THE LEGAL CONTROL OF NUCLEAR ENERGY BETWEEN STATES

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INTRODUCTION

On both national and international levels, the production of energy from nuclear sources is one of the most highly regulated human activities. The intricate web of global, regional, and State-wide controls operate to ensure that materials related to the peaceful production of nuclear power are not diverted for use in illicit weapons programs. From the beginnings of the nuclear age, nuclear policy has been based on two primary goals: the encouragement of expansion of civilian nuclear power facilities into new areas of the world, and the desire to limit the number of States with the capabilities to produce nuclear weapons. On one level, the global non-proliferation regime has been remarkably successful over the past thirty-five years. While three States acquired nuclear weapons from 1945-54, the rate of "overt" horizontal proliferation[1] has declined in each ensuing decade: two States acquired nuclear weapons from 1955-64, one State joined the nuclear weapons club from 1965-74,[2] and no other State has seen fit to claim military nuclear status[3] or has been conclusively demonstrated to have acquired nuclear weapons since.[4] However, on another level the non-proliferation regime has clearly not eliminated the possibility of new nuclear perils. Iraq, Israel, India, Pakistan, Argentina, Brazil, and South Africa are among the States which have taken at least some steps toward the manufacture of nuclear explosives,[5] and several other States have both the access to materials and technological capability to undertake nuclear weapons programs.[6]

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1. "Horizontal proliferation" refers to the acquisition of nuclear weapons by previously non-nuclear weapons States.

2. This includes the "peaceful" nuclear explosion undertaken by India.

3. *See, e.g.,* Sanders, *Non-Proliferation in the Year 2000*, in 9 DISARMAMENT 106 (1986).

4. *See generally* Fischer, *International Safeguards*, in SAFEGUARDING THE ATOM: A CRITICAL APPRAISAL 8 (J. Goldblatt ed. 1985); *Nonproliferation Regime: Safeguards, Controls, and Sanctions*, in THE NUCLEAR CONNECTION: A REASSESSMENT OF NUCLEAR POWER AND NUCLEAR PROLIFERATION 187-89 (A. Weinberg, M. Alonso & J. Barkenbus eds. 1985).

5. *See, e.g.*, L. SPECTOR, THE UNDECLARED BOMB (1988); LIMITING NUCLEAR PROLIFERATION (J. Snyder & S. Wells eds. 1985).

6. *See, e.g.*, Fialka, *North Korea May be Developing Ability to Build Nuclear Weapons*, Wall St. J., July 19, 1989, at A16.

This Article examines the impact of legal regulation of nuclear energy between States. Limiting the access of non-nuclear weapons States ("NNWS") to nuclear materials and technology remains the linchpin of the non-proliferation system. As the focus of new civilian nuclear power installations moves from the traditional market economy States of the West toward the States of former Eastern bloc and other newly-industrializing States, the rigorous system of nuclear materials safeguards must move to accommodate the shifting locus of world nuclear activity. While the international safeguards system is highly-developed, the global accounting system it has erected is often supplemented by even more stringent national export and bookkeeping regulations in leading nuclear States,[7] and by non-treaty agreements between the world's leading suppliers of nuclear materials and technology.[8] The emerging nuclear power-producing States, which have assumed new importance as "second-tier suppliers,"[9] generally lack such supplemental safeguards, and international controls must be ready to take full account of the operating procedures of the new facilities in these States. The changing global context of nuclear power production (and the attendant increase in the nuclear materials trade) highlights the words of Dr. Norbert Pelzer that: "Chernobyl has shown that national regulation is not enough."[10]

Nuclear energy has been found to be a viable source of electrical energy, and nuclear reactors now produce over seventeen percent of the world's electricity.[11] As noted above, the patterns of past and future nuclear expansion are decidedly different. In 1988, nuclear power programs in Member States of the Organization for Economic Cooperation and Development ("OECD") accounted for nearly eighty-one percent of the total nuclear-generated electricity in the world.[12] However, by 2005 it is expected that OECD States will account for only two-thirds of all nuclear power.[13] This reflects the expected rapid development of nuclear facilities in the former Soviet bloc States of the now-defunct Council for Mutual Economic Assistance ("CMEA") and in States which

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7. For example, the U.S. Nuclear Nonproliferation Act of 1978, 22 U.S.C. §§ 3201-3282 (1988), unilaterally imposed new conditions on existing supply agreements.

8. *See infra* section III.B.2. for a discussion of the role of the London Supplier's Group. Additionally, multinational bodies have traditionally closely regulated and monitored exports of high-technology devices with potential nuclear weapons applications. The most prominent of these bodies (the Coordinating Committee for Multinational Export Controls or "COCOM") had previously required that producers of such items obtain licenses prior to exporting to Eastern Europe. To assist development of the region after Soviet domination ended, COCOM lifted controls over the sale of a wide range of high-tech items on July 1, 1990. The items cleared for export included several "dual-use" items with nuclear weapons applications. Mann, *Iran's Nuclear Plans Worry U.S. Officials*, L.A. Times, Jan. 27, 1991, at A28-29.

9. *See New Nuclear Suppliers: Second-Tier Issues*, in THE NUCLEAR SUPPLIERS AND NONPROLIFERATION 93-128 (R. Jones, C. Merlini, J. Pilat & W. Potter eds. 1985).

10. Pelzer, *Current Problems of Nuclear Liability in the Post Chernobyl Period–A German Standpoint*, 39 NUCLEAR L. BULL., June 1987, at 66.

11. 1989 Y.B. INT'L ATOMIC ENERGY AGENCY, at C8.

12. *Id.*

13. *Id.* at C9-10.

are outside both the OECD and former CMEA. This emerging regional pattern of nuclear growth will present new challenges for international control mechanisms.

Additionally, there is always the risk of surreptitious diversion of the materials and the technology of manufacturing fissionable materials for weapons, and the theft of nuclear materials. An Oak Ridge study on the feasibility of a "quick and dirty" reprocessing plant for extracting plutonium from spent fuel rods concluded that a "bandit nation" could have a nuclear plant in operation in six months which could produce enough plutonium to make ten bombs per month.[14]

Another problem with the use of nuclear energy is that an aggressor in an armed conflict can attack a nuclear installation, such as a power plant, despite international agreements prohibiting such attacks. For example, in November 1987, the Bushehr reactor in Iran was targeted by Iraqi warplanes,[15] and the United States has bombed nuclear reactors within Iraq.[16]

These dangers, which are inherent in the use of nuclear energy, illustrate the need for control at the international level. This Article will examine international laws regarding the control of nuclear weapons, materials and knowledge. The Article will also examine the experience of these laws and their impact. Additionally, references will be made to the numerous international agreements structuring liability for nuclear accidents or incidents, and the role that these agreements play in encouraging or discouraging the spread of the peaceful uses of nuclear technology. In conclusion, this Article will point out that although numerous international arrangements exist, the international control of nuclear energy is far from complete.

I. THE NECESSITY OF INTERNATIONAL NUCLEAR SAFEGUARDS: NUCLEAR REGULATION AND *JUS COGENS*

The international controls over nuclear weapons, materials and knowledge are so firmly entrenched that it has been suggested that there is now an international norm prohibiting States from entering into agreements which would encourage the horizontal proliferation of nuclear weapons. In international law there are certain fundamental legal norms that individual States may not vary by agreement. This is termed *jus cogens*.[17] Examples include the general prohibitions against genocide and slavery. *Jus cogens* is characterized by four criteria: a foundation in morality; importance to international peace and order;

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14. The Times (London), Mar. 5, 1978, at 2.

15. At the 1985 Review Conference of the Nuclear Non-Proliferation Treaty, Iran alleged that Iraq had attacked its nuclear facilities. As part of a compromise, mention of the Iranian allegations was excluded from the Conference's Final Declaration, reproduced as U.N. Doc. NPT/CONF.III/64/I. *See* Shaker, *The Legacy of the 1985 Nuclear Non-Proliferation Treaty Review Conference*, in NUCLEAR NON-PROLIFERATION: AN AGENDA FOR THE 1990S 18-19 (J. Simpson ed. 1985).

