Weapons Proliferation*, in STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, NUCLEAR PROLIFERATION PROBLEMS 170-79 (1974) [hereinafter cited as NUCLEAR PROLIFERATION PROBLEMS], includes as "non-governmental personnel" one person acting alone, criminal groups, terrorist groups, managers and personnel of nuclear facilities who are acting for their own gain, and political factions within a nation.

36. PREVENTING NUCLEAR THEFT: GUIDELINES FOR INDUSTRY AND GOVERNMENT (R. Leachman & P. Althoft ed. 1972); M. WILLRICH & T. TAYLOR, NUCLEAR THEFT: RISKS AND SAFEGUARDS (1974); ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, FINDINGS SUPPORTING DETERMINATION RELATED TO INTERNATIONAL NUCLEAR POWER EXPORT ACTIVITIES 107-18 (1975)[hereinafter cited as ERDA FINDINGS]; LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at V-34 to V-40.

37. The Nuclear Regulatory Commission recently stated that at least 175 threats of violence or actual incidents of violence have taken place against U.S. nuclear facilities since 1969, although no diversion of nuclear material has been reported. Attacks on nuclear facilities have also been reported in France, Argentina, and Italy. L.A. Times, Apr. 25, 1976, § II, at 1, col. 2.

38. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, 1 U.S. NUCLEAR POWER EXPORT ACTIVITIES 6-1 to 6-8 (ERDA-1542, 1976) [hereinafter cited as EXPORT ACTIVITIES], examines the rationale for thefts of differing nuclear materials and concludes that while some nuclear materials are likely to be more attractive to terrorists and other groups than other such materials, there is no way to predict the probability of thefts occuring.

39. 120 CONG. REC. S6623 (daily ed. Apr. 30, 1974). Other studies have also reported a substantial threat. L.A. Times, Apr. 25, 1976, § II, at 1, col. 2.

In the past, questions of physical protection[40] were left exclusively to the national government having possession of the nuclear material and facilities.[41] The IAEA provided advice,[42] but did not require physical security. The questions of proper responsibility for, and adequacy of, physical protection seemed likely to remain unsolved either until a significant diversion occurred or until technology provided economical solutions not in conflict with national sovereignty. However, as a result of a recent agreement, the United States, along with certain other nuclear-exporting nations, will require importing countries to have "adequate" physical security.[43]

III. THE PRESSURES FOR PROLIFERATION

Non-nuclear nations have three major inducements to acquire nuclear weapons: (1) the need to maintain or increase security; (2) the desire for greater international prestige; and (3) the need for independent energy sources.[44] Unfavorable balance of payments created or exacerbated by the recent petroleum crisis is the major pressure on nuclear nations (and others) to export nuclear technology and source material.[45] As described below, however, a number of factors, including technological advances in armaments and recent multinational safeguards agreements, may mitigate these proliferation pressures.

A. *Security*

A nation becomes concerned with its security when it per-

40. Willrich, *supra* note 35, at 179-86, discusses possible safeguards against non-governmental diversions.

41. U.S. agreements for cooperation in nuclear matters have not required the imposition of the relatively strict U.S. standards of physical security (which the Rosenbaum Report, *supra* note 39, considers inadequate) on recipient nations. CONGRESSIONAL RESEARCH SERVICE FOR THE SENATE COMM. ON GOVERNMENT OPERATIONS, 94TH CONG., 2D SESS., UNITED STATES AGREEMENTS FOR COOPERATION IN ATOMIC ENERGY 14-15 (Comm. Print 1976).

42. See note 18 *supra*. The original guidelines were IAEA, RECOMMENDATIONS FOR THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL (1972), reprinted in PEACEFUL NUCLEAR EXPORTS, *supra* note 16, at 789. Newly revised guidelines are in IAEA, THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL, IAEA Doc. INFCIRC/225, Sept. 1975, and reprinted in 2 EXPORT ACTIVITIES, *supra* note 38, at C-8.

43. Statement of Fred C. Ikle, Director, United States Arms Control and Disarmament Agency, before the Senate Subcommittee on Arms Control, International Organizations, and Security Agreements, Feb. 23, 1976.

44. These pressures are explored in G. QUESTER, THE POLITICS OF NUCLEAR PROLIFERATION 2-8 (1973) [hereinafter cited as QUESTER], and analyzed in depth in L. JENSEN, RETURN FROM THE NUCLEAR BRINK 1-48 (1974) [hereinafter cited as JENSEN].

45. QUESTER, *supra* note 44, at 8-11; JENSEN, *supra* note 44, at 51-75.

ceives a danger of attack on its territory. Such an attack may utilize nuclear armaments, conventional (high explosive) armaments, or a combination of the two. A threatened attack with either type of armament creates an incentive for a nation to acquire nuclear weapons in order to deter that attack; however, the remedies to minimize this perceived need for additional security vary with the type of armament that is threatening.

Until recently, nuclear weapons and delivery systems were perceived in the context of a cold war in which the nuclear nations directed their weapons exclusively against an opposing superpower or its nuclear allies. The relatively bipolar alliance system, the then prevailing concept of international politics as a zero-sum game, and the dominant strategic theory of mutual assured destruction (which targeted all nuclear weapons on adversary nuclear nations) all gave a measure of credibility to assurances by nuclear nations that the non-nuclear nations were not nuclear targets, and that if a non-nuclear nation became the target of nuclear aggression, other nuclear nations would come to its defense.

Two events changed this situation and increased the perceived need[46] by non-nuclear nations for nuclear weapons. First, the bipolar alliance system has fallen into decay and is being replaced by a number of regional power centers.[47] This decreases the credibility of guarantees given by nuclear powers to protect non-nuclear nations from nuclear aggression.[48] Second, technological breakthroughs have enabled nuclear nations to maintain the necessary deterrence against other nuclear nations, while at the same time targeting strategic nuclear weapons on non-nuclear nations.[49] These two factors increase the

46. Jensen did content analysis on speeches made at the 1968 U.N. General Assembly debate on NPT and discovered that security was the most salient issue raised by the speakers. JENSEN, *supra* note 44, at 2. *See also* Gellner, *The Conference on Non-Nuclear-Weapon States, 1968: A Survey of Views and Proposals*, in *Hearing on the Nonproliferation Treaty Before the Senate Comm. on Foreign Relations, 91st Cong., 1st Sess.*, pt. 2, at 450 (1969).

