Law and the H-Bomb: Strengthening the Nonproliferation Regime to Impede Advanced Proliferation

Richard L. Williamson Jr.

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Richard L. Williamson, Jr. *

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* Professor of Law, University of Miami. J.D., Harvard Law School, 1984; M.A., The American University, 1977; A.B., University of Southern California, 1967. This article deals with the law and policy of nuclear nonproliferation. In that regard, the author formerly was Chief of the International Nuclear Affairs Division of the U.S. Arms Control and Disarmament Agency (ACDA) and for six years dealt personally with a number of the issues and incidents discussed in this article. The author has had no access to classified information for over twelve years, and to the best of his knowledge, this article contains none. The author would like to thank the many individuals in the federal government who provided information under assurances of anonymity. He would also like to express his special appreciation to Thomas W. Graham of the Rockefeller Foundation and his colleague, Bernard H. Oxman, for their invaluable suggestions, and to his research assistants on this project, Jennifer Jones, Olga Kazakevitch, and Irit Tamir.

Suppose that in 1996, a virulently anti-Western, antisecular, anti-Christian, anti-Jewish Islamic extremist group takes over Saudi Arabia, Yemen, the United Arab Emirates, Oman, Qatar, and Bahrain in rapid succession. It fuses them into a new federation following elections which are reasonably fair, albeit carried out in an atmosphere of fundamentalist religious fervor. The new state successfully avoids the excesses of many recent revolutions—taking no foreign hostages, violating the immunity of no embassies, and seizing no neighboring territory. In short, it takes no steps which would give the other regional powers, the West, or the world community
at large any handy pretext, let alone justification under international law, to intervene. Then, applying its enormous wealth to the acquisition of advanced military capabilities, it strives to become a major regional military power.

Now consider two different scenarios. In the first, the lessons of Iraq’s nearly successful efforts to acquire nuclear weapons are forgotten, and efforts to improve the control of weapons of mass destruction languish. The new federation has only modest difficulty obtaining materials, parts, and expertise relevant to the indigenous construction of nuclear weapons and is able to purchase long range delivery systems. By 2015, the federation has 500 nuclear weapons of a proven, tested design, each powerful enough to destroy a large city. It can deliver these weapons on regional targets or at intercontinental range with purchased state-of-the-art bombers and nuclear submarines, both carrying indigenously produced but adequate cruise missiles.

In the second case, the world’s nations continue to build on the Nuclear Nonproliferation Treaty (NPT) and to supplement it with bold, new, and legally binding instruments constraining nuclear weapons and delivery systems. As a result, despite its enormous resources, by 2015 the

1. This is a hypothetical, not a prediction; as should be clear from the recent civil war in Yemen, the bigger challenge in the Arabian peninsula is keeping countries from falling apart, not creating new federations. In putting forward this hypothetical, no implication is intended that behavior threatening to the international community is the exclusive province of the Gulf region or of Islamic fundamentalists. Indeed, the most serious current concern is with North Korea, which is seeking nuclear weapons and which has shown itself both willing and capable of carrying out extraordinarily bizarre and dangerous acts. See infra note 38.


3. As this Article is being written, Saudi Arabia, Qatar, Bahrain, and Yemen are currently NPT parties; Oman and the United Arab Emirates are not. That raises the question of whether, under prevailing state succession doctrine, such a federation would have the option of succeeding to the NPT party status of its former members or the nonparty status of the others. The current state of international law on succession to treaty rights has been properly described as “murky.” Stefan A. Riesenfeld & Frederick M. Abbott, A U.N. Dilemma: Who Gets the Soviet Seat on the Security Council, CHRISTIAN SCI. MONTR., Oct. 4, 1991, at 19. In U.S. practice, a state succeeds to the treaty obligations and rights of the predecessor state only if it accepts those agreements and the other party or parties agree or otherwise acquiesce in the acceptance. See, e.g., In re Extradition of Tuttle, 966 F.2d 1316 (9th Cir. 1992) (quoting RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 210(3) (1987)). For a more sophisticated view than that of the Restatement, see George Bunn & John B. Rhinelander, The Arms Control Obligations of the Former Soviet Union, 33 VA. J. INT’L. L. 323 (1993). In any case, most discussion concerning the doctrine in recent years has dealt with the break-up of the Soviet Union and Yugoslavia, and not with the fusion of states into a new federation. In this hypothetical, the new federation would not accept obligations of the NPT. Of course, assuming that decision is the new federation’s legal right, it could still have political ramifications and bring into question the willingness of the United States and the European Union to recognize the new entity. The EU has made “[a]cceptance of all relevant commitments with regard to disarmament and nuclear non-proliferation as well as to security and regional stability” one of the requirements for recognition. Declaration on Yugoslavia and on the Guidelines on the Recognition of New States, 91 I.L.M. 1485 (1992).
 federation is only able to acquire five heavy low-yield devices, deliverable by jerry-rigged transport aircraft.

Here is the question: is there any difference between the two scenarios from the perspectives of United States, regional, and global security? For the prospects for arms control? In terms of its impact on the prospects for a more peaceful international legal order? Even posing these questions answers them, for it would be hard to argue that the two circumstances are equally dangerous. Yet to date, the international community has crafted its nuclear nonproliferation policies almost exclusively in support of the wholly admirable goal of preventing countries from acquiring any nuclear explosives.¹ Except in the area of ballistic missile controls, little of a concrete nature has been undertaken with the specific goal of keeping nuclear threshold states from advancing to militarily more significant capabilities. Indeed, at a time when nonproliferation efforts have had an unusually large number of successes, current interest seems aimed more at “coping” with or “countering” further proliferation than trying to prevent it.⁵ Yet these approaches are unnecessarily defeatist because cop-