16. For a discussion of attacks on alleged nuclear weapons program facilities in the Middle East, see Mann, *supra* note 8, at A1.

17. *See* Vienna Convention on the Law of Treaties, *opened for signature* May 23, 1969, art. 53, U.N. Doc. A/Conf. 39/27, *reprinted in* 8 I.L.M. 289 (1969).

general acceptance in the international community; and service to global interests rather than those of the individual State.[18]

In examining the sale of nuclear weapons, Walter Gangl concludes that such action would be in violation of *jus cogens* since the prohibition of nuclear weapons proliferation is a fundamental norm of international law.[19] He further argues that the sale of peaceful nuclear technology, for example the generation of electricity, should be removed from international commerce until more demonstrably effective safeguards are developed to prevent the illegal movement and use of weapons grade material. Such safeguards should include the inspection of nuclear installations, and audits of material stocks and records involving the movement and use of peaceful nuclear technology by inspectors from international organizations.

Regardless of whether the duty to protect against the spread of dangerous nuclear technology has risen to the status of a fundamental peremptory norm in international law, it is clear that all States with nuclear programs have voluntarily accepted at least some degree of international control over their nuclear activities. The implementation of effective safeguards closely followed the development of nuclear power generation. In fact, the peaceful development of nuclear energy has been enabled and positively encouraged by agreements between States and international organizations. Thus, while the duty to avoid nuclear proliferation may not be regarded as *jus cogens*, it is perhaps a more likely candidate for status as a norm of customary international law.[20] As noted above,[21] no State has admitted to joining the nuclear weapons club in nearly thirty years, and India's detonation of a "peaceful" device in 1974 marks the most recent conclusive demonstration of horizontal proliferation. Thus, it has been argued that the treaties forming the non-proliferation regime form a new source of customary international law binding on both signatories and third parties.[22]

II. THE DEVELOPMENT OF INTERNATIONAL CONTROLS: INTERNATIONAL ORGANIZATIONS

After World War II, Western States foresaw the development of nuclear energy replacing fossil fuels as essential to the continual well-being of mankind. The early attempts to internationalize the promotion of nuclear energy were not successful. The Acheson-Lilienthal Report in 1945, which led to the Baruch Plan,[23] advocated an international agency "to which should be entrusted all

18. Note, *The Jus Cogens Dimensions of Nuclear Technology*, 13 CORNELL INT'L L.J. 63 (1980).

19. *Id.* at 74-77.

20. *See* McFadden, *Nuclear Weapons Free Zones: Toward an International Framework*, 16 CAL. W. INT'L L.J. 217, 236-38 (1986).

21. *See supra* note 3 and accompanying text.

22. McFadden, *supra* note 20, at 237.

23. Bernard Baruch, *Speech at the 1st United Nations Atomic Energy Commission*, July 2, 5, and 12, 1946.

phases of the development and use of atomic energy."[24] Unfortunately, the Baruch Plan was frustrated by Soviet non-cooperation. The development of the peaceful use of atomic energy was forced into independent national programs following the United States McMahon Act.[25] The McMahon Act prevented the dissemination of information about U.S. research leading up to the explosion of the atom bomb. In 1954, when it became clear that States other than the U.S. were making independent moves in bomb development and peaceful uses, the spirit of cooperation was rekindled by the Eisenhower initiative.[26] From this developed the International Atomic Energy Agency ("IAEA") and the conventions concerning the non-proliferation of nuclear weapons and the liability for nuclear damage in case of an incident at a nuclear installation. Nuclear energy has since been developed to the point where it is a viable alternative to fossil fuel energy. It is said to be a cheaper, cleaner, and more reliable means of providing electrical power.[27] Criticisms of this conclusion have been made.[28] However, details published regularly by the United Kingdom's Central Electricity Generating Board[29] ("CEGB") run counter to this criticism. In recent years, interest in nuclear energy has been renewed by the realization that the environmental risks associated with nuclear power may, in the long run, be significantly lower than those associated with energy generated from fossil fuels.[30]

Through treaties, those States possessing nuclear weapons have endeavored to limit the proliferation of bomb-making materials. These treaties[31] have limited the possession of independent means of bomb manufacture. Under the treaties, States are required to enact legislation to prevent the diversion of bomb-making materials and equipment by fraud, theft, or deliberate means. There are, however, certain States that are not bound by treaties; moreover, some who are bound are able to rationalize the clandestine breach of those treaties. These States may be able to manufacture atomic bombs.

While the limitation of nuclear weapons proliferation has provided the impetus for most international controls, the potential for damage and injury caused by the release of radioactive contamination has also encouraged the development

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24. U.S. State Department Publication 2498, *Report on the International Control of Atomic Energy*, Mar. 1946.

25. Atomic Energy Act of 1954 ("McMahon Act"), 42 U.S.C. §§ 2011-2296 (1988), *as amended* by Act of Aug. 30, 1954.

26. United Nations, *Atoms for Peace*, U.N. General Assembly, 8th Sess., 1954.

27. 26 NUCLEONICS WEEK 9 (1985).

28. *See, e.g.*, D. PEARCE, DECISION MAKING FOR ENERGY FUTURES (1979).

29. The Central Electricity Generating Board is the sole supplier of electricity in the United Kingdom. The Board has an obligation under the Electricity Act of 1957 to provide low cost electrical power. If privatization is undertaken, the separate companies formed will not have the statutory obligation to meet supply demands.

30. In particular, nuclear energy production does not contribute gases which exacerbate global warming. *See generally* Goodrich, *Hans Blix: Nuclear Energy Could Ease Climate Change*, Christian Science Monitor, Oct. 30, 1989, at 8.

31. *See infra* section III.

of international agreements. Whether radioactive materials are carelessly released into the environment, the channeling of responsibility to the nuclear plant operator is not sufficient. Little immediate damage will exist from the low level of releases and may not reach a danger level until after the operator has disappeared. Following the Chernobyl accident in the Soviet Union in April 1985, more attention has been focused on this problem and conventions have been established whose concern is early notification and international assistance in the case of a nuclear emergency.[32]

Following the Eisenhower initiative, three international organizations were formed: the International Atomic Energy Agency ("IAEA") by the United Nations; the Nuclear Energy Agency ("NEA") by the OECD; and the European Atomic Energy Community ("EURATOM"), now embodied within the European Community ("EC"). Together, these organizations are an integral component in the implementation of the rules and procedures which form the ground level of a global non-proliferation regime.[33]

A. The International Atomic Energy Agency

The statute of the IAEA[34] was ratified by the United Kingdom on July 29, 1957 and came into force on that day. As of August 1989, there are 113 State signatories to the Statute. Article II of the statute describes its objectives:

> The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.

The agency is authorized by article III of the statute to encourage and assist research and development of atomic energy for peaceful purposes; to make provision of materials, services,[35] equipment and facilities to meet the needs of research and development for the needs of the underdeveloped world; to foster the exchange of scientific or technical information and to encourage the training of scientists and experts; to establish and administer safeguards to ensure that knowledge, materials and equipment are not used to further any military purpose; and to establish standards of safety for the protection of health and

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32. *See infra* section III.D.

33. For an examination of the prerequisites to the formation of an international "regime" and the status of the non-proliferation system as a coherent regime, see Smith, *Explaining the Non-Proliferation Regime: Anomalies for Contemporary International Relations Theory*, in 41 INTERNATIONAL ORGANIZATIONS 253 (1987).

34. *Opened for signature*, Oct. 26, 1956, 8 U.S.T. 1094, T.I.A.S. 3873. The IAEA statute has been amended twice, in 1963 and in 1970.

35. Ha Vinh Phuong, *Procedures for the Supply of Materials Through the IAEA*, OECD-NEA Paris 1985, at 61-65.

property.[36] In a review of twenty-five years of operation of the IAEA,[37] the Director General, Dr. Hans Blix, noted that the agency had promoted its work with considerable success in the field of food and agriculture, medicine, energy and nuclear safety in a practical way and without much drama.