47. A. HARTLEY, AMERICAN FOREIGN POLICY IN THE NIXON ERA 13 (Adelphi Paper No. 110, 1974).

48. For an assessment of this problem as it affects the U.S. guarantee to Japan, see R. CLOUGH, EAST ASIA AND U.S. SECURITY 91-93 (1975).

49. Nuclear missiles are now able to offer this dual use because of new rapid retargeting capabilities and increases in the number of targets that can be destroyed by a given number of missiles. The introduction in the U.S. of the Command Data

credibility of the use of nuclear weapons against non-nuclear nations.[50] Since the only generally accepted defense against the threat of nuclear attack is deterrence through threatened retaliation by other nuclear weapons, these events serve to strengthen non-nuclear nations' perception of nuclear weapons as necessary to maintain their prior level of security.

Nuclear weapons also have deterrence value against the threat of attack by conventional weapons. Nuclear weapons in this instance act to increase a nation's security as against a conventionally armed adversary. For this reason, nations in conflict situations (such as Israel) may be tempted to manufacture nuclear weapons,[51] although such manufacture may act to spur regional nuclear proliferation and in time cancel whatever security increase was initially achieved.

From a security standpoint, increasing the prospects for nonproliferation means: (1) reducing the perceived threat of nuclear attack; (2) reducing the perceived threat of conventional attack; (3) devising substitutes with substantial deterrence value to replace nuclear weapons; and (4) strengthening the belief that proliferation will be the precursor of a nuclear holocaust. As explained below, a continuing opportunity exists to implement the first and last of these strategies, and technological advances may now provide a means to implement the third strategy.

Reducing the perceived threat of nuclear attack involves short-term assurances and long-term substantive changes. In the short term, nuclear nations must voice assurances that their nuclear weapons targeting policy does not threaten non-nuclear nations, that they will react strongly to any threat of nuclear attack on non-nuclear nations, and that they will avoid the use of nuclear weapons against non-nuclear nations. These assurances were last provided substantively in 1968 through United Nations Security Council Resolution 255;[52] this Resolu-

---

Buffer System allows individual missiles to be retargeted in 36 minutes and the entire Minuteman III missile force to be retargeted in 10 hours. DEPARTMENT OF DEFENSE, ANNUAL DEFENSE DEPARTMENT REPORT: FY 1977, at 79 (1976). The U.S. targeting policy which promotes nuclear insecurity is dismissed in L. DAVIS, LIMITED NUCLEAR OPTIONS (Adelphi Paper No. 121, 1976).

50. Rathjens, *Flexible Response Options,* 18 ORBIS 687 (1974).

51. *Supra* note 21.

52. S/Res./255, 23 U.N. SCOR 1430th meeting in U.N. Doc. S/PV 1430 (1968). The resolution applauded the:

tion has been criticized, however, for its vagueness and lack of firm commitment.[53] Another opportunity for providing such assurances came at the recent Geneva Review Conference: an Additional Protocol to the NPT restating the pledge of assistance to threatened non-nuclear nations in slightly stronger language was proposed,[54] but was not included in the Final Declaration.

Reducing the perceived threat of nuclear attack can also be achieved by actively supporting the movement for nuclear-weapons-free zones. These zones—areas in which nuclear weapons would be banned—would act to strengthen the perceived security of nations within the zones by reducing fears that neighbors will choose to acquire nuclear weapons. In recent years the Indian Ocean, the South Pacific and South America have been proposed as nuclear-weapons-free zones. The proposal for a "Zone of Peace" comprising the Indian Ocean and littoral countries, although repeatedly passed by the U.N. General Assembly, is embroiled in a controversy over international freedom of the seas and the zone's possible effect on the current U.N. Law of the Sea Conference. Generally, the

---

> . . . intention expressed by certain states that they will provide or support immediate assistance, in accordance with the Charter, to any non-nuclear-weapon State Party to the Treaty on the Non-Proliferation of Nuclear Weapons that is a victim of an act or an object of a threat of aggression in which nuclear weapons are used.

53. Goldblatt, *The U.N. Security Council Resolution of 19 June 1968 and the Security of Non-nuclear-weapon States*, in NUCLEAR PROLIFERATION PROBLEMS, *supra* note 35, at 236. *See also* M. WILLRICH, NON-PROLIFERATION TREATY: FRAMEWORK FOR NUCLEAR ARMS CONTROL 166-73 (1969). For an analysis of the problems of unilateral guarantees by nuclear nations to non-nuclear nations, see Schwarz, *Inhibition Through Policy: The Role of the Non-Nuclear Powers*, in A WORLD OF NUCLEAR POWERS? 143-47 (1966). A general discussion of "no first use" declarations in the context of nuclear nonproliferation is in *Nuclear Proliferation: Future U.S. Foreign Policy Implications, Hearings Before the Subcomm. on International Security and Scientific Affairs of the House Comm. on International Relations, 94th Cong., 1st Sess.*, 33, 59-60, 234 (1975) [hereinafter cited as *Nuclear Proliferation*].

54. *Final Documents of the Review Conference of the Treaty for Non-Proliferation of Nuclear Weapons*, NPT/CONF/22, at 2 [hereinafter cited as *Final Documents*], which said in part:

> Article 3. In the event a non-nuclear-weapon State Party to the Treaty becomes a victim of an attack with nuclear weapons or of a threat with the use of such weapons, the States Parties to the Protocol, at the request of the victim of such threat or attack, undertake to provide to it immediate assistance without prejudice to their obligations under the United Nations Charter.

nuclear nations have not favored the Indian Ocean zone.[55] The recent proposal for a South Pacific nuclear-free zone[56] is certain to encounter the same resistance, as well as French intransigence toward interference with her nuclear testing area. South America, acting through the Treaty for the Prohibition of Nuclear Weapons in Latin America,[57] has made the most progress toward actually implementing such a zone, although the Treaty has not yet entered into force for all Latin American nations.[58]

In the long term, however, reductions in the perceived threat of nuclear attack will require substantive changes by the nuclear nations to make the international environment less threatening. This must include a reduction in the number of existing nuclear weapons, a reduction or end to nuclear weapons testing, and an increased emphasis on international cooperation and compromise. But more is needed: until the causes and dynamics of a "fear of nuclear attack" can be clearly identified and understood, attempts by nuclear nations to restructure the international environment to promote nonproliferation must be haphazard and will often take a back seat to more compelling national policies.