¹. There is vast literature on the general topic of nuclear nonproliferation. Hundreds of books and thousands of articles have been written on the subject in the past three decades, certainly far too many to survey here. For example, the Programme for Promoting Nuclear Non-Proliferation (PPNN), in the most recent edition of Newsbrief, lists 10 books and over 160 articles, reports, and other materials that have come out in just its fourth quarter review. Recent Publications, Newsbrief (PPNN, New York, N.Y.), Fourth Quarter 1994, at 21-25. Two noteworthy books on the general subject of non-proliferation are LOUIS DUNN, CONTROLLING THE BOMB (1982) and BENJAMIN N. SCHIFF, INTERNATIONAL NUCLEAR TECHNOLOGY TRANSFER (1983). The best works on the status of nuclear weapons efforts and programs which may be relevant to nuclear weapons in particular countries are by Leonard S. Spector. These include NUCLEAR PROLIFERATION TODAY (1984); THE NEW NUCLEAR NATIONS (1985); GOING NUCLEAR (1987); THE UNDECLARED BOMB (1988); and LEONARD S. SPECTOR & JACQUELINE R. SMITH, NUCLEAR AMBITIONS (1990). See also NUCLEAR PROLIFERATION IN SOUTH ASIA (Stephen P. Cohen ed., 1991). Important earlier works on the subject include ARNOLD KRAMISH, THE PEACEFUL ATOM IN FOREIGN POLICY (1969); A WORLD OF NUCLEAR POWERS? (Alastair Buchan ed., 1966); MASON WILLICH, NON-PROLIFERATION TREATY: FRAMEWORK FOR NUCLEAR ARMS CONTROL (1969); and ALBERT WOHLSTETTER ET AL., SWORDS FROM PLOW-SHARES: THE MILITARY POTENTIAL OF CIVILIAN NUCLEAR ENERGY (1979). Keeping up with nonproliferation developments can be challenging. Fortunately, there are two very helpful compilations, PPNN’s Newsbrief, supra, put out quarterly, and Proliferation Watch (U.S. Senate Committee on Governmental Affairs, Washington, D.C.), published five times yearly.

⁵. Four categories of counter-proliferation measures have been suggested:

(1) Political accommodation, whereby the international system would reconcile itself to the new nuclear powers and make adjustments to meet the changed regional security situation. See, e.g., Shai Feldman, Managing Nuclear Proliferation, in LIMITING NUCLEAR PROLIFERATION 301 (Jed C. Snyder & Samuel F. Wells, Jr. eds., 1985).

(2) Cooperation with the new nuclear states to make their forces more secure and safe. This sounds innocuous, but it can be very dangerous. See infra note 229.

(3) Construction of defensive systems to protect against ballistic missiles. If such anti-ballistic missile defense (ABM) systems could be successful, they would tend to reduce the incentives for the development of nuclear forces in some threshold states, as they would have to assume that many of their nuclear weapons might be destroyed before reaching their targets. Three major problems arise when attempting to cope with advanced proliferation through the development and deployment of ABM systems. The first is cost. If the issue is global security, then designing, testing, and deploying
ing with large and sophisticated nuclear forces, which are deliverable at intercontinental distances, will be far more difficult than coping with small crude ones, which pose threats only to their nation’s immediate neighbors.

This nearly exclusive focus on preventing the acquisition of a first nuclear device is based, in part, on the common-sense proposition that if countries never acquire nuclear explosive devices, they will never acquire anything more significant. Sadly, we cannot be certain that a nation of actual or potential concern will never cross the initial threshold or put itself into a position to do so on very short notice. Indeed, at least three countries—Israel, India, and Pakistan—are already in that posture, and a fourth—South Africa—was, but it recently stepped back and adhered to the NPT. Several more states seem to be positioning themselves to “go nuclear” within the next decade.6

We need a better strategy, an integrated one which will make it far harder, more time consuming, and extremely expensive for the current and future nuclear threshold countries to acquire more significant

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enough anti-ballistic missiles to eliminate entirely the actual and potential ballistic missile threats faced by every country cannot be accomplished for less than hundreds of billions, and more likely trillions, of dollars. It is hard to imagine where resources of this magnitude would come from. Second, it is still unclear whether such anti-ballistic missile systems will work sufficiently well to provide real security. Declining Pentagon estimates of the success rate of Patriot missiles in the Gulf War are, at a minimum, grounds for adopting a wait-and-see attitude toward the efficacy of ground based missile systems intended to destroy intermediate range ballistic missiles (IRBMs) and intercontinental ballistic missiles (ICBMs). General H. Norman Schwartzkopf was quoted two weeks into the war as stating that “the Patriot’s success, of course, is known to everyone; it’s 100 percent so far.” Barton Gellman, New Study Cuts Patriot Missile Success Rate to 9 Percent, Wash. Post, Sept. 9, 1992, at A4. Later, the Pentagon revised its estimates of success downward four times, judging that over 70% of Patriot engagements against the Scud were successful in Saudi Arabia and over 40% were successful in Israel. John A. Farrell, Pentagon Reduces Its Success Rate for Patriot in War, Boston Globe, Apr. 8, 1992, at 1. A General Accounting Office report, challenged by the Pentagon, said it could confirm a kill rate of only 9%. Gellman, supra. Third, even if such systems could be made highly successful, they will literally do nothing to protect against other types of delivery methods such as naval systems, bombers, and/or cruise missiles.

(4) Enhanced military preparation to be able to deter or to attack the new nuclear states. Some in the U.S. nuclear weapons establishment want to develop a whole new class of low yield nuclear weapons (equivalent to roughly 1000 tons of TNT) to attack targets in nascent proliferating countries. It is hard to imagine anything which would provide a country already possessing some nuclear weapons capabilities with a stronger incentive for advanced proliferation than the need to have enough weapons, with enough explosive power, to deter the United States from such attacks.