It is significant that although the IAEA deals only with the peaceful uses of atomic energy, it administers a far-reaching and systematic on-site inspection of the industrial and development activities of 114 non-nuclear weapon States who are signatories to the Non-Proliferation Treaty.[38] Following the Chernobyl nuclear reactor accident in the Soviet Ukraine, the IAEA investigated and convened an international conference to determine the reasons for the accident.[39] The IAEA was instrumental in setting up the conventions for notification of neighboring States in the event of a nuclear accident with trans-border implications and for mutual assistance between States in that event.[40]

B. The Organization for Economic Cooperation and Development and the Nuclear Energy Agency

The OECD was created by the Convention of the Organization for Economic Cooperation and Development signed in Paris on December 14, 1960, and came into force on September 30, 1961. The signatories to the Convention originally were nineteen European States and the United States. Subsequently, four non-European States joined.[41] The NEA was established on April 20, 1972. The Member States of the OECD, together with the Commission of the EC, take part in the work of the NEA. The primary objectives of the NEA are the promotion of cooperation between the members in the safety and regulatory aspects of nuclear development, and the assessment of the future role of nuclear energy as a contributor to economic growth. The NEA works in close collaboration with the IAEA, with which it has concluded a Cooperation Agreement to achieve its objectives

> [by] encouraging harmonization of governments' regulatory policies and practices in the nuclear field, with particular reference to the safety of nuclear installations, [and the] protection of man against ionizing radiation and preservation of the environment. [The Agreement also encourages the harmonization of radioactive] waste management and nuclear third party liability and insurance . . . keeping under review the technical and economic characteristics of nuclear power growth and of the nuclear field cycle, and assessing

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36. Ha Vinh Phuong, *IAEA Safety Standards, Their Legal Status and Implementation*, OECD-NEA Paris 1985, at 3-7.

37. 24 IAEA BULL. SUPP., 1982, at 3.

38. *See infra* section III.A.

39. 28 IAEA BULL., 1986, at 9.

40. *See infra* section III.D.

41. Twelfth Report of the OECD-NEA (1983).

> demand and supply for the different phases of the nuclear field cycle and the potential future contribution of nuclear power to overall energy demand; . . . developing exchanges of scientific and technical information on nuclear energy, particularly through participation in common services; . . . [and] setting up international research and development programmes and undertaking jointly organized and operated by OECD countries.[42]

In the field of legal affairs, the NEA is responsible for the administration of the Paris Convention on Third Party Liability in the Field of Nuclear Energy[43] and the Brussels Convention Supplementary to the Paris Convention.[44] In September 1988, the NEA and the IAEA jointly convened a conference in Vienna where a Joint Protocol was adopted and signed by twenty States.[45] Taken as a whole, the Paris and Brussels Conventions, along with the Vienna Protocol, outline the basic principles governing the liability of: (1) the operator of a nuclear facility; and (2) the State where the facility is located in the event of damage exceeding specified limits.

The liability issues raised by the disposal of nuclear substances in the context of waste management and decontamination of nuclear installations was considered by the NEA in 1983. It was agreed by the NEA experts that the definition of "nuclear installation" in the Paris Convention should include waste disposal facilities. However, other arrangements may be needed for the post closure phase.[46]

C. The European Atomic Energy Community

The EURATOM was created by the European Atomic Energy Community Treaty, which entered into force on January 1, 1959. On January 22, 1972, the United Kingdom signed the Accession Treaty for membership in the European Economic Community and the EURATOM. The European Communities Act (1972) gave this legal effect in the U.K.[47] The basic aim of the EURATOM Treaty is "to contribute to the raising of the standard of living in Member States and to the development of exchanges with other countries by creating conditions

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42. *Description of Licensing Systems and Inspections of Nuclear Installations* 149-55 (OECD-NEA 1980).

43. *See infra* section III.D.; Strohl, *The Concept of Nuclear Third Party Liability and its Implementation by Legislation in OECD Member Countries,* OECD Paris 1985, at 70-85.

44. *See infra* section III.D.

45. *See* von Busekist, *A Bridge Between Two Conventions On Civil Liability for Nuclear Damage: The Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention,* 43 NUCLEAR L. BULL. 10 (July 1989).

46. *Long-Term Management of Radioactive Waste, Legal Administrative and Financial Aspects* at 86-88 (OECD 1984).

47. *The European Communities Act 1972* § 2, 42 Halsbury's Statutes of England (3d), at 79.

necessary for the speedy establishment and growth of nuclear industries."[48] Article 2 of the Treaty provides that to achieve this aim, the Community will: promote research and the dissemination of information; establish and ensure the application of uniform safety standards for the protection of health; facilitate investment and ensure particularly by encouraging business enterprise the creation of the basic facilities necessary for the development of nuclear energy in the Community; ensure a regular and equitable supply of ores and nuclear fuels to all users in the Community; establish the necessary control measures to ensure that nuclear materials are not diverted to purposes other than those for which they are intended; exercise the right of ownership of special fissile material; create a common market for specialized nuclear material and equipment; and co-operate with other countries and international organizations to promote the peaceful uses of nuclear energy.[49]

In international dealings, the EC may act for its constituent members. It may, as in the Convention on the Physical Protection of Nuclear Material,[50] allow its partners to act separately but at the same time be party to the Treaty in the EC. In this latter case it was necessary to clarify the position for third parties by a separate statement.[51]

It can be seen from the foregoing that the common intent of these treaties is the encouragement of the development of nuclear energy by cooperation and agreement. This intent has not always been carried out consistently. For example, under article 93 of the EURATOM Treaty, the free transfer of nuclear materials is allowed between Member States. However, under the IAEA Treaty, ten States have submitted a list of materials and facilities that would not be exported to non-nuclear weapon States without prior IAEA agreement. Therefore, the nuclear weapons States within the EC have agreed to the free transfer of materials to non-weapon States within the EC, but have fettered their freedom to do so without IAEA permission. Thus, a European nuclear plant operator using fuel exported from the United States would have to agree to limitations regarding the place of reprocessing before a U.S. export license would be granted to satisfy the terms of the U.S. Non-Proliferation Act.[52]

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48. Treaty Establishing the European Atomic Energy Community (EURATOM), art. 1, 298 U.N.T.S. 169, 172.

49. *Id.* art. II.

50. *See infra* note 60. The Convention on the Physical Protection of Nuclear Materials requires each party to the Convention to ensure that nuclear material is protected to an agreed level while in transit within the party's territory. The Convention does not apply to nuclear material used for military purposes.

51. Statement by the representative of the Commission of the EC at the informal meeting on the Convention on the Physical Protection of Nuclear Materials, Vienna, Sept. 24-25, 1979.

52. *See supra* note 7.

III. CONTROL OF NUCLEAR MATERIALS, KNOWLEDGE AND WEAPONS

A. International Conventions Concerning Nuclear Materials, Physical Protection and Safeguards

Three major concerns arise from the use of nuclear energy: (1) the possible use of nuclear weapons and therefore war; (2) the spread of radioactive contamination in the environment; and (3) the liability for nuclear damage in such an event. These concerns are manifest in a nuclear explosion. The manufacture of a nuclear explosive device, given the economic resources, the knowledge, and the nuclear material, can be undertaken by persons with access to everyday machine tools and conventional materials.[53] Therefore, controlling the spread of nuclear weapons can only be achieved by controlling the nuclear materials and knowledge. Limitations on the risk of environmental contamination by radioactive releases from nuclear explosions is accomplished by treaties which seek to eliminate[54] or control[55] such explosions.

States which already have nuclear weapons may reduce the risk of contamination and war by limiting the number of weapons they possess as well as controlling their use (limiting the vertical proliferation of nuclear weapons).[56] States without nuclear weapons may reduce the risk of contamination and war by refusing to develop them, thereby keeping the total number of States with nuclear weapons to a minimum (limiting horizontal proliferation). Limitation of horizontal proliferation has been achieved by the Non Proliferation Treaty[57] ("NPT") signed by weapons States and by non-nuclear weapons States alike. The Treaty limits the transfer of knowledge, facilities, and nuclear materials. Possession of nuclear materials (and therefore potential nuclear weapons) by non-weapons States who are not a party to the NPT is controlled to some extent by national legislation of weapons States,[58] by common policy between States,

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53. *See generally Who has the Bomb?* TIME 36 (June 3, 1985); Blix, *Building Confidence*, 26 IAEA BULL., at 5 (1984); comments by Senator John Glenn, N.Y. Times, Apr. 26, 1981, sec. IV, at 3.