Reductions in the perceived threat of conventional attack will derive from reductions in the number and intensity of disputes between nations, mitigation of regional conventional arms races,[59] and the use of strengthened international adjudicatory machinery,[60] to name just a few of the many factors thought to influence international conflict. These factors can be altered by both non-nuclear and nuclear nations.

---

55. Misra, *International Politics in the Indian Ocean,* 18 ORBIS 1093-99 (1975). The official U.S. policy toward nuclear-weapon-free zones is given in NUCLEAR PROLIFERATION, *supra* note 53, at 236.

56. 18 SURVIVAL 32-33 (1976).

57. *Done* Feb. 14, 1967, 634 U.N.T.S. 281.

58. See U.S. ARMS CONTROL AND DISARMAMENT AGENCY, ARMS CONTROL AND DISARMAMENT AGREEMENTS 55-60 (1975) for a brief history of the Treaty and its accompanying protocols.

59. A comprehensive analysis of regional arms races is found in STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, THE ARMS TRADE WITH THE THIRD WORLD (1971). One example of regional conventional arms control is Latin America's Ayachuco Pact. N.Y. Times, June 30, 1975, at 4, col. 4.

60. A proposal for strengthening the machinery is R. HOLTON, AN INTERNATIONAL PEACE COURT (1970). F. GRIEVES, SUPRANATIONALISM AND INTERNATIONAL ADJUDICATION (1969) describes the contemporary international justice structure.

Unfortunately, no effective substitute has been found to replace nuclear weapons as a deterrent against the threat of strategic nuclear attack.[61] While the "weight of world opinion" and collective security through a strengthened U.N. security force have been proposed as substitutes for nuclear weapons, the utility of these proposals remains to be shown. The idea that economic forces are achieving more weight in this increasingly interdependent global society of nations has gained respectability in the last decade, but the ability of these forces to effectively counterbalance the threat of nuclear weapons in any particular circumstance is problematical.[62] In spite of the uncertainty of these forces, however, they should be strengthened whenever possible, as they may well be the ultimate solution to the problem of nuclear weapons and their proliferation.

Fortunately, less devastating means have been invented to maintain a nation's security in the face of a threatened conventional attack. The new technology of precision-guided conventional munitions promises to strengthen the capabilities of the defender nation over a conventional attacker at a reasonable cost, certainly at a cost much less than that of acquiring nuclear weapons.[63] The proliferation of these munitions should encourage feelings of greater security in nations subject to regional adversary relationships.[64]

Another avenue for decreasing the likelihood of proliferation rests on the belief that proliferation equals nuclear disaster. The belief that increasing the number of nations possessing nuclear weapons increases the probability that they will be

---

61. Conventionally-armed long-range cruise missiles equipped with the new terminal guidance technology may offer a partial substitute. Burt, *The Cruise Missile and Arms Control,* 18 SURVIVAL 15 (1976). For the view that long-range cruise missiles will only lead to additional nuclear weapons proliferation, see STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE, WORLD ARMAMENTS AND DISARMAMENT: SIPRI YEARBOOK 1975 337 (1975).

62. For an analysis of the present-day relationship between economic forces and military power, see Bergsten, *et al., International Economics and International Politics: A Framework for Analysis,* in WORLD POLITICS AND INTERNATIONAL ECONOMICS 6-10 (1975).

63. J. DIGBY, PRECISION-GUIDED WEAPONS 12 (Adelphi Paper No. 118, 1975).

64. *But see* Merglen, *Military Lessons of the October War,* in THE MIDDLE EAST AND THE INTERNATIONAL SYSTEM 26-27 (Adelphi Paper No. 114, 1975), who states that the impact of precision-guided missiles depends on the type of war (in guerilla wars the new technology strengthens the rebels), the characteristics of opposing equipment, and geographical factors, among others.

used rests on a number of hypotheses: the increased chance that nuclear weapons will be launched by mistake or by a local commander who can evade poor command and control procedures, the greater chance for theft by—or transfer to—extranationalist (terrorist) groups, the fear that nations lacking strong conventional forces will use their nuclear weapons at the onset of any hostilities, and the greater number of independent national decision makers who may miscalculate.[65]

It is unfortunate that the validity of this belief depends on the advantage of nonproliferation to the international community as a whole. From the perspective of each individual nation, the acquisition of a nuclear explosive capability brings immediate advantages and few, if any, disadvantages. Since it is not clear even to the most ardent nonproliferationist when the prudent level of proliferation has been breached, each aspiring nation can argue in favor of nonproliferation but state that an exception should be made in its case and that the world will be no worse off for one more nuclear power.[66] India's "peaceful" nuclear explosion made it clear that the magic number of nuclear nations was not five, and that a single increment of proliferation did not precede nuclear disaster.[67] However, the nonproliferation proponents hold the strong argument that unlimited proliferation increases the chance of nuclear disaster, and no one can tell which new nuclear power will precipitate an international nuclear conflict.[68] This uncertainty, and the inertia of the status quo, clearly serve the nonproliferation cause and should be strengthened whenever possible.

B. *Prestige*

A nation's drive for increased prestige and a higher international status forms another inducement to acquire nuclear

65. For these and other arguments, see Bull, *Rethinking Non-proliferation*, 51 INT'L AFF. 177-79 (1975) [hereinafter cited as Bull], and G. FISCHER, THE NON-PROLIFERATION OF NUCLEAR WEAPONS 30-32 (1971).

66. India's justification for her PNE is given in Subrahmanyam, *Indian Attitudes Toward the NPT*, in NUCLEAR PROLIFERATION PROBLEMS, *supra* note 35, at 259-60. *See also* Trivedi, *India's Approach Towards Nuclear Energy and Non-Proliferation of Nuclear Weapons*, in ARMS CONTROL ASSOCIATION, NPT: PARADOXES AND PROBLEMS 42-46 (1975) [hereinafter cited as NPT: PARADOXES AND PROBLEMS].