6. Iraq was seeking nuclear weapons and has not given up its interest in obtaining them, though its capabilities were significantly set back by allied bombing in the Gulf War and by U.N. teams dismantling some of its facilities after the war. See infra note 40. Some experts believe North Korea may already have two nuclear weapons. Other nations which have been mentioned as having possible nuclear weapons ambitions include Libya, Iran, Syria, Taiwan, Algeria, South Korea, and Cuba. The evidence of an intent to obtain nuclear weapons is far stronger for some of these countries than for others. The degree to which they already possess nuclear materials, equipment, and technology also varies greatly. Argentina and Brazil, two countries on everyone’s list of potential proliferators until quite recently, have largely resolved concerns as to their nuclear programs and intentions. See infra note 48.
nuclear weapons capabilities and which will instead provide them with a politically attractive and legally binding means to keep their existing capabilities limited, at least pending developments in regional security which might induce them to abandon their nuclear weapons capabilities.

This article examines this "advanced proliferation" problem and the tools available to the international order to minimize it. In addition to its intrinsic importance, the problem has important implications for our understanding of how international law works in the area of international security. This article demonstrates the power of complex international regimes to transform aspects of international society, but it also argues that further progress in this field will almost certainly require a greater resort to standards which are binding under international law, i.e., treaties and collective action through international organizations.

Part I provides the background on the advanced proliferation problem. It includes definitions, a brief overview of the science and technology of nuclear weapons, reasons why we should be concerned with advanced proliferation, the kinds of weaponry advances with which we should be concerned, and the status of advanced nuclear weaponry efforts in the threshold countries. Part II discusses the legality of further nuclear weapons proliferation under international law. It explains the existing nuclear nonproliferation regime and its relationship to international law. It also provides illustrations of the vitality of that regime. Part III explores measures which can be taken by the international community to restrain advanced proliferation, including new constraints on advanced nuclear weapons development, new initiatives to restrain delivery systems, and additional arms control measures to freeze the threshold states' current nuclear weapons capabilities in place, thereby temporarily allowing them

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7. Many of the issue areas discussed in this article not only have international law implications but are also subject to various U.S. statutes, regulations, and, in a few cases, court opinions. These are dealt with in this article, if at all, only in passing.

8. The topic also has important implications for international relations theory. It suggests that complex regimes, such as that for nuclear nonproliferation, differ from simple international regimes in that they have a transformative quality, significantly altering the perceptions of states on the norms of international behavior and of their national interest. Such regimes subtly alter the international order, giving greater emphasis to collective interests in a world still dominated by state autarchy. In short, once set in motion and given careful tending, such complex regimes change the international landscape. For a more thorough discussion, see infra note 180. For an excellent analysis of contemporary international relations theory which discusses these and other theories in considerable detail, while it also discusses the relationship of international relations theory to developments in international law, see Anne-Marie Slaughter Burley, *International Law and International Relations Theory: A Dual Agenda*, 87 Am. J. Int'l L. 205 (1993). See also infra note 179.

9. Most measures to strengthen the nonproliferation regime in the past 15 years, and all aspects of the current constraints on the spread of ballistic missiles, rely on nonlegally binding measures. These nonbinding measures have sometimes proven to be the only practical means available to resolve some international security conflicts. They will unquestionably be an important element in dealing with the advanced proliferation problem. However, some aspects of the problem cannot be dealt with in that manner, and legally binding measures will be required. See infra part III.
to keep their bombs "in the basement" while prohibiting the growth of the size and sophistication of those arsenals.

I. Background to the Advanced Proliferation Problem

A. Definition of Advanced Proliferation

"Nuclear proliferation" was first used to mean the acquisition of nuclear weapons by nations which did not already have them, and that is still the most common usage. Over time, however, additional jargon developed in the field. That kind of nuclear proliferation came to be called "horizontal." There is a second kind, "vertical proliferation," the proliferation of ever greater numbers and growing sophistication of nuclear weapons in the hands of the five existing nuclear weapons states.10 "Advanced proliferation" could be defined conceptually as the process of subsequent vertical nuclear proliferation by states which have recently achieved horizontal proliferation.

A more functional definition of advanced proliferation is the development of a militarily significant nuclear force (i.e., beyond a first nuclear device) by one or more of the nuclear threshold states. Gains in military power could take several forms, perhaps occurring simultaneously, including growth in the number of weapons, increases in their yield, and improvements in their deliverability.11

B. The Science and Technology of Nuclear Weapons

This is not the place to provide a full explanation of the science and technology relevant to the acquisition of nuclear weapons. However, since the problem has a substantial technical component, a brief overview may be helpful to some readers.12

All peaceful and military uses of nuclear energy derive from an unusual property of one isotope of uranium, namely U235. When such an atom is hit by a neutron, it destabilizes and breaks apart into two fragments, releasing energy and one or more additional neutrons. Under proper conditions, this phenomenon can be used to create a chain reaction in which neutrons released by the fissioning of one U235 atom are captured by other U235 atoms. If this chain reaction is controlled in a

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10. Article IX(3) of the NPT, supra note 2, defines as "nuclear weapons states" those states that have manufactured and exploded a nuclear device prior to January 1, 1967, i.e., the United States, the Soviet Union (Russia), the United Kingdom, France, and China. They remain the only states which have declared themselves to possess nuclear weapons. They are also the five permanent members of the U.N. Security Council.

11. These and other constituent elements of advanced proliferation are explored in detail in part I.D, infra.

12. Those with knowledge of the relevant technical background may wish to skip this section. It is a highly condensed explanation which, given the need for brevity, leaves many key facts not fully explained. Readers interested in obtaining additional information on various technical aspects of the nuclear proliferation problem should consult THE NUTS AND BOLTS OF NUCLEAR PROLIFERATION: A GUIDEBOOK (David H. Albright, Center for War, Peace, and the News Media ed., 1991).
Nuclear reactor\textsuperscript{13} so that the number of U\textsubscript{235} atoms which undergo fission remains constant, a useful source of energy results. On the other hand, if conditions are such that the chain reaction grows exponentially, a powerful explosion can occur.