54. The Antarctic Treaty, *opened for signature* Dec. 1, 1959, 12 U.S.T. 794, T.I.A.S. No. 4780, 402 U.N.T.S. 71; The Treaty on Principles Governing the Activities of States in the Exploration of Outer Space Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205; The Treaty for the Prohibition of Nuclear Weapons in Latin America, *opened for signature* Feb. 14, 1967, 634 U.N.T.S. 281 [hereinafter Tlatelolco Treaty].

55. The Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outerspace, and Under Water, *opened for signature* Aug. 5, 1963, *entered into force*, Oct. 10, 1963, T.I.A.S. 5433, 480 U.N.T.S. 43.

56. The limitation of vertical proliferation ("arms control") continues to be the subject of discussion and negotiation between the nuclear weapons States, primarily the U.S. and the U.S.S.R.

57. Treaty on the Non-Proliferation of Nuclear Weapons, *opened for signature* July 1, 1968, 21 U.S.T. 483, T.I.A.S. 6839, 729 U.N.T.S. 161.

58. *See, e.g.*, the U.S. Non-Proliferation Act (1978), *supra* note 7. Under the Act the U.S. can control future disposal of nuclear fuel in such a way as to constrain the freedom of European operation of fuel reprocessing plants from treating foreign fuel.

and by the Convention on the Physical Protection of Nuclear Materials.[59] As will be seen later,[60] a small number of States have, nevertheless, made nuclear weapons. The NPT, signed by 136 States as of 1987, is a "bargain" between nuclear weapons States and non-nuclear weapons States whereby:

- the nuclear weapons State agrees not to transfer and the non-nuclear weapons State agrees not to accept or seek or receive assistance in the manufacture of nuclear explosives[61] (*i.e.,* the limitation of horizontal proliferation);
- all parties agree to participate in the exchange of equipment, materials and technological information for the peaceful use of nuclear energy,[62] and that potential benefits from the peaceful application of nuclear explosives will be made available to non-nuclear weapons States;[63] and
- each of the parties undertake to pursue negotiations in good faith to cease the nuclear arms race[64] (*i.e.,* the limitation of vertical proliferation).

The undertaking must be verified by participation in a safeguards system before the assistance is granted. A safeguards agreement must be signed by the non-nuclear weapons States with the IAEA in accordance with article III of the Treaty. Article III(A)(5) of the IAEA statute authorizes the agency

> to establish and administer safeguards designed to ensure that special fissionable and other materials . . . are not used in such a way as to further any military purpose and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy.[65]

The objective of safeguards is "the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown and the deterrence of such diversion by the risk of early detection."[66] By June 1985, 84 States had signed safeguards agreements and safeguards measures were in force in 78 States. At the end of 1987, safeguards were in place in 57 countries converting 905 nuclear installations.[67]

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59. Convention on the Physical Protection of Nuclear Materials, *opened for signature* Mar. 3, 1980, 28 I.L.M. 1419 (1979).
60. *See infra* section III.B.2.
61. Treaty on the Non-Proliferation of Nuclear Weapons, *supra* note 57, arts. I, II.
62. *Id.* art. IV sec. 2.
63. *Id.* art. V.
64. *Id.* art. III sec. 2; art. VI.
65. Statute of the International Atomic Energy Agency, *supra* note 34, art. III.
66. IAEA Docs. INFCIRC/66/Rev2; INFCIRC/153 (corrected).
67. Schuricht & Larrimore, *Safeguarding Nuclear Fuel Cycle Facilities,* 30 IAEA BULL. 8 (1988).

Despite the NPT, it is possible that unsafeguarded facilities which are connected to the flow of nuclear material might also exist within NPT States.[68] As indicated above, any State with a sufficiently well-developed infrastructure can create a nuclear explosion. However, it would take three to four years and significant amounts of appropriate nuclear materials would be required. The first signs of such development should theoretically be revealed in safeguards reports and should give the rest of the world time to react. However, in practice this may not be the case as safeguards are applied at four different levels:

- under the NPT, for non-nuclear weapons States, all nuclear materials in present and future nuclear activities fall under safeguards agreements (*i.e.*, "Full Scope Safeguards");
- safeguards are applied in regional agreements such as the Tlatelolco Treaty;[69]
- safeguards are applied under bilateral agreements outside the NPT and will in such cases be limited to specific facilities only; and
- safeguards are applied only to civil facilities by nuclear weapons States (France 1981; U.K. 1978; U.S. 1980; U.S.S.R. 1985) which leaves military facilities unmonitored.

Only in the first case can there be reasonable certainty that nuclear material is not being diverted. In the three remaining cases there is the danger of diversion. Also, there are nuclear weapons States who are not party to the NPT[70] and there are non-nuclear weapons States who are not party to the NPT who have nuclear programs and who may well be making nuclear weapons.[71] In order to block possible loopholes, the U.S. introduced the Non-Proliferation Act[72] which requires the application of full safeguards before approving the export or re-export by the third country of nuclear material, equipment, or assistance. However, without similar action by all nuclear weapons States, this Act is only of limited value.

Finally, the NPT itself is set for a review conference in 1995.[73] While a total

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68. *See generally* H. Gruemann, 25 IAEA BULL. 27-29 (1983).

69. *See supra* note 54. For a discussion of the Tlatelolco Treaty, *see infra* section III.B.1.

70. In particular, the States which admittedly possess nuclear explosive devices are China, France, and India.

71. Chief among these are Argentina, Brazil, Israel, Pakistan, and South Africa.

72. *See supra* note 7.

73. By its terms, the future of the NPT beyond its initial authorized period can only be decided at a conference of the parties. Thomas Graham, Jr. of the United States Arms Control and Disarmament Agency outlines the 1995 possibilities as follows: (1) If no conference is held or no agreement reached, the NPT will continue in force indefinitely until there is an agreement as to its fate; (2) If a review conference is held and agreement is reached, the agreement will by the terms of the NPT be limited to either continuing the Treaty indefinitely or continuing for a fixed period or periods of time. The review conference may not impose new substantive conditions for the continuation of the NPT. Graham, *The Duration of the Nuclear Non-Proliferation Treaty: Sudden Death or New Lease on Life?* 29 VA. J. INT'L L. 661 (1989).

collapse of the NPT regime is highly unlikely,[74] it is probable that many States will voice serious concerns similar to those set forth in previous decennial conferences. Underlying the tensions in NPT negotiations is the basic realization that the NPT attempts to cement the world nuclear order which existed in the mid-1960s. Some States feel very strongly that the NPT regime results in a "certain dilution and diminution of sovereignty,"[75] and the nuclear weapons States must continue to persuade these States that their interests are best served by the continuation of the safeguards system and the rejection of nuclear weapons. Nevertheless, barring the total collapse of the regime, even if the NPT is not renewed the individual IAEA and Tlatelolco Treaty safeguards agreements would remain in tact.[76] However, given the nature of the safeguards documents themselves, IAEA safeguards would no longer apply to most plants in EURATOM, or to any of the reactors in the East European non-nuclear weapons States.[77] The uncertain status of the NPT regime after 1995 has highlighted the importance of other nuclear controls at the State and regional level, as well as the importance of the growing self-policing of the nuclear industry itself. The main aspects of these control mechanisms are described below.

B. Control of Nuclear Weapons, Materials and Knowledge

1. Weapons Control Treaties. The Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water[78] is an agreement by the U.S., U.S.S.R. and U.K. to prohibit and prevent nuclear explosions in the atmosphere, outer space, underwater, and in an environment which would cause radioactive contaminated debris outside the territorial limits of the State for an unlimited period.[79] Each party also undertook to refrain from causing, encouraging or participating in a nuclear explosion anywhere in those environments. The Treaty, therefore, allows each of the three States to freely conduct underground explosions in its own territory and to participate in similar explosions in a third country. The non-signatory weapons States of France, China, and India have now similarly restricted testing to underground sites.[80] Radioactive contamination in the atmosphere has been reduced as a direct result

74. *Id.* at 675. Graham finds it "difficult to imagine the parties deciding to end the Treaty, given the degree to which international efforts to allow nuclear commerce have been integrated into a network of safeguards agreements." *Id.*

75. *See* Quester, *Preventing Proliferation: The Impact of International Politics*, in NUCLEAR PROLIFERATION: BREAKING THE CHAIN 214 (1981).