67. Bull, *supra* note 65, at 178-80.

68. The Review Conference's Final Declaration clearly links further proliferation to the possibility of international nuclear disaster, thereby adding further credibility to the hypothesis. *Final Documents*, NPT/CONF/35/I, Annex I, at 1.

capability. Generally, international status is concomitant with relative national power and the freedom to use that power. In the present international situation where so few nations have nuclear weapons, the acquisition of a nuclear explosion capability by a nation is certain to enhance its relative national power and—as India illustrated—to enhance its international status. Prestige is enhanced as well when a nation has full control of its programs and facilities; a nation subject to frequent IAEA inspections and NPT restrictions will tend toward diminished prestige.

A nation may attempt to increase its prestige in order to have a greater ability to influence international events, to give a greater weight to a particular viewpoint, to be included in international conferences or consultations, to enhance deterrence of adversary nations, or to placate the domestic polity.[69] The increasing availability of nuclear technology[70] and the decreasing cost of preparing nuclear explosives[71] may make nuclear proliferation an increasingly attractive method of achieving these goals in a relatively short time.

However, recent events have helped devalue nuclear capability as a currency of international status and prestige. The Vietnam War illustrated the disutility of nuclear weapons in wars of national liberation, and India's nuclear status reduced the incremental gain that each new nuclear nation can achieve upon admission to the "nuclear club." In addition, by remaining non-nuclear and achieving high status, nations like Japan and Germany have shown the availability of alternative routes to great power status.

The value of nuclear weapons can also be diminished by reducing the discrimination against non-nuclear nations caused by the NPT. This discrimination takes two forms: discrimination in NPT obligations and discrimination in nuclear opportunities. Measures which have been taken to reduce the

69. H. MORGENTHAU, POLITICS AMONG NATIONS 69-78 (4th ed. 1966).

70. The international channels for the transfer of nuclear technology are described in 1 EXPORT ACTIVITIES, *supra* note 38, at 3-165 to 3-166.

71. India claimed the cost of building the explosive device was $400,000, but this understates the actual cost since the research and development was funded through the nuclear power program. Press Release No. 8/74, Information Service of India, June 17, 1974, at 7-8. For recent technological breakthroughs that promise to reduce the cost of building nuclear explosives, *see* note 33 *supra*.

NPT discrimination in obligations include applying IAEA safeguards to peaceful nuclear reactors in some nuclear nations[72] and promoting regional enrichment and waste processing facilities under multinational control, in order to reduce the dependency of non-nuclear nations on nuclear nations.[73]

Discrimination in nuclear opportunity—that is, the liberty to pursue technological progress via an unfettered nuclear research program—can be minimized by: (1) inducing all nations to become parties to the NPT, thereby equalizing opportunity for non-nuclear nations, or (2) increasing the rewards available to non-nuclear nations that are parties to the NPT to compensate for their inability to utilize nuclear explosions in research.[74] Under Articles IV and V of the Treaty, a non-nuclear nation's special rewards would be any benefits of nuclear explosion research conducted by nuclear nations, a low-cost peaceful nuclear explosion service, and preferential access to peaceful nuclear equipment, materials, and information. In fact, while IAEA disseminates some information, much nuclear information and technology is not made available by nuclear nations. In addition, the PNE service has not been successful[75] and other benefits of discriminatory access on the basis of NPT membership have not materialized.[76]

C. *Economic*

Certain economic factors also act to foster the development of nuclear explosion capabilities in non-nuclear countries. Four are prominent: (1) the need for progress; (2) the

72. MADDOX, *supra* note 16, at 24-25.

73. The problem of inadequate enrichment facilities and national control of the available enrichment technology is discussed in LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at IV-30 to IV-34. The Review Conference in its Final Declaration recognized possible advantages of multinational fuel cycle centers. *Final Documents*, NPT/CONF/35/I, Annex I, at 6. And the United States has begun to conduct the studies necessary to promote multinational fuel cycle centers. Press Release No. 76-3, U.S. Arms Control and Disarmament Agency, Feb. 23, 1976. NUCLEAR PROLIFERATION, *supra* note 53, at 88-90, 148, provides a brief look at problems associated with regional enrichment facilities.

74. The Final Declaration of the Review Conference recommended that the developed states make special contributions for the peaceful uses of nuclear energy in developing states. *Final Documents*, NPT/CONF/35/I, Annex I, at 5.

75. *IAEA Activities Under Article V of NPT*, NPT/CONF/12, at 9-10, reprinted in PEACEFUL NUCLEAR EXPORTS, *supra* note 15, at 831-32.

76. The proposal that nuclear parties to the Treaty should export nuclear technology and source material only to other nations party to the Treaty has never been implemented by nuclear nations.

costs of nuclear dependency; (3) the need for a PNE capability; and (4) the need to establish a more favorable balance of payments.

The discriminatory nature of the NPT extends to future commercial benefits. According to many non-nuclear nations the NPT will act to retard their progress in technological development by limiting the amount of nuclear research that they can accomplish. Since nuclear nations alone can conduct the nuclear explosions which may be necessary for full research and testing, these nations are more likely to discover and initially utilize technological breakthroughs that may be the keys to a better society. Non-nuclear nations will be relegated to the permanent position of nuclear consumers purchasing progressive nuclear technology and "spin off" products from nuclear nations and thereby paying indirectly for the research they cannot fully conduct themselves. Since nations are loath to allow the direction and extent of their social progress to be dictated by external research and marketing decisions, pressures mount for independent national nuclear research programs which include a nuclear explosion capability.

The direct costs of nuclear dependency are also difficult for non-nuclear nations to bear. While the expense of IAEA inspections is shared by all nations, the inconvenience of the inspection falls in main on the non-nuclear nations. Since the number of peaceful nuclear facilities is expected to rise sharply in the coming decades, both the expense and inconvenience of IAEA monitoring will weigh more heavily on the non-nuclear nations.[77] In addition, non-nuclear nations now must ship nuclear materials to and from nuclear nations for reprocessing and enrichment.[78] The difficulty of shipping and guarding this material means additional expense to the nation's nuclear program and provides another incentive to acquire an indigenous reprocessing and enrichment capability, each a step toward a nuclear explosion capability.

77. This problem was recognized by the Review Conference, which recommended limiting the costs to developing nations. *Final Documents*, NPT/CONF/35/I, Annex I, at 4.

78. *See* note 73 *supra*, for activity toward regional fuel cycle centers. Studies are being conducted in the U.S. to determine the feasibility of an "international nuclear transportation service," which might ease transportation problems and provide increased security. N.Y. Times, May 15, 1976, at 5, col. 7.