However, U\textsubscript{235} is found in nature mixed with the far more common U\textsubscript{238} isotope.\textsuperscript{14} It is possible to create a controlled chain reaction using natural uranium\textsuperscript{15} and a moderator\textsuperscript{16} of either nuclear-grade graphite\textsuperscript{17} or heavy water.\textsuperscript{18} On the other hand, natural uranium does not have a sufficient density of U\textsubscript{235} atoms to create a chain reaction of the uncontrolled sort necessary for either nuclear weapons or to fuel the more common type of reactors, which use ordinary light water as both the moderator and coolant. To do either, it is necessary to "enrich" the U\textsubscript{235} fraction by increasing its concentration relative to the more common U\textsubscript{238}. If the enrichment process continues until the U\textsubscript{235} fraction is greatly increased, typically to ninety percent or more, the resulting highly enriched uranium (HEU) can then be used to create a nuclear

\begin{itemize}
\item Nuclear power reactors produce electricity. Naval reactors propel submarines and surface naval vessels. Research reactors are used to generate isotopes used in industry, agriculture, and medicine and to carry out various kinds of scientific research.
\item About 0.7\% of all uranium found in nature is U\textsubscript{235}.
\item Natural uranium fuel has the same ratio of U\textsubscript{238} to U\textsubscript{235} as uranium ore. However, it does not have the same chemical composition or physical form. The uranium must be mined, refined, fashioned into ceramic pellets in the form of uranium dioxide (UO\textsubscript{2}), and placed in tubes usually made of specially prepared zirconium alloys.
\item A typical nuclear reactor needs a moderator (graphite, heavy water, or ordinary "light" water) to decrease the velocity of the neutrons, thereby increasing the probability that they will strike and fission a U\textsubscript{235} atom. A coolant (which can be either a liquid like heavy or light water or a gas such as helium) is also necessary in order to maintain the reactor temperature and, in power generation reactors, to produce steam. Finally, control rods are needed to absorb excess neutrons, thereby preventing the nuclear chain reaction from accelerating out of control.
\item Nuclear grade graphite is made by special processes which remove trace impurities that "poison" the nuclear chain reaction. Large graphite moderated reactors have been operated in the United States, the United Kingdom, France, China, and the former Soviet Union. The reactor which caught fire at Chernobyl was a graphite moderated reactor; it was the graphite which provided most of the fuel for the fire. There is currently little interest in graphite reactors for commercial power generation. On the other hand, there is increasing concern that small graphite moderated reactors will be used for nuclear proliferation purposes. North Korea has such a reactor. See infra note 38. Until recently, the Brazilian military had plans to acquire several. See infra note 48.
\item Heavy water (D\textsubscript{2}O) appears identical to ordinary water, but instead of hydrogen atoms with a nucleus of only one proton, the molecule contains the heavier deuterium isotope, which has one proton and one neutron. Deuterium exists in nature but only as a very small percentage of all hydrogen. It can be concentrated by any of several means, but commercial-scale production of heavy water has proven a difficult and expensive technology. Nuclear power plants utilizing natural uranium and heavy water are currently operational only in Canada, India, Argentina, and Pakistan. Countries of proliferation concern would probably face difficulties obtaining heavy water which is not subject to the safeguards (inspection) system of the International Atomic Energy Agency (IAEA). Heavy water moderated research reactors with a capacity to produce enough plutonium for at least one simple nuclear weapon per year are currently operating in Canada, India, Taiwan, and Israel.
\end{itemize}
explosion.\textsuperscript{19}

Since U\textsubscript{235} and U\textsubscript{238} are isotopes of the same element, they are virtually identical and thus their separation is not possible by normal chemical means. Instead, various enrichment technologies have been developed to separate U\textsubscript{235} from U\textsubscript{238} utilizing small differences in the mass or other properties of the two isotopes. The most common approach to the large-scale enrichment of uranium is called gaseous diffusion.\textsuperscript{20} Concern about proliferation from the enrichment route has increased considerably in the past quarter century\textsuperscript{21} because of the development of another enrichment technology called centrifuge enrichment or ultracentrifugation.\textsuperscript{22} This is the process Pakistan used to obtain the nuclear materials for its weapons.\textsuperscript{23} Other enrichment techniques are possible and have been implicated in actual or potential nuclear proliferation problems, including calutrons,\textsuperscript{24} nozzle processes,\textsuperscript{25} and laser isotope separation processes.\textsuperscript{26}

\textsuperscript{19} There is no international consensus on terminology, and it is therefore impossible to say at exactly what point enriched uranium qualifies as "highly enriched" or "HEU." \textit{But see infra note} 30.

\textsuperscript{20} Gaseous diffusion facilities send uranium hexafluoride (UF\textsubscript{6}) gas through a long series of specially constructed membranes through which the slightly smaller U\textsubscript{235} atom diffuses more readily than the U\textsubscript{238}. Facilities for commercial separation of U\textsubscript{235} by this method are enormous, requiring very large and highly specialized equipment and consuming extraordinary amounts of electrical energy. Commercial gaseous diffusion facilities exist only in the United States, France, and the former Soviet Union. Unfortunately, facilities too small to compete in supplying enrichment services internationally can still be large enough to produce enriched uranium for many nuclear weapons. Gaseous diffusion plants of various sizes have been built in the United Kingdom, China, and Argentina, either for nuclear weapons, as pilot plants for possible future commercial-scale enrichment, or for both.


\textsuperscript{22} Centrifuges spin at extraordinary speed, using slight differences in weight to separate the U\textsubscript{235} from the heavier U\textsubscript{238} isotope. The development, construction, and operation of large-scale facilities for centrifuge enrichment require the mastery of several different sophisticated technologies. The construction of the centrifuges themselves requires precision machining and exotic materials. Moreover, operating many centrifuges together in a successful "cascade" also requires considerable expertise, specialized electronics, and vacuum technology. Centrifuges have been developed commercially by URENCO, a consortium of British, Dutch, and German firms, which is the only entity currently offering commercial enrichment services using centrifuges. Centrifuge programs in states of actual or potential proliferation concern are or were known to exist in, among others, Pakistan, India, Brazil, and Iraq.