76. *See* Pilat, *A World Without the NPT?* in NUCLEAR NON-PROLIFERATION: AN AGENDA FOR THE 1990S 167 (J. Simpson ed. 1987).

77. *See* Fischer, *Defects of the Safeguards Documents*, in SAFEGUARDING THE ATOM, *supra* note 4, at 85.

78. The Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outspace, and Under Water, *supra* note 55.

79. *Id.* art. I, para. 1(a), (b).

80. For a detailed discussion of India's nuclear program, *see* Cronin, *India and Pakistan*, in LIMITING NUCLEAR PROLIFERATION, *supra* note 5, at 59-88.

of the implementation of this Treaty.

In certain parts of the world the presence of nuclear weapons has been completely prohibited by agreement. The Antarctic Treaty[81] between twelve States which have a direct interest in the area prohibits nuclear explosions and the depositing of nuclear waste material.[82] However, with the agreement of all the parties, peaceful research (perhaps including peaceful nuclear explosions) may be allowed. In the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies,[83] the U.S., U.S.S.R. and U.K. agreed not to place nuclear weapons outside the earth's atmosphere.[84] The depositing of nuclear waste is subject to prior consultation between the signatories.[85] However, France, China and India (weapons States with the technological capability to launch nuclear weapons into orbit) are not signatories to the Treaty.

In the Treaty for the Prohibition of Nuclear Weapons in Latin America ("The Tlatelolco Treaty"),[86] parties who have a territorial interest in the area and all nuclear weapons States have agreed to use nuclear material and facilities exclusively for peaceful purposes and to prohibit and prevent nuclear weapons in the area.[87] Twenty-three States have signed and ratified the Treaty. Argentina has signed but not ratified. Brazil and Chile have signed and ratified but have not taken up a waiver[88] allowing the Treaty to become effective when all States in a defined region of Latin America ratify the Treaty.[89] The participation of these three States is therefore perfunctory. Unlike the NPT itself, the Tlatelolco Treaty prohibits "the receipt, storage, installation, deployment and any form of possession of any nuclear weapon, directly or indirectly, by the Parties themselves, or by anyone on their behalf or in any other way."[90] Thus, the Treaty closes the gaping NPT "loophole" which allows a weapons State to place nuclear weapons on the territory of a non-nuclear weapons State as long as the possession and control of the weapons remains with the nuclear State.

The Tlatelolco Treaty has two protocols. One requires the ratification of the Treaty by States outside the area which have *de jure* or *de facto* responsibility for territories within the region. The Treaty requires that States sign an IAEA Safeguards Agreement which allows the IAEA to carry out periodic, systematic

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81. The Antartic Treaty, *supra* note 54.

82. *Id.* art. V.

83. The Treaty on Principles Governing the Activities of States in the Exploration of Outer Space Including the Moon and Other Celestial Bodies, *supra* note 54.

84. *Id.* art. IV.

85. *Id.* art. IX.

86. Tlatelolco Treaty, *supra* note 54.

87. *Id.* art. I.

88. *Id.* art. 28(2).

89. *Id.* art. 25.

90. *Id.* art. 1(b).

inspections of nuclear installations.[91] The second protocol requires that all recognized nuclear weapons States guarantee that they will respect the regime established by the Treaty, that they will not contribute to any actions which might entail a violation of the Treaty, and that they will not use or threaten to use nuclear weapons against parties to the Treaty. At present, the second protocol has been signed by all admitted nuclear weapons States. India (which has exploded a nuclear device) has not signed.

While the Tlatelolco Treaty has not yet achieved its objective, its existence has allowed the clear identification of intent to prohibit nuclear weapons in a large area of the world. However, it is also clear where possible violations of the Treaty may originate. Brazil, which has the financial capacity to make a bomb[92] (the cost to a State with some existing nuclear facilities to make a bomb is less than ten million dollars per year over four to five years), and an operating nuclear power station, is attempting to set up a nuclear fuel manufacturing facility.[93] In addition, Brazil has an uranium enrichment facility[94] and has not signed a safeguards agreement with the IAEA. Chile has a research reactor, supplied by the U.K., and has also not signed a safeguards agreement with the IAEA. Argentina has the financial strength to embark upon a nuclear weapons program and it has two power reactors, one of which uses natural uranium, and has on-load refuelling (a "CANDU" reactor). This latter reactor allows the easier removal of irradiated fuel from power reactors, which makes tracing nuclear materials considerably more difficult. Such fuel may be used as feedstock for reprocessing recovery of the fissile material used in nuclear weapons.[95] Argentina is hopeful of reaching a safeguards agreement[96] but is reported to be building a pilot fuel reprocessing plant with assistance from Germany and Italy.[97] Argentina is resisting the ratification of the Tlatelolco Treaty and claims that the Treaty offers no protection against nuclear weapons States introducing nuclear weapons into the Latin American region. Argentina also rejects the U.S. interpretation that the Treaty definition of "nuclear weapons" includes peaceful nuclear explosions; and it further disagrees with the U.S.'s refusal to consider the prohibition of transport of nuclear weapons in the region. The Argentine government is concerned that the reports from the special inspections mandated under the Treaty will not remain confidential. Despite the staunch opposition from both Brazil and Argentina to the "discriminatory" NPT system, the two States recently agreed among themselves

91. *Id.* art. 28(1).

92. For an approximation of the cost of nuclear weapons programs, *see, e.g.*, BRITO, INTRIGILATOR & WICK, STRATEGIES FOR MANAGING NUCLEAR PROLIFERATION 248 (1983).

93. House, *Brazil Reveals Secret Military Nuclear Project*, The Independent (London) Sept. 9, 1987.

94. *See* NUCLEONICS WEEK, Apr. 14, 1988, at 6.

95. J. GOLDBLAT, NON-PROLIFERATION: THE WHY AND THE WHEREFORE 70 (1985).

96. NUCLEONICS WEEK, Oct. 18, 1984, at 9.

97. NUCLEONICS WEEK, May 30, 1985, at 4.

to ban production of nuclear weapons and to prohibit nuclear tests.[98]

It can be seen, therefore, that there are significant obstacles to achieving the full list of the objectives of the Treaty: "[t]he military denuclearization of Latin America, . . . a measure which will spare their people from squandering of [sic] their limited resources on nuclear armaments."[99] However, the Treaty has acted as a stimulus to the institution of similar measures in other areas of the world, most notably in the Indian Ocean and the South Pacific. The nuclear weapons States' interests in the South Pacific have been exposed by the sinking of the "Rainbow Warrior," a ship which was leading a protest against French weapons tests in the South Pacific area.[100] The South Pacific Nuclear Free Zone Treaty,[101] (the Rarotonga Treaty), which entered into force on December 11, 1986, calls upon the nuclear weapons testing States to refrain from using a nuclear weapon against any party to the Treaty and from conducting nuclear explosive tests in the zone. Additionally, the parties may not manufacture nuclear weapons or allow the placement of nuclear weapons on their territories. However, the wording of the Rarotonga Treaty may be construed to allow the innocent passage of seagoing vessels carrying nuclear weapons, thereby calling into question the very concept of the South Pacific as "nuclear-free."[102]

2. Non-Treaty Measures. Attempts have been made outside the Treaties to control the transfer of nuclear fuel enrichment and reprocessing technology and, hence, nuclear material manufacture. The London Suppliers Group, a club of fifteen members, was set up in the 1970s.[103] Its guidelines include:

- "trigger list" items (*i.e.*, special materials and equipment used in weapons manufacture), should be exported only when covered by IAEA safeguards and on receipt of formal assurances that exclude uses which would result in a nuclear explosion;
- "trigger list" items should be under effective physical protection;
- restraint should be exercised in the export of sensitive facilities and technologies (*i.e.*, those with reprocessing and enrichment applications) and of weapons-usable materials;
- assurances concerning the possible future retransfer of "trigger list" items

98. *In Review: Latin America*, Los Angeles Times, Dec. 4, 1990, at H3. Brazilian President Fernando Collor de Mello characterized the signing of the agreement as a "decisive step."