The third economic argument turns on the perceived benefits of peaceful nuclear explosions *qua* explosions. For performing jobs such as excavations, one estimate places the cost of a ten kiloton nuclear explosive at $35 per ton of explosive power and a 100 kiloton nuclear explosive device at $4.50 per ton, versus a cost for conventional explosives of $460 per ton.[79] However, this estimate fails to reflect the cost of safeguards that may be necessary for nuclear excavation, such as moving populations to safer areas and preventing radioactive contamination from escaping into the atmosphere. Despite the apparent low cost of nuclear explosions for peaceful uses, the practicality of PNEs remains in doubt. Although the Soviet Union continues to tout the PNE as commercially valuable, the United States "Plowshare" program for testing PNEs has produced only marginal evidence of commercial benefit and has been virtually abandoned.[80] Nonetheless, non-nuclear nations remain attracted to the potential of PNEs for accomplishing huge tasks at reduced costs,[81] and the IAEA, at the request of the United Nations, has been studying the economic feasibility of applied PNEs.

The last factor to consider is the energy crisis. The sharply increasing costs of oil imports have had two effects: non-nuclear nations are attracted to nuclear energy in order to reduce their dependence on costly oil energy and the industrialized nuclear nations come under pressures to export nuclear facilities and technology in order to generate the capital inflow necessary to balance the huge expenditures for imported petroleum. In effect, the energy crisis has edged the potential nuclear suppliers and purchasers closer together.

The economic picture is not all one-sided, however, since a number of factors combine to constrain the further prolifera-

79. JENSEN, *supra* note 44, at 59-60.

80. MADDOX, *supra* note 16, at 29-30. Scoville, *Peaceful Nuclear Explosives—An Invitation to Proliferation*, in NPT: PARADOXES AND PROBLEMS, *supra* note 66, at 47, provides a short history of the problems and disappointments in the U.S.-U.S.S.R. PNE programs. One reason the U.S.S.R. may continue to have optimism about PNE utility is the availability of vast, sparsely settled space in the Soviet Union which reduces the cost of radiation safeguards and movement of population.

81. The most recent proposal to be publicized concerned an Egyptian plan to use PNEs to blast a canal from the Mediterranean Sea to the Kattara Depression 42 miles inland, thereby creating an artifical salt lake 4,300 square miles in size. Denver Post, Nov. 27, 1975, at 59, col. 3.

tion of nuclear power plants in less-developed countries. First, in many less-developed countries the capacity of the national electric grid is not sufficient to accomodate a nuclear generating plant of the relatively large sizes now offered for sale and still maintain reliable service in the event of reactor shutdown.[82] There are presently no plans to market smaller nuclear power plants.[83] Second, the cost of commercial reactor technology is itself skyrocketing.[84] And third, the dependency in fuel reprocessing and reactor servicing that follows purchase of nuclear reactors means that non-nuclear nations will look more favorably on developing indigenous sources of fuel, such as coal, oil shale, or hydroelectric power.[85]

A number of steps have been suggested by which nuclear nations could defeat the economic pressures for nuclear proliferation. Countries rich in nuclear technology and/or source materials could form a cartel to restrict the supply of technology and uranium in order to drive up prices and make proliferation more expensive.[86] They could agree to place uniform (or IAEA) safeguards on all nuclear exports,[87] or allow nuclear exports only to countries party to the NPT. Finally, the nuclear nations could endeavor to provide the promised preferential treatment to non-nuclear NPT-party nations.

The most effective anti-proliferation device, at least in the short term, would be a comprehensive suppliers' cartel. While such a cartel would not eliminate the ability of many non-nuclear nations to develop a nuclear explosion capability, it would force significant delay on most nations and would restrain the competition by nuclear nations to export the technology. However, while cartelization of nuclear technology and source material could meet the needs of nuclear-exporting nations for higher prices and income, it would also increase the discrimination toward the non-nuclear nations.

---

82. LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at II-8.

83. *Id.* at II-42.

84. *Id.* at II-12 to II-13.

85. *Id.* at III-38 to III-41. NUCLEAR AGE, *supra* note 17, at 1-17, provides an overview of non-nuclear energy sources.

86. *See* Willrich & Marston, *Prospects for a Uranium Cartel*, 19 ORBIS 166 (1975). An alternative to the price/supply cartel is a market-sharing cartel, which has been advocated as a device to reduce nuclear export competition. Ribicoff, *A Market-Sharing Approach to the World Nuclear Sales Problem*, 54 FOREIGN AFFAIRS 769 (1976).

87. This was recommended by the Review Conference. *Final Documents*, NPT/CONF/35/I, Annex I, at 4.

To date, nuclear nations have not attempted to restrict exports in any comprehensive fashion[88] or to maintain artificially high prices. The difficulty of utilizing a cartel strategy to promote nonproliferation lies in the structure of the market for nuclear technology, the difficulty in differentiating peaceful nuclear technology from nuclear weapon technology, and the language of Article IV of the Treaty. The market for nuclear technology and source material contains numerous suppliers, and these suppliers for both economic and political reasons do not appear capable of the concerted action necessary to maintain high prices or successfully restrict exports.[89]

In fact, the haste of supplier nations to get into the nuclear reactor market has depressed prices below the market level, and exporting governments have often subsidized sales.[90] Further, Article IV(2) of the NPT requires the "fullest possible" exchange of information and technology for peaceful nuclear uses. Such transfers cannot be explicitly restricted or terminated without violating the NPT,[91] and a cartel involving only nuclear weapon technology is impossible because the technol-

88. The U.S. has stated that it will use restraint in exporting the technology of fuel enrichment, spent fuel processing, and heavy water. Statement of Fred C. Ikle, Director, United States Arms Control and Disarmament Agency, before the Senate Subcommittee on Arms Control, International Organizations, and Security Agreements, Feb. 23, 1976. That "restraint" falls short of the comprehensiveness necessary for successful cartel action is shown by the export actions of West Germany and France, *supra* note 20, and of India, *supra* note 22.

89. Nor do supplier nations appear willing to impose a total embargo on all nuclear exports. For a summary of the arguments for and against a total moratorium on U.S. nuclear exports (and the conclusion that such a moratorium would not be in the national interest and would actually stimulate proliferation), see ERDA FINDINGS, *supra* note 36, at 138-45. Variations on a total embargo—abrupt or phased termination of exports, embargo of only new orders and embargo of only certain nuclear exports—are explored in 1 EXPORT ACTIVITIES, *supra* note 38, at 9-11 to 9-20. *See also* Joskow, *The International Nuclear Industry Today*, 54 FOREIGN AFFAIRS 788 (1976).