\textsuperscript{23} The Pakistani government was able to circumvent much of the centrifuge development process because one of its nationals, A.Q. Kahn, who worked at a URENCO supplier in the Netherlands, stole the plans for the centrifuges. \textit{See, e.g.}, Rod Nordland, \textit{The Bombs in the Basement}, Newsweek, July 11, 1988, at 42. At first, Pakistani agents were able to obtain the needed parts, materials, and expertise from Western companies, many of which were unaware of the uses to which their equipment or technology would be put. Subsequent diplomatic initiatives and improved export controls in Western countries greatly slowed, but did not halt, the Pakistani effort.

\textsuperscript{24} A calutron is a device for separating isotopes by electromagnetic means. It was the first approach used by the United States during World War II, but it was abandoned in favor of gaseous diffusion. In the past three decades, however, aspects of the technology have become easier to master. Iraq based its enrichment program in good part
There is an alternate route to nuclear weapons that does not require the enrichment of uranium. In a nuclear reactor, some of the neutrons released from the fissioning of U235 do not go into a continuation of the chain reaction but are instead captured by the U238 in the nuclear fuel. When this happens, the U238 undergoes two internal changes and becomes a new man-made element, plutonium, specifically Pu239. Plutonium, like U235, can be used either as a nuclear fuel or as the material for a nuclear explosive. In order to remove the plutonium from the uranium, no isotopic separation is necessary; because the plutonium and uranium are different elements, chemical separation techniques performed in a reprocessing plant will suffice. Thus, to acquire weapons by the plutonium route, a country must have both a nuclear reactor (preferably one which can run on natural uranium) and a reprocessing plant.

25. West Germany developed, but never deployed, an enrichment technology called the Becker nozzle process (named after its inventor Erwin Becker) which uses large compressors to accelerate uranium hexafluoride gas through a slit over a curved surface (sometimes called a fixed wall centrifuge). *Jet Nozzling*, *ECONOMIST*, Oct. 11, 1975, at 57. It later sold this technology—under IAEA safeguards and strict controls for replication of the technology—to Brazil in a controversial deal. Richard House, *Bomb Potential Denied; Brazil's Nuclear Dream Falters*, *WASH. POST*, Feb. 12, 1983, at A8. The South Africans have also developed and deployed a nozzle process, which they call the "helicon" process. They claim their technology is indigenous, although they apparently received some assistance from individuals and firms in Germany without the active support of the German government.

26. Technologies for uranium enrichment using laser separation are under development in several countries, most notably the United States, but also in France, South Africa, India, and Israel. In theory, laser isotope separation techniques could make the proliferation problem much worse because they are so efficient that a laser isotope separation facility, sufficient for producing a few nuclear weapons per year, would be small and difficult to detect. Developing such a technology would be such a major scientific undertaking for any country that wholly indigenous development of laser isotope separation, for the vast majority of countries, would not be a wise strategy for acquiring nuclear weapons materials. However, once developed by the more advanced countries, information about any technology eventually leaks out and can be copied by others with far less effort.

27. Reprocessing on a large scale, while easier than enrichment, is not without difficulty. The "fission products," the fragments resulting from the splitting of the U235 or Pu239 atoms, are intensely radioactive. Therefore, specially shielded chemical facilities are needed in order to separate the plutonium from the uranium and nuclear waste.

28. Natural uranium reactors are preferable to would-be proliferators because natural uranium, while scarce, is far easier to obtain than enriched uranium without encountering IAEA safeguards obligations and other controls. Commercially viable power reactors using heavy water are a technological marvel currently available only from Canada and Germany. The constraints on the construction of much smaller heavy water or graphite moderated research reactors are far less severe. Plutonium for
To cause a nuclear explosion, it is necessary to have enough weapons usable nuclear material,\(^3\) called a "critical mass."\(^3\) Under the right conditions, an amount of HEU or plutonium which is subcritical in one configuration can be brought together in an alternate configuration that has more than a critical mass. With HEU devices, sufficiently rapid assembly of a critical mass can be achieved by relatively simple means, as was done with the bomb dropped on Hiroshima.\(^3\) With plutonium devices, high explosives are used to create an implosion which rapidly squeezes a sphere of plutonium into a much smaller supercritical shape.\(^3\)

Weapons can also be extracted from a reactor which utilizes enriched uranium. Doing so, however, would have a serious cost associated with it. All actual and potential suppliers of enriched uranium on a commercial scale are NPT parties and are thus obliged to require IAEA safeguards as a condition of supply. Under NPT article III(2), supra note 2, each state party agrees not to provide, \textit{inter alia}, enriched uranium to any non-nuclear weapons state unless it will be subject to IAEA safeguards. Accordingly, if a non-nuclear weapons state were to violate or abrogate safeguards on spent fuel containing plutonium and use it for weapons purposes, the IAEA Director General could no longer certify that safeguards would be applied to that country. Therefore, no NPT party could legally supply that country with enriched uranium fuel. In time, the violating state's power reactors would have to shut down.

29. Countries of proliferation concern known to have nuclear reactors which are not under international safeguards (or whose safeguards status is in doubt) but which are capable of generating at least one nuclear weapon's worth of plutonium per year and which also have a reprocessing plant of appropriate size to separate the plutonium, include India, Israel, and North Korea. Many other countries have appropriately-sized reactors under IAEA safeguards and small shielded facilities where limited reprocessing might be carried out.

30. An enormous amount of nonsense can be found in the press about which kinds of nuclear materials are "weapons-grade." In brief, with two minor exceptions not relevant here, all plutonium in sufficient quantity is weapons usable. Indeed, both France and the United States have tested nuclear explosive devices which used so-called reactor-grade plutonium. However, not all plutonium is weapons-optimal. The best "low burn-up" plutonium has a very low fraction of the isotope U234 in it. In contrast, not all uranium is weapons usable. It is infeasible to make deliverable nuclear devices if the U235 percentage is below 20%. Enriched uranium above 20% is weapons usable, but not optimal, until the enrichment level reaches at least 90%. For countries already possessing enrichment technology, raising the enrichment from 20% to 90% poses few obstacles. For less advanced countries and terrorist groups, the need for further enrichment poses an insurmountable barrier.