99. Tlatelolco Treaty, *supra* note 54, Preamble.

100. *See generally* Rieman, *Creating a Nuclear Free Zone Treaty That is True to its Name: The Nuclear Free Zone Concept and a Model Treaty*, 18 DEN. J. INT'L L. & POL'Y 209, 222 (1990).

101. *Opened for signature* Aug. 6, 1985, 24 I.L.M. 1440. *See also* Papadimitritopoulos, *The Raratonga Treaty: A Regional approach to Non-Proliferation in the South Pacific*, 30 IAEA BULL. 31 (1988).

102. This is the interpretation by the United States. *See* Rieman, *supra* note 100, at 228-43.

103. The Nuclear Supplier's Guidelines ("NSG") do not constitute a formal international agreement. A major accomplishment of the NSG was to persuade France, which is not a party to the NPT, to require safeguards on its exports of nuclear materials. *See, e.g.*, NATIONAL ACADEMY OF SCIENCES (U.S.), NUCLEAR ARMS CONTROL: BACKGROUND AND ISSUES 235 (1985).

should be required by the original suppliers of these items; and
- "best endeavors" should be exercised in advising prior consent for reprocessing.

All major supplying States,[104] including France, subscribed to the guidelines. However, the group only requires that safeguards be applied to the nuclear materials supplied by their members. Argentina has been able to set up a full unsafeguarded fuel cycle. The transfer of enrichment technology to Australia and Mexico, both uranium exporters, is under negotiation. In addition, discussions have been held by the U.S.S.R. with Libya and Cuba, none of which subscribe to safeguards agreements.

A declaration of common policy by the Member States of the European Community[105] was made on November 20, 1984. The declaration noted that the Member States had adopted the IAEA guidelines for the export of nuclear material, equipment or technology and declared a common policy regarding the transfer of material between Member States. This declaration reaffirms the basic principle of the EURATOM Treaty of unrestricted transfer of materials between the Member States. However, the unrestricted transfer would run counter to the NPT undertaking to adopt safeguards. Therefore, additional requirements for monitoring and control of the transfer of nuclear materials between Member States are laid down to satisfy the NPT undertaking. They are:

- common agreement regarding storage of plutonium and enriched uranium;
- certification of transfers, intermediate storage and use of plutonium and enriched uranium; and
- a specific mutual agreement to transfer to a third state of plutonium and uranium enriched to above twenty percent.

The EURATOM Treaty allows that installations and technology reacting to enrichment reprocessing and production of heavy water may be transferred between Member States provided it is operated only to produce enriched uranium to not more than twenty percent (a level which is approaching weapons grade material) without the agreement of the supplying Member State. The retransfer of the facility or technology may only be made with the prior agreement of the supplying Member State.

The measures described above are outside the NPT and, while they are intended to effect control over non-nuclear weapons States who are not members of the NPT, such measures can be seen to weaken the NPT. NPT members who are non-nuclear weapons States are in fact at some disadvantage, and are not exclusively given access to the technology and materials. Dr. Hans Blix[106] has

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104. The United States, the United Kingdom, the Soviet Union, France, Germany, Japan, Canada, Belgium, Italy, the Netherlands, Sweden, Switzerland, Czechoslovakia, Poland, Australia, and Finland all stated early on that their nuclear export policies will adhere to NSG guidelines.

105. *See* 35 NUCLEAR L. BULL. (June 1985).

106. Blix, *Safeguards and Non-Proliferation*, 27 IAEA BULL., No. 2, Summer 1985, at 3-7.

observed that the NPT has, nevertheless, since 1964 limited the number of nuclear weapons States to less than the fifteen to twenty expected by President Kennedy of the United States.[107] In a report of the IAEA on safeguards, it is noted that no activities which would indicate a diversion of safeguarded material have been detected, although some minor discrepancies have been found.[108]

However, a view from outside the IAEA is less reassuring. The nuclear weapons States have not kept their part of the bargain to find ways of limiting material proliferation; outside full-scope safeguards to which the report refers, there is a firm indication of horizontal proliferation—France, China and India have nuclear weapons. Israel, Pakistan, South Africa, Brazil and Argentina are suspected of having weapons or of being close to having them. Other States, not all of whom are outside the NPT, have made moves which, if successful, could have placed nuclear weapons in their possession. South Korea, Taiwan, and Chile have been and are still negotiating to obtain fuel enrichment technology. In 1974, France withdrew from negotiations with South Korea to construct an enrichment plant. There are other indications that States are moving towards weapons capability: the Israeli bombing of the safeguarded Osirak research reactor in Iraq was such an indication.[109] If we take into account all of the potential nuclear weapons States, President Kennedy's fears of there being twenty weapons States in as many years may have become a reality, and the IAEA expressions of confidence may be misplaced.

C. Protection of Nuclear Material from Terrorist Action

As well as the possible loopholes in the NPT which would allow the transfer and use of nuclear materials to make nuclear weapons, the possibility of nuclear material being stolen for use by non-treaty States or by terrorist organizations forms a second major international concern. The physical protection of nuclear material is entirely within the jurisdiction of the State. However, in international transport the cooperation of States is necessary. To this end, the Convention on the Physical Protection of Nuclear Materials[110] entered into force on February 8, 1987, with forty member States and twenty-one ratifications.[111] The Convention, which does not apply to nuclear material used for military purposes,[112] requires each party to the Convention to take steps to ensure that nuclear material during international transport is protected to an

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107. *See* J. NYE, STRATEGIES FOR MANAGING NUCLEAR PROLIFERATION 279 (1976).

108. NUCLEONICS WEEK, July 11, 1985 at 14.

109. Such extreme self-help incidents also evidence the lack of complete confidence that some States have in the efficacy of IAEA safeguards.

110. Convention on the Physical Protection of Nuclear Materials, *supra* note 59.

111. Individual parties have enacted the substantive provisions of the Convention in their municipal laws. For example, the United Kingdom ratified the Convention on March 3, 1980 and some of its provisions became law by the *Nuclear Materials (Offenses) Act of 1983*, 12 Halsbury's Statutes of England (4th), at 827.

112. Convention on the Physical Protection of Nuclear Material, *supra* note 59, art. I.

agreed level while in its territory.[113] Nuclear material is categorized according to its usefulness as a feed stock for weapons[114] and appropriate levels of protection are specified.[115] Each party agrees not to export or import nuclear material or to allow transit through its territory unless it is protected.[116] In the event of theft or suspicion of theft, the parties undertake to cooperate and provide assistance in the protection and recovery of the material involved.[117] The parties also agree to consult and cooperate in the design of physical protection systems. Each party agrees to treat as punishable offenses the intentional commission of certain acts[118] which include: (1) alteration or disposal of nuclear material which is likely to cause death, serious injury or damage to property;[119] and (2) an attempt or participation in such an act[120] or a threat to cause damage or to refrain from an act.

D. Third Party Nuclear Liability

The third major concern relating to nuclear energy involves the risk of a nuclear accident. Following the Chernobyl accident, the international community moved quickly to codify the responsibilities of operators of reactors involved in accidents and those of the States where a nuclear accident has occurred. The area of liability has been addressed through the Conventions on Third Party Nuclear Liability.[121] Since the Chernobyl accident, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency[122] entered into force on February 26, 1987, and the Convention on Early Notification of a Nuclear Accident[123] came into force on October 27, 1986.

To encourage the development of the peaceful uses of nuclear energy, the question of risk of nuclear damage was addressed in 1960 when sixteen European States signed the Paris Convention.[124] The signatories were "[d]esirous of ensuring adequate and equitable compensation for persons who suffer damage

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113. *Id.* art. II.

114. *Id.* Annex II.

115. *Id.* Annex I. For example, Category III (the lowest) material must be stored in a controlled area; Category II material must be stored in an enclosed area under surveillance; and Category I material must be stored as for II, where access to the areas must be restricted to persons who are considered trustworthy and under surveillance by guards who are in close communication with appropriate response forces.