90. LDC NUCLEAR POWER PROSPECTS, *supra* note 22, at IV-35 to IV-37. *See also* NUCLEAR PROLIFERATION, *supra* note 53, at 101-02.

91. The argument has been made that Article IV is an empty gesture, since control of nuclear technology and information will in the future be held by national industrial concerns that will utilize secrecy as a normal commercial practice and that will act in concert with the nation's interest. Thus, commercialization of nuclear energy may sharply limit the scope of any "possible" governmental exchange of technology. Goldschmidt, *International Nuclear Collaboration and Article IV of the Non-Proliferation Treaty*, in NUCLEAR PROLIFERATION PROBLEMS, *supra* note 35, at 204-05. Proposals have been put forth in the United States to permit private companies to own nuclear enrichment facilities, but these proposals have not yet been accepted. N.Y. Times, Apr. 5, 1976, at 15, col. 1.

ogy for a PNE is indistinguishable from that for a nuclear weapons explosion. In short, although a cartel of nuclear exporting nations is legally[92] and technically feasible, it lacks practicability.

The application of mandatory safeguards by exporting nations has been a more fruitful strategy in minimizing and canalizing export pressures. Twice in recent years nuclear nations have agreed to make mandatory IAEA safeguards on their nuclear exports. In 1974, Britain, Canada, the United States, West Germany, the U.S.S.R. and a number of smaller nations agreed that all of their exports of fissionable material made to nations not party to the NPT would be placed under IAEA safeguards.[93] The second agreement, which was revealed in February 1976, added Japan and France to the above list[94] and stated that all recipient nations must apply IAEA safeguards to all nuclear imports from these nuclear nations.[95] In addition, both agreements required reassurances from the recipient nation that the nuclear material and technology would not be diverted to the production of any nuclear explosive device, and that the imported material would not be retransferred by the recipient nation without adequate safeguards. While this uniform application of safeguards does not equalize NPT obligations between nuclear and non-nuclear parties, it does move to equalize the economic burden of safeguards which had hitherto often been imposed to varying degrees on different nuclear importing nations. Further, these agreements reduce the advantages to non-nuclear nations of remaining outside the NPT.

---

92. *See* Joelson & Griffin, *The Legal Status of Nation-State Cartels under United States Antitrust and Public International Law*, 9 INT'L LAW. 615 (1975).

93. IAEA Doc. INFCIRC/209, Sept. 1974, at 3, and subsequent additions.

94. N.Y. Times, Feb. 24, 1976, at 1, col. 8. Sweden, the German Democratic Republic, the Netherlands, and Italy may soon subscribe to the agreement. N.Y. Times, June 2, 1976, at 16, col. 1.

95. Statement of Fred C. Ikle, Director, United States Arms Control and Disarmament Agency, before Senate Subcommittee on Arms Control, International Organizations, and Security Agreements, Feb. 23, 1976, at 1. This agreement was the product of a conference of major nuclear exporting nations, sometimes called the Nuclear Suppliers Conference, which has been meeting in London. A new session of the Conference, which is expected to consider special controls and supervision for exports of nuclear reprocessing equipment, began June 1, 1976, in London. N.Y. Times, June 2, 1976, at 16, col. 1.

The policy of restricting all nuclear exports to non-nuclear nations that have ratified the NPT has never been implemented by any nuclear nation. The question was last raised in the U.S. in the context of President Nixon's offer to sell nuclear power plants to Egypt and Israel.[96] At that time the argument was made that such a policy would be unproductive because of the number of available nuclear suppliers and would be counterproductive since it would reduce U.S. influence in those nations.[97] Because many non-NPT nations are the more developed Third World nations presently important to the foreign policies of nuclear nations, these arguments remain valid today.

Proposals for the preferential treatment of non-nuclear nations, mandated by Article V, were presented once again at the Geneva Review Conference. Such preferential treatment as proposed would include reduced rates in the supply of nuclear equipment, material and information, and a Special Fund provided by developed nations and under the supervision of the IAEA which would be used for technical assistance to non-nuclear nations and for nuclear research.[98] Although a recommendation to this effect was included in the Final Declaration,[99] no concrete developments have since emerged.

IV. PROPOSED INTERNATIONAL SOLUTIONS

Although it has many loopholes, there is little immediate likelihood that substantive amendments will be proposed to "tighten up" the NPT. There are a number of reasons for this, including the fact that the prospect for proliferation via non-nuclear parties to the NPT appears remote and the problem that making the obligations of the NPT more difficult to evade would likely require deeper intrusions into the sovereignty of non-nuclear nations. The NPT, moreover, is difficult to amend.[100]

96. N.Y. Times, July 10, 1974, at 4, col. 1. However, a resolution which urges such a restriction (provided other major nuclear suppliers agree) is currently before the Senate Foreign Relations Committee after having passed the House. H.R. Con. Res. 570, 94th Cong., 2d Sess. (1976).

97. 1 EXPORT ACTIVITIES, *supra* note 38, 4-1 to 4-7, 9-20.

98. *Final Documents*, NPT/CONF/35/II, Annex II, at 17.

99. *Id.*, NPT/CONF/35/I, Annex I, at 5.

100. The complex amendment procedures of Article VIII of the Treaty in effect give each nuclear nation which is a party to the Treaty and all nations on the IAEA Board of Governors an absolute veto over the amendment.

In addition, it is unlikely that the IAEA safeguards system will be extended in scope or significantly improved. At present, the system monitors compliance with Article III (non-diversion) obligations only. Other NPT obligations of non-nuclear nations—not to manufacture and not to import—can be policed only with radical (and improbable) increases in IAEA inspection authority and concomitant increases in staffing and cost. Similarly, any expansion of IAEA vigilance through an intensified application of present operational procedures would be costly. Consequently, significant improvements are likely only when technology provides new and economical solutions that do not extensively conflict with national sovereignty.[101] While the IAEA continues to research improvements in safeguards, no such solutions appear on the horizon.