31. The amount of material required to make a critical mass depends on its isotopic composition, chemical form, density, shape, and various other factors. For planning purposes, the IAEA assumes a critical mass is 25 kg. (about 55 lbs.) of HEU or 8 kg. (about 17.6 lbs.) of plutonium. However, smaller amounts can be used. See infra part I.D.3.

32. During World War II, the United States was severely limited in the amount of nuclear material available to it. It was confident that the "gun-type" device it had assembled using HEU would detonate. Testing the device would have used up precious material. While the "gun-type" nuclear weapons design is reliable and obviates the need for nuclear explosive testing, it does have limitations. It cannot be used with plutonium as the explosive material. It is wasteful in the amount of nuclear material used when compared with implosion designs. It is very heavy, and thus it cannot be used with certain delivery systems. Of states of proliferation concern, it is believed that only South Africa chose to limit itself to this weapons design. See infra note 211.

33. Prior to the implosion, the plutonium is subcritical in the configuration in which it is placed in the bomb. The squeezing of the plutonium into a smaller shape makes the same amount of plutonium become supercritical. Implosion approaches are
Important differences exist between nascent proliferation and advanced proliferation in terms of the areas which pose difficulties. For a beginning program, the vast majority of the difficulty comes from developing and constructing facilities for the production of HEU or separated plutonium. In advanced proliferation, the absolute demand for special nuclear material increases considerably, but the relative importance of obtaining those materials decreases. Instead, weapons design and access to more advanced delivery systems take on a comparatively greater importance.

C. Reasons for Concern with Advanced Proliferation

The nonproliferation agenda is crowded. The situation in North Korea continues to be dangerous. The fact that Iraq could covertly acquire

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desirable for HEU and plutonium because less nuclear material is needed. They are essential with plutonium because any nuclear reaction creates tremendous heat and pressure which will naturally cause the plutonium to fly apart into a noncritical mass. With plutonium there is a greatly increased probability that the device will pre-ignite, flying apart before enough of the chain reaction has taken place to cause the intended nuclear yield.

34. True quantification of that difficulty is not possible because much depends on the technology selected to produce the nuclear materials, the device design, the degree of outside assistance the country can obtain, and whether the country is constructing the facilities overtly or going through the more difficult and expensive approach of attempting to hide reactors, enrichment plants, and weapons-oriented facilities. These factors will vary considerably from country to country. Nevertheless, one can say that roughly 75% to 95% of the total effort will be aimed at obtaining nuclear materials, with the rest devoted to designing and manufacturing the explosive devices themselves.

35. "Special nuclear material" is the U.S. term for enriched uranium, plutonium, or U235, which, in nonproliferation jargon, contrasts with source material, which is natural uranium, thorium, and depleted uranium (in the enrichment process, the level of U235 drops from its normal 0.7% to a lower level, commonly 0.2% to 0.3% in the residual uranium). Confusingly, the IAEA uses "special fissionable material" to mean the same thing as the U.S. term special nuclear material.

36. See infra part I.D.1.

37. Information on the materials and technologies relevant to more advanced nuclear weapons designs are described throughout this article, especially in part I.D.2-4, part III.A2-3, and part III.C.2, infra.

38. The situation in North Korea is not yet fully settled. On October 21, 1994, the United States and North Korea (DPRK) entered into an agreement in which the United States undertook to supply North Korea with two light water reactors and heavy oil to meet energy needs until the reactors are built. North Korea would freeze its existing nuclear program, meaning that work would halt on its 50 MW and 200 MW reactors, and they would eventually be dismantled. The 5 MW reactor would cease to operate, and its fuel would be disposed of without reprocessing in North Korea (meaning in practice that it would have to be removed from the country). North Korea would remain in the NPT and comply with its safeguards agreement, but until the new reactors were substantially completed, the DPRK would not be required to let the IAEA carry out a supplemental inspection of two suspected sites (euphemistically called "all steps that may be deemed necessary by the IAEA . . . [to verify] the accuracy and completeness of the DPRK's initial report on all nuclear material to the DPRK"). Both countries would work to normalize relations. For a more thorough discussion, see Editorial Note, Newsbriefs, (PPNN, New York, N.Y.), 4th Quarter 1993, at 1-4. (The text of the U.S.-DPRK Framework Agreement can be found in id. at 27-28.) There is ample opportunity for things to go wrong with this agreement, and thus a residual risk that the situation will lead to renewed political tension, a nuclear arms race, or worse. In any
extensive technology relevant to nuclear weapons while publicly appearing to remain in compliance with its NPT obligations and those of the associated safeguards (inspection) system of the International Atomic Energy Agency (IAEA) revealed serious weaknesses in aspects of the current nonproliferation regime. Concern remains high over the nuclear intentions of several states such as Iran, Libya, and Iraq, even if their current capabilities are modest. The demise of the Soviet Union left the status of some of its successor republics, most notably Ukraine, under the NPT and other arms control treaties uncertain. While many of those difficulties were finally resolved, full implementation of the non-nuclear weapons status of Belarus, Ukraine, and Kazakhstan is still several years away.

The event, the primary focus of this article is the countries which have the near-term potential to acquire significant nuclear forces. As that category will not include North Korea for many years, if ever, this article will deal only briefly with the North Korean situation. See infra notes 86, 222 & 226.