116. *Id.* art IV.

117. *Id.* art V.

118. *Id.* art. VII.

119. *Id.* art. VII(1)(a).

120. *Id.* art. VII(1)(f)-(g).

121. *See infra* notes 124, 126.

122. The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, 25 I.L.M. 1377 (1986).

123. The Convention on Early Notification of a Nuclear Accident, 25 I.L.M. 1370 (1986).

124. Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention), *opened for signature* July 29, 1960, modified by an Additional Protocol *signed* 28 July 1964, in IAEA, INTERNATIONAL CONVENTIONS ON CIVIL LIABILITY FOR NUCLEAR DAMAGE 22 (1976).

caused by nuclear incidents whilst taking the necessary steps to ensure that the development of the production and uses of nuclear energy for peaceful purposes is not thereby hindered."[125] The Paris Convention came into force on April 1, 1968, and established three basic principles, discussed in more detail below, which apply to the operator of a nuclear facility: (1) absolute and exclusive liability; (2) limitation of liability; and (3) financial security.

In the event of a nuclear incident where the damage exceeds the operator's liability, the Brussels Supplementary Convention,[126] which came into force on December 4, 1974, sets down arrangements between States for sharing the cost of compensation. The Vienna Convention,[127] which embodies the same principals as the Paris Convention in a world-wide forum, came into force on November 12, 1977. Two protocols to setting high compensation limits under the Paris and Brussels Conventions were adopted on November 16, 1982. In September 1988, a Joint Protocol was adopted by the IAEA and the NEA in Vienna. The basic principles of the Paris Convention are set out below.[128]

To ensure that the operator of a nuclear installation is exclusively liable for nuclear damage while the material is being transported by sea, the Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material was adopted in Brussels on December 17, 1971. Also adopted in Brussels on May 25, 1962 was the Convention on the Liability of Operators of Nuclear Ships. This was set up on the same principals as the Paris and Vienna Conventions and will come into force when it is signed by a State which has authorized the operation of a nuclear ship under its flag.

1. Absolute and Exclusive Liability. The Paris and Vienna Conventions have the same objectives, which are based on the Paris Convention. The Paris Convention will therefore be used to briefly outline their common principles.

The participating States agreed to the principle that the victim of a nuclear incident is to obtain compensation without having to identify the person responsible, or prove fault. Under the Conventions, the parties agreed to make the proprietor of a nuclear installation strictly liable for the damage caused by a nuclear incident to person and property.[129] A nuclear incident is defined as an occurrence that causes damage.[130] This means that the operator is absolutely liable for all damage caused by a nuclear incident either within, or in transport to or from, his nuclear installation.

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125. *Id.* Preamble.

126. The Convention Supplementary to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy (Brussels Supplementary Convention), *opened for signature* Jan. 31, 1963, modified by an Additional Protocol *signed* January 28, 1964. Text has been published in IAEA, INTERNATIONAL CONVENTIONS ON CIVIL LIABILITY FOR NUCLEAR DAMAGE 43 (1976).

127. The Vienna Convention on Civil Liability for Nuclear Damage, *opened for signature* May 21, 1963, 2 I.L.M. 727 (1963).

128. *See infra* section III.D.1.

129. Paris Convention, *supra* note 124, art. III.

130. *Id.* art I.

The operator is also exclusively liable; no other person is held liable for the nuclear damage. All liability is "channelled" to the operator who is exonerated only in limited cases where the particular States' legislation provides. For example, the operator is not liable (1) where a carrier or person handling radioactive waste would be liable in place of the operator,[131] or (2) where the damage is caused by armed conflict[132] or by natural disasters which are catastrophic and completely unforeseeable.

Where nuclear damage is caused jointly by a nuclear incident and another occurrence and the extent of the non-nuclear damage is not separate, the whole damage will be covered by the Convention and the operator will be liable for the entire damage.[133] It is also agreed under the Convention that the normal rules of tort of the participating State apply to claims or compensation of damage to on-site property such as the reactor.[134] Similarly, there is no recovery for damage to the means of transport.[135]

2. Limitation of Liability. Although under the Conventions it is agreed that the operator is strictly liable for damage caused by a nuclear incident, the liability under the Paris Convention is limited to a maximum of fifteen million European Monetary Agreement units of account ("EMA u/a").[136] The operator is required to have insurance or other coverage for this amount to be drawn solely for compensation of damage caused by a nuclear incident.[137] The effect of this is that all insurance is channelled to the operator, and separate covers for the various persons who might have been liable under common law is avoided. The right to compensation is lost if the action is not brought within ten years from the date of the nuclear incident.[138] The Brussels Supplementary Convention sets up two further levels of compensation: above 15 and up to 70 million EMA u/a is covered by the government of the liable operator and between 70 and 120 million EMA u/a is shared between the parties of the Convention.

The Soviet Union is not a party to either the Paris or Vienna Conventions. Therefore, the Chernobyl accident did not test the efficacy of the Conventions. It is of concern, however, that the damage within the Soviet Union was far in excess of seventy million EMA u/a, and damage to people may occur or become manifest long after the ten year limitation period.

3. Social Security. In many States, persons suffering injury will receive compensation through the social security system established by their government.

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131. *Id.* art. IV(d).

132. *Id.* art. IX.

133. *Id.* art. III(b).

134. *Id.* art. III(a)(ii)(1).

135. *Id.* art. III(a)(ii)(2).

136. *Id.* art. VII. The EMA u/a is the European unit of account, also known as the European Currency Unit ("ECU"). On March 25, 1991, 1 ECU = U.S. $1.23.

137. Paris Convention, *supra* note 124, art. X.

138. *Id.* art. VIII.

Under the Conventions, it is left to the contracting party to decide: (1) whether the rights of such person vis-a-vis the operator will be contained or abolished; (2) whether they can claim compensation from the operator in addition to social insurance benefits; and (3) whether the social security institution concerned may recover from the operator compensation furnished to persons injured. Under the Conventions, a person who has had to furnish compensation under the law of the non-contracting State is permitted to take legal action to acquire the right of the person thus compensated. This right is not acquired by persons against whom the operator has a right of action under the Convention.

4. Legal Action. The Conventions allow an operator to take legal action to recover damages only where this course is expressly allowed by contract.[139] Such legal action may also be taken where damage is caused intentionally by the individual sued[140] or in case of transit of nuclear material through a State which applies a higher limit of damages, and if the transport has been made without consent.[141] Actions based on tort are precluded except where they may involve the nuclear installation and property of the operator on the site of the nuclear installation.[142] The normal rules of tort apply to such damage which may enable the operator to sue the supplier. The Conventions do not prevent a State from taking criminal sanctions against persons who cause nuclear damage by intentional or negligent acts or omissions. The operator's right of action is not affected where the source of ionizing radiation is not covered by the Convention[143] or against other operators in case of joint liability.

The Conventions concentrate jurisdiction in the court of the State where the nuclear incident occurred.[144] That State has jurisdiction even where damage is sustained in another State and may not delegate to another State's courts any claims for nuclear damage.[145]

E. Experience of Nuclear Energy International Agreements

The contamination of the atmosphere by nuclear explosions has decreased since the agreement to stop atmospheric testing. Meanwhile, the number of potential nuclear weapons States and the number of weapons held by the nuclear weapons States have both increased. The incomplete coverage of the major multilateral treaties has led to more specific bilateral arrangements and informal agreements. Nevertheless, both the arrangements made under multilateral treaties and bilateral agreements depend on the effectiveness of safeguards and

139. *Id.* art. VI(f)(ii).
140. *Id.* art. VI(f)(i).
141. *Id.* art. VI(b).
142. *Id.* art. III(a)(ii).
143. *Id.* art III(b).
144. *Id.* art. XIII(a).
145. *Id.* art XIII.

the IAEA. Operable safeguards systems have been set up and tested. For example, the IAEA survey of the Osirak reactor was shown to be accurate in its report. In order to ensure true limitations of weapons, full-scale safeguards must operate and be seen to operate. This is not yet the case as nuclear weapons States exclude weapons materials from safeguards, and bilateral treaties or contracts only require safeguards on specific material covered by the treaties or contracts. True non-proliferation will come only when all materials are the subject of surveillance under safeguards. International control of nuclear material has been proposed with the creation of plutonium banks, central storage of high level waste, and central reprocessing on a regional basis.[146]

Ever since the Atoms for Peace proposal it has been the guiding principle of the non-proliferation regime that the economic advantages offered by the peaceful uses of atomic energy provide the stimuli to induce non-nuclear weapons States to eschew weapons programs. Many States, including South Korea and Japan, would not be able to continue their present rate of economic expansion without nuclear electricity. Other areas of the world benefit from the advances in agricultural technology made possible by the irradiation techniques for improvement of the strains of seeds and the irradiation of food to prevent deterioration.[147] This technology will allow longer storage of food and assist in alleviating famine. Should these inducements be sufficiently strong, and if the NPT, safeguards, and the IAEA are effective, there will foreseeably be a continuing limitation on the horizontal proliferation of nuclear weapons.