The low probability of substantial improvements in the NPT or its mode of implementation means that realistic efforts to encourage nonproliferation must look to other strategies. These closely interrelated strategies include increasing the number of subscribers to the NPT and countering the on-going pressures that encourage non-nuclear nations to "go nuclear" and nuclear nations to assist them. While significant movement toward universal adherence to the NPT is unlikely to occur until the substantial pressures promoting proliferation are eased, the causal connection may be reversed if a number of non-party nations—particularly the nuclear-capable and nuclear nations—were to ratify the NPT.[102] The resulting "bandwagon effect" might overpower the pressures for proliferation acting on remaining non-party nations and bring about unanimous ratification. Regardless of the order in which these strategies are pursued, the goal remains a universal ratification of the NPT in order to significantly delay further proliferation.[103]

These strategies can be implemented by formal international agreements of two types, both of which have a low proba-

101. The Review Conference, while recommending that safeguards be improved, qualified that recommendation by calling for "optimum cost effectiveness" in the implementation of the safeguards. *Final Documents*, NPT/CONF/35/I, Annex I, at 3.

102. Japan's recent ratification of the NPT may aid this movement toward universal adherence. N.Y. Times, May 25, 1976, at 2, col. 7.

103. *Final Documents*, NPT/CONF/35/I, Annex I, at 1. Not all nations are in agreement with this goal, however.

bility of success. The first type of international agreement is a supplemental agreement, that is, an agreement closely tied to the NPT. At the recent Geneva Review Conference two Additional Protocols to the NPT were proposed which set forth in contractual terms trade-offs between additional NPT ratifications and actions by nuclear nations. Additional Protocol I required nuclear powers to suspend all underground nuclear testing for ten years once one hundred nations had ratified the NPT, to extend that suspension by three years each time five additional nations ratified the NPT, and to make the suspension of underground tests permanent once all other nuclear nations become parties to the NPT.[104] Additional Protocol II proposed an initial major reduction in nuclear strategic delivery vehicles once the number of NPT parties reached one hundred and further incremental reductions in such vehicles whenever an additional ten nations became parties.[105] Since neither Additional Protocol was included in the Final Declaration of the Review Conference, the likelihood of agreements of this type coming into force in the near future is not high.[106]

The second approach utilizing international agreements would require the implementation of the NPT's Article IV, which urges movement toward a treaty on general and complete disarmament. Since the rationale for the NPT closely ties nuclear war not only to proliferation between nations but also to arms races among existing nuclear nations, movements to halt or reverse the costly nuclear arms races should diminish the perceived militarization of the international environment.[107] While international agreements such as the Seabed Arms Control Treaty and SALT I are now in effect, these were not perceived by non-nuclear nations at the Review Conference as having materially reduced the arms race or the quantity of nuclear weapon power in the world today.[108] The continuing

104. *Id.*, NPT/CONF/35/II, Annex II, at 4.

105. *Id.*, at 8.

106. Epstein states that the nuclear powers at the Review Conference rejected both Protocols. W. EPSTEIN, RETROSPECTIVE ON THE NPT REVIEW CONFERENCE: PROPOSALS FOR THE FUTURE (Stanley Foundation Occasional Paper No. 9, 1975).

107. The connection between a comprehensive test ban treaty and the NPT is briefly explored in *Hearings on S.Res. 230 and S.Res. 273 Before the Subcommittee on Arms Control, International Law and Organization of the Senate Committee on Foreign Relations, 92d Cong., 2d Sess.*, 5 (1972).

108. *Final Documents*, NPT/CONF/35/I, Annex I, at 8. Also see, for example, the

purchases by nuclear nations of more and improved nuclear warheads, nuclear delivery systems, and other arms reinforces the image of nuclear nations lusting for military power.[109] Since the NPT, in essence, attempts to trade a portion of the sovereignty of non-nuclear nations for comprehensive arms control by nuclear powers, the failure to achieve meaningful arms control emphasizes the discriminatory nature of NPT's obligations. In the near future, breakthroughs in the progress of arms control negotiations significant enough to alter the perceptions of the non-nuclear nations do not appear likely;[110] thus, this approach, too, offers little hope for moderating nuclear proliferation.

V. CONCLUSION

From the foregoing, it is clear that future nonproliferation is by no means assured. The NPT "dike" contains a number of weak spots, any one of which may in time develop into a major breach, and many international pressures encourage non-nuclear nations to exploit these weaknesses.

There are no easy solutions. Prospects for multilateral treaties to close the NPT loopholes are poor. No major improvements to the current safeguards system are on the horizon, and substantial increases in IAEA staffing and budget are improbable. Comprehensive arms control is likely to take decades (if it can be accomplished at all), and international conflict is certain to continue. What, then, can be expected in the future?

First, the non-nuclear, NPT-member nations are unlikely to develop nuclear weapons in the near future. Since relatively few nuclear reactors as yet have been completed in most na-

---

Yugoslav statement on this point. *Final Documents*, NPT/CONF/35/II, Annex II, at 32. The point is amplified in Epstein, *NPT Article VI: How Have the Parties Met Their Obligations?*, in NPT: PARADOXES AND PROBLEMS, *supra* note 66, at 74.

109. This image is reinforced as well by a recent study sponsored by private arms control organizations in the United States, which found world military expenditures to be at a record high and characterized the arms race as "out of control." N.Y. Times, Mar. 1, 1976, at 1, col. 1.

110. The difficulty of achieving a general and complete disarmament is examined in J. DOUGHERTY, HOW TO THINK ABOUT ARMS CONTROL AND DISARMAMENT 107-29 (1973). Nonetheless, there continues to be progress in arms limitation: the most recent agreement is a size limitation on underground nuclear tests for peaceful purposes. N.Y. Times, May 29, 1976, at 1, col. 1.

tions,[111] there presently exists little nuclear source material which, althouqh safeguarded, is available for clandestine diversion. In addition, considerations of cost and competing priorities, as well as the generally low level of technological development[112] and the commitment to the NPT, combine to minimize the near-term potential for proliferation in this group of nations. This delay is advantageous, since it will provide the IAEA with the opportunity to develop the more effective safeguard techniques which might make these nations permanently "safe" from indigenously-developed nuclear weapons.

Second, the recent actions of the major nuclear exporting nations, which admirably mitigate certain proliferation pressures, also promote an extensive proliferation of nuclear capabilities among the non-NPT nations. Consequently, the near-term threat to nonproliferation and the NPT is likely to come from those non-NPT nations with perceived economic, security or prestige needs and a level of development sufficient to support a nuclear program.