40. Prior to and during the Gulf War, there was considerable skepticism as to how close Iraq was to a nuclear weapons capability and how large its nuclear programs were. See, e.g., David Albright & Mark Hibbs, *Iraq and the Bomb: Were They Even Close?* BULL. ATOMIC SCI., Mar. 1991, at 16. The author was one of the skeptics. However, although it was not “months away” as President Bush had stated, it is now clear from the IAEA inspection reports that Iraq had made very considerable progress toward a nuclear weapon. See *U.N. Role in the Persian Gulf and Iraqi Compliance with U.N. Resolutions: Hearing of the Europe and Middle East Subcomm. and the Human Rights and International Organizations Subcomm. of the House Foreign Affairs Comm.*, 102d Cong., 1st Sess. 160 (1991) (testimony of Thomas R. Pickering, then-U.S. Ambassador to the United Nations), reprinted in *FED. Nws SERVICE*, Oct. 21, 1991 [hereinafter Pickering Testimony] (Iraq was “engaged in an ambitious nuclear weapons development program, which may have been within one to two years of producing a nuclear weapon at the time it was interrupted.”).

Some observers believe that the combined effect of air and cruise missile attacks during and since the war, along with the destruction of equipment by U.N. inspectors, has fully destroyed Iraq’s nuclear capabilities, at least in terms of equipment and materials, if not expertise. See, e.g., Paul Lewis, *U.N. Issue, Again: The Rein on Hussein*, N.Y. TIMES, July 14, 1993, at A6. Meanwhile, concern over the intent of the Iraqi nuclear program remains and has entered the popular culture, sometimes with strange results. See, e.g., *Psychics Wanted—But You Already Knew That*, ORLANDO SENTINEL, July 8, 1993, at 18 (Prophet in Parowan, Utah declares the United States will be in a nuclear war with Iraq by year’s end; will sell survival information kit for $6.00.).

41. In the U.S. view, and that of virtually the entire world, only one state, Russia, may legally succeed to the nuclear weapons state status of the former Soviet Union under the NPT. See Bunn & Rhinelander, supra note 3. While all tactical nuclear weapons have been relocated to Russia, some of the more powerful (and more difficult to remove) strategic nuclear weapons remain in Belarus, Ukraine, and Kazakhstan. They are under the nominal control of the Commonwealth of Independent States and apparently under the operational launch control of Russia. Belarus, which had nuclear-armed SS-25 ICBM missiles, has adhered to the NPT as a non-nuclear weapons state. Its Parliament consented to NPT adherence and ratification of START I on Feb. 4, 1993. Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms, July 31, 1991, U.S.-U.S.S.R., TREATY Doc. No. 20, 102d Cong., 1st Sess. (1991) [hereinafter START I]; *Belarus Approves First Arms-Limitation Pact*, N.Y. TIMES, Feb. 5, 1993, at A8. The SS-25s are to be sent to Russia for dismantling by the end of 1994. Arnold Biechman, *Dismal Days for Post-Soviet Belarus*, WASH. TIMES, Feb. 13, 1993, at C3. The Belarus decision is notable
Soviet breakup also raises the prospects of a frightening legacy—nuclear mercenaries—as well as the possibility that nuclear materials may begin moving to terrorists or rogue regimes through the black market.\textsuperscript{42} Extending not only because of the potentially grave consequences if it had not done so, but also because it is arguably the first nation with nuclear weapons in its possession to de-nuclearize. But see infra note 211, concerning South Africa.


\textsuperscript{42} See infra part III.A.4.

\textsuperscript{43} There have been numerous press accounts of attempted sales of plutonium or highly enriched uranium, purportedly from the former Soviet Union. \textit{See}, e.g., Bruce
sive and time-consuming preparations and consultations are already underway for the twenty-fifth anniversary review conference of the NPT, at which a decision must be made whether to extend the period of validity of the treaty indefinitely or for some fixed period. Finally, the many recent positive nonproliferation developments, including NPT adherence by South Africa, France, and China, the decision of Argentina and Brazil to place all their nuclear facilities under IAEA safeguards, the major

Frankel, New Mafia Begins Trafficking in Uranium, USA TODAY, Feb. 17, 1993, at IA; Jonathan Kaufman, Smuggling of Nuclear Material from Former USSR Rising Sharply, Boston Globe, Dec. 9, 1992, at Nat'l. 1; Steve Coll, For Sale: Nuclear Contraband; Smuggling Cases Worry Europe, Wash. Post, Nov. 29, 1992, at A1. Although some of these have been shown to be frauds, and although there have been many such scares in the past which proved to be groundless, the threat is being taken very seriously this time. See Davis Press Briefing, supra note 41. For a report by two highly regarded experts, see William C. Potter & Leonard S. Spector, Nuclear Terrorism Is Next Russian Nightmare, Houston Chronicle, Dec. 20, 1994, at A29.

44. Article X(2) of the NPT, supra note 2, requires such a review conference. A majority of the parties are needed to make the decision on indefinite extension, extension for some other period, or (though no one favors this) non-renewal of the treaty. Obviously, this is a matter of great importance, and it will interact with other developments, including not only those directly involving nonproliferation but also nuclear disarmament and cooperation in peaceful uses of atomic energy.


48. Argentina, Brazil Sign Arms Pact, Chi. Trib., Dec. 14, 1991, at 13. For years, Argentina and Brazil accepted safeguards only when suppliers of reactors, nuclear materials, or sensitive technology made them a condition of transfer. While they proclaimed their programs were intended only for peaceful purposes, both nations had significant clandestine programs to produce enriched uranium. Argentina built a secret facility at Pilcaniyeu for enriching uranium using the gaseous diffusion process. Argentina's military leaders began the facility in 1978, and its existence was disclosed in 1983. Michael R. Gordon, Argentina and Brazil Begin Nuclear Discussions, N.Y. Times, July 22, 1987, at A3. The plant has a production capacity of 20,000 separative work units (SWU) (about the size of the Y plant in South Africa which produced the HEU for its nuclear weapons), and the government planned to increase it five fold. It was designed to produce 20% enriched uranium. Richard Kessler, CNEA Officials Provide More Details About Pilcaniyeu Enrichment Plant, Nuclear Fuel, May 30, 1988, at 4. Brazil had a secret military facility, also since disclosed and now called the Aramar Experimental Center, for developing uranium enrichment by the centrifuge method at Ipero. By 1988, it had enriched uranium to 5% and planned to reach 20% that year. Rik Turner, Samay and Alfonsin Inaugurate Brazilian Enrichment Facility, NUCLEONICS Wk., Apr. 14, 1988, at 6. The Brazilian military planned to build a small plutonium production reactor. Mark Hibbs, Policy Shift to Full-Scope Safeguards Could Happen Soon, Brazil's Geldemberg, Nuclear Fuel, Oct. 29, 1990, at 6. Brazilian civilian President Collor later admitted that Brazil had a nuclear weapons program under military leadership since 1975. Id. Collor then personally closed what was said to be a nuclear test site in the Amazon built by the Air
improvement in the existing export control lists, and the decisions of all major suppliers to require full-scope safeguards will require some time to be fully incorporated into the existing nonproliferation regime. Is this