The conventions on nuclear liability enable the operator of a nuclear installation to have a finite financial risk from a nuclear accident. The States party to the conventions share the risk up to an upper financial limit. However, in light of the experience of the Chernobyl accident, it is evident that such limits would be exceeded. In an address to the Munich Conference in 1984,[148] Professor Herzog noted that under German law there is no barrier to the amount of compensation for claims in spite of the language embodied in the Convention. Herzog pointed out that for natural disasters such as floods, there is no obligation for the State to compensate victims. However, it usually does so without limiting the amount available for compensation. While strictly outside the scope of this Article, it is interesting to note that the U.S. Price-Anderson Act,[149] which covers nuclear insurance, requires contractor indemnity of seven billion dollars indexed every five years for inflation.

The question concerning priority of claims would arise in the event the value of claims exceeds the various limits. Would, for instance, the costs of emergency measures taken to prevent or minimize the consequence of a nuclear accident be included? The question of the liability in connection with decommissioning

146. *See, e.g.*, WALKER & LONNROTH, NUCLEAR POWER STRUGGLES (1983).

147. See generally the discussion of the growing array of peaceful uses of nuclear energy outlined in 1989 Y.B. INT'L ATOMIC ENERGY AGENCY.

148. International Conference on Civil Liability for Nuclear Damage (OECD-NEA 1985).

149. 42 U.S.C. § 2012 (1988).

and the final disposal of waste is not clearly stated in the conventions and needs further study. The problem of proving causation inherent in claims for injuries from occupational radiation exposure caused by the inadvertent or planned escape of radioactive material (not by an explosion but by leakage deliberate or accidental) is still to be resolved.

The concept of absolute and exclusive liability for damage caused by a nuclear incident was initiated by international agreement. The concept of keeping risk as low as reasonably achievable ("ALARA") has been fostered by the international bodies set up to promote and regulate the use of nuclear energy. For example, in English law these two concepts have come together against the background of health and safety legislation in the Nuclear Installations Act of 1985 and the conditions attached to a licenses granted under that Act. The use of ALARA has been challenged in the courts,[150] and while the courts have not rejected the use of the concept in licensing, they do not fully support its use in all respects under the Act.

In the United Kingdom, the operator of a nuclear installation is liable for damages up to the limit of twenty million pounds set by the Nuclear Installations Act of 1986. The owner of an industrial facility using radioactive materials is not strictly liable and liability could only be established by action in the court. The damages in a case similar to the one involving the release of a radioactive isotope from a scrapped radiotherapy machine in Brazil in 1987 would amount to many tens of millions of dollars.[151] Uncertainties exist, however, where the damages arise from government action and not from the radiation itself, for example, the restriction of the slaughter of sheep for consumption to prevent the spread of radiation following the Chernobyl accident. Within the United Kingdom, such damages have been compensated by the government. However, a foreign government may also dispute liability, as seen in the Chernobyl incident, where the U.S.S.R. refused compensation to the United Kingdom.

Court decisions in the United States have failed to establish a rational basis for determining eligibility for compensation in such cases which have inherent deferred radiation damages. Already in the U.S. the courts are extending the liability regime beyond that covered in the Convention. In *Silkwood v. Kerr-McGee Corp.*,[152] the United States Supreme Court approved a state court award of punitive damages in a radiation industry case. Today, personal injury claims are typically brought by nuclear installation workers both in the U.K. and the U.S. These claims have so far usually been settled out of court even though the

150. R. v. British Nuclear Fules plc. (June 1985) Crown Court Carlisle, U.K. (unpublished). In this case BNF was fined for releasing liquid radioactive waste into the Irish Sea. The waste had a radioactivity level lower than that authorized by a license under the Radioactive Substances Act (1960), but the jury decided that this level was not "as low as reasonably achievable."

151. For an account of the widespread injuries caused by this accident involving the theft and dismantling of a piece of medical radiology equipment, see *The Radiological Accident in Goiana, Brazil, 1989*, Y.B. INT'L ATOMIC ENERGY AGENCY, Annex at D91.

152. 464 U.S. 238 (1984).

cause of damage was not admitted to result from a nuclear incident.[153]

Although the courts have begun to chip away at the firm liability limits imposed by the conventions, the limitations on liability form an important part of international nuclear energy policy. Clearly, these conventions will continue to act as a spur to the installation of new nuclear facilities in each of the States party to the conventions. The promotion of the value of peaceful uses of nuclear energy forms an essential part of the "bargain" underpinning the entire global non-proliferation regime. It is hoped that the fear of very stringent limitations on future nuclear trade which would undoubtedly follow a conclusive showing of widespread horizontal proliferation will act as a strong disincentive to the States on the brink of acquiring nuclear weapons.

CONCLUSION

The development of weapons and the generation of electricity using nuclear energy has been carried out with full knowledge of the potential harm which may be caused by uncontrolled use. This development has been fostered by the political process. Nuclear materials and the technology have been used for the generation of electricity as an alternative to coal and oil. From a broad perspective, the complex system of international, national, and industry-wide controls has operated to encourage the growth of the nuclear energy industry through the minimization of certain types of politically unacceptable risk. The risk of diversion of material and technology to weapons manufacture is minimized by the arrangement under the NPT which facilitates effective inspection of nuclear installations as part of IAEA safeguards agreements. Similar arrangements are in place to prevent the diversion of nuclear materials to terrorist activity and to States not party to the NPT. While these treaties have not prevented the spread of the manufacture of nuclear weapons entirely, proponents of the modern non-proliferation regime can point to several impressive achievements. For example, the treaties concerning the testing of nuclear weapons have been effective in limiting the amount of radioactive contamination in the atmosphere. In subscribing to the arrangements under treaties, States have accepted obligations to the international community for the control and inspection of material stocks and nuclear reactor inspections.

Concerns for international security and protection of the environment have tempered the explicit and implicit encouragement given to the nuclear industry by national and international legislation and agreements. The question of the impact of nuclear programs on the environment is implicit in the regulation of radioactive material. The question of the final disposal of radioactive waste has yet to be resolved. It poses questions of liability stretching many generations into the future. Dumping at sea, even though legally permitted for low level

153. For a more extensive discussion of problems of causation in radiation injury claims, see Riley, *Radiation as the Cause of Personal Injury in Compensation Claims*, 18 ANGLO-AM. L. REV. 75 (1989).

waste, has been suspended because of adverse public opinion. The search for additional surface sites for the burial of low level radioactive waste has similarly been suspended because of adverse public opinion.

This analysis has shown that while there are limited international arrangements to prevent the spread of nuclear installation, and while governments have legal obligations to protect the public in the event of a nuclear incident, such arrangements are far from complete. In the international arena, the efficacy and political implications of the non-proliferation regime will come under close scrutiny as the NPT nears possible expiration in 1995. Even barring the unlikely collapse of the NPT, the new focus of nuclear power expansion in the non-OECD States will present challenges to the IAEA safeguards bureaucracy as these non-OECD States begin to emerge as a new second-tier of nuclear suppliers not subject to the self-regulation of the London Supplier's Group. It is likely that the continued globalization of nuclear power will result in new controls and organizations at both the worldwide and regional levels as the world attempts to cope in a new nuclear context.