Through the recent Nuclear Supplier's Conference, the exporting nations have achieved agreement on the application of IAEA safeguards to all their nuclear exports, and special controls for reprocessing technology are now under consideration.[113] Further, nations which have begun exporting reprocessing equipment are imposing restrictions more extensive than current IAEA safeguards.[114] In short, the reaction of the major

111. As of May 15, 1976 only 35 commercial reactors were operating in non-nuclear nations which had ratified the NPT, although another 163 were planned or under construction. Of these 35 reactors, six are in the German Federal Republic, eight are in Japan, and seven are in Canada. NUCLEAR PROLIFERATION, *supra* note 53, at 393-401.

112. One recent French estimate stated that Iran would require 15 to 20 years to develop independently its own nuclear explosive device. N.Y. Times, May 29, 1976, at 5, col. 7.

113. *Supra* note 106.

114. The agreement by West Germany to provide reprocessing and enrichment technology to Brazil contains a provision that the technology cannot be duplicated without IAEA safeguards being applied to the replication. NUCLEAR PROLIFERATION, *supra* note 53, at 165. The recently cancelled French-South Korean agreement on reprocessing contained a similar restriction. *Id.* at 170. The United States is attempting to tie reactor fuel sales to explicit guarantees that the importing nation will share control of any reprocessing plant built on its territory or under its control, N.Y. Times, May 17, 1976, at 3, col. 1, and may soon require the termination of military and economic assistance to any country that imports or exports reprocessing or enrichment equipment. N.Y. Times, June 17, 1976, at 17, col. 2.

exporting nations has been to sharply tighten control over exports.

While there is clearly a need for improved export controls,[115] the fear is that the extensive non-safeguarded nuclear technology and source material currently existing in certain non-NPT nations may negate the effectiveness of these new restrictions by providing alternative, and more convenient, sources of supply.[116] As the traditional supply of nuclear materials and technology becomes increasingly restricted, nuclear importing nations may turn to the relatively advanced non-NPT nations such as India, China, South Africa, or Israel for less restricted nuclear supplies.

This would present no proliferation potential for those importing nations party to the NPT, since IAEA safeguards would attach once the material was received. However, an active trade among the non-NPT nations could result in a dramatic increase in the number of "quasi-nuclear" nations—that is, nations like India which possess extensive non-safeguarded nuclear technology and a nuclear explosion capability, although likely few or no nuclear weapons initially.[117] The non-NPT supplier nations would have economic and political incentives to outbid the traditional supplier nations by applying less stiff controls over their nuclear exports, and the non-NPT importing nations—having already shown their disposition toward international safeguards—would be unlikely to apply additional safeguards to their imported materials. The result would be an increase in the nuclear capabilities of many of the non-NPT nations: those nations having relatively advanced nuclear establishments would conduct nuclear explosions for

115. The shortcomings of Canadian (and possibly American) export controls aided India's explosion program. *See* note 30 *supra*. The need for tighter controls was also shown by a Pakistani situation in which differing safeguard standards permitted the wastes from a Canadian-supplied reactor to be available for use in a French-supplied reprocessing plant. N.Y. Times, Mar. 10, 1978, at 1, col. 8.

116. Uncertainties in American supplies of enriched uranium have already caused Brazil to look for other suppliers, NUCLEAR PROLIFERATION, *supra* note 53, at 229-30, and has caused concern in Common Market countries, N.Y. Times, Apr. 15, 1975, at 7, col. 1.

117. The difficulties and disincentives that medium and small nations face in developing an effective nuclear force are analyzed in G. KEMP, NUCLEAR FORCES FOR MEDIUM POWERS: STRATEGIC REQUIREMENTS AND OPTIONS (Adelphi Paper No. 107, 1974). Specific problems that Israel would have in developing a viable nuclear option are discussed in McPeak, *Israel: Borders and Security*, 54 FOREIGN AFFAIRS 436-38 (1976).

research and would expand their nuclear capacity in order to meet the new export market, and those nations having unfilled nuclear needs and ambitions (such as Pakistan, Brazil, Argentina and Egypt) would move to purchase this less-restricted technology and use it in the most effective manner.[118]

The nuclear self-sufficiency of these non-NPT nations would destroy the current linkage which induces nuclear importing nations to accept IAEA safeguards in return for progressive nuclear technology. Consequently, the movement toward universal adherence to the NPT would likely cease. At that point, the nonproliferation battle would shift toward avoiding situations which would precipitate the manufacture of nuclear weapons by those non-NPT nations, or, if nuclear weapons had already been manufactured, limiting their number and capabilities.

Steps can be taken to mitigate the likelihood of this new round of uncontrolled proliferation. First, those nations having non-safeguarded nuclear technology should be invited to participate in the Nuclear Supplier's Conference and encouraged to follow the example of non-party France by subscribing to the Conference's agreements. Second, actual and potential non-NPT supplier nations which remain committed to less restrictive export policies should be encouraged to reverse that stance by economic and political incentives from other nations. And third, as a last defense, strong incentives should be applied to non-NPT nations that show an interest in receiving inadequately safeguarded technology in order to induce them to come within the IAEA safeguards system.

---

118. This may already be happening between India and Argentina. *See* note 22 *supra*. In addition, Egyptian scientists are reported to be working in Indian nuclear facilities. H. MAULL, OIL AND INFLUENCE: THE OIL WEAPON EXAMINED 23 (Adelphi Paper No. 117, 1975). While no transfers have been reported to non-NPT nations, South Africa is now entering the nuclear market, having established ties with Iran for the transfer of uranium and joint development of enrichment facilities. R. Harkavy, *The Pariah State Syndrome as an Arms Control Dilemma: Conventional Arms Acquisition and Nuclear Proliferation* 64-65 (mimeo, 1976 meeting of American Political Science Association).

These moves toward increased control of nuclear supplies will reduce the likelihood of proliferation in the non-NPT nations and will maintain the incentive for nations to adopt, and remain within, IAEA safeguards. The failure to pursue these measures will speed proliferation and seriously undercut the future effectiveness of the NPT.

*Douglas Triggs**

---

* B.A., 1968, Augustana College; M.A., 1974, University of Michigan: J.D. candidate, University of Denver.