The new civilian leadership in both countries agreed to improve nuclear cooperation (as a part of a broader program of economic cooperation and integration) and to allow their respective experts to inspect each other's nuclear facilities. On July 18, 1991, Brazil and Argentina entered into a bilateral treaty at Guadalajara, Mexico, which established a joint control entity, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Material (ABACC), which requires IAEA safeguards. See IAEA: "Argentina and Brasil Sign Safeguards Agreement," EUR. ENERGY, Jan. 10, 1992, available in LEXIS, News Library, Arcnews File; "Brasil & Argentina Eschew the Bomb," LATIN AM. WILY. REP., Aug. 1, 1991, at 4, available in LEXIS, News Library, Arcnews File. The next step was to convert that agreement in principle into a binding obligation. Later, the two countries (and Chile) announced their intention to ratify the Treaty of Tlatelolco and bring it into force. See Treaty for the Prohibition of Nuclear Weapons in Latin America, Feb. 14, 1967, 694 U.N.T.S. 281 [hereinafter Treaty of Tlatelolco]; IAEA, Declaration by the Governments of Argentina, Brasil and Chile on the Entry into Force for Them of the Treaty of Tlatelolco, IAEA Doc. INFCIRC/410 (Sept. 21, 1992). In a dramatic ceremony upon the occasion of the signing of the agreement, Presidents Collor and Menem addressed a special meeting of the IAEA Board of Governors, correctly describing the agreement as an "historic" and significant contribution to nonproliferation and disarmament. IAEA: Argentina and Brasil Sign Safeguards Agreement, supra; John R. Redick, Argentina-Brazil Nuclear Non-Proliferation Initiatives, PPNN ISSUE REV., Jan. 1994, at 1. Subsequently, on Jan. 18, 1994, Argentina ratified the Treaty of Tlatelolco and, along with Chile, waived the entry into force conditions, thereby bringing the Treaty into immediate effect. OPANAL General Conference Doc. CG/E/415 Rev. (Feb. 4, 1994). Brazil deposited its waiver of conditions on May 30, 1994. Telephone Interview between Mrs. Eva Lopez of the OPANAL Secretariat, Mexico City, and Mr. Edgardo Roman, Foreign Law Librarian, University of Miami (July 1, 1994). Argentina subsequently adhered to the NPT on February 10, 1995. Statement by President Clinton on Argentina's Adherence to the Nuclear Non-Proliferation Treaty, U.S. NEWSWIRE, Feb. 13, 1995, available in LEXIS, News Library, Usnwr File. For an excellent analysis of the factors which contributed to the change from a near-nuclear arms race between Argentina and Brazil to their full integration into the nonproliferation regime, see John R. Redick et al., Nuclear Rapprochement: Argentina, Brazil and the Nonproliferation Regime, WASH. Q., Winter 1995, at 107.

Completion of the ratification and waiver into force conditions by Argentina and Brazil, and the other de-nuclearization steps they took, was a major accomplishment. Brazil and Argentina have long been competitors for influence and prestige, but they have not been serious security threats to each other and have not had a direct military conflict since the two modern states took form, i.e., since Uruguay was established and recognized. The only military conflicts in which they directly participated were ones where they were on the same side. There was accordingly no security need for nuclear weapons, but both countries' militaries nevertheless took active steps toward their acquisition. If they had chosen another course, both states would be very high on the list of states about whom there would not only be proliferation concern, but who seem likely candidates for advanced proliferation given their extensive nuclear programs and ballistic missile activities.

49. See infra notes 245-246 and accompanying text.
50. A state following a full-scope safeguards policy will sell nuclear materials and equipment only to countries that have all their nuclear materials regulated by the IAEA safeguards system. See infra note 217 and accompanying text. Such a policy goes beyond the obligations imposed on nuclear suppliers by the NPT, supra note 2, which only requires safeguards on the nuclear materials and equipment being supplied or produced from such supply. Specifically, article III(2) provides that
the time to raise a new concern? If threshold countries get the bomb, isn’t the harm to international security interests already done?

To understand why we should be very concerned about advanced proliferation and why the international legal order needs to move decisively to deal with it, it is useful to recall the major reasons why any further nuclear weapons proliferation would be disadvantageous.

1. Increased Risk of Widespread Casualties

The acquisition of nuclear weapons by additional states could increase the risk that nuclear weapons might actually be used again. The potential for armed conflict in the Middle East, South Asia, the Korean peninsula, or between warring republics of the former Soviet Union is serious enough without the risk that the antagonists might fight with nuclear weapons. Of course, this consideration might be fully or partially offset by the possibility that the risks of conflict breaking out will be reduced if both sides in a regional dispute have nuclear weapons. Whatever the merits of that

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.

This is in contrast to article III(1) which requires those non-nuclear-weapons states that are party to the NPT to have IAEA safeguards on all their peaceful nuclear activities. Thus, it is possible under the NPT for a party to supply a nuclear power reactor to a nonparty, even though the recipient country has other facilities which are not under IAEA safeguards. Indeed, many such transfers took place.

51. This is not a theoretical concern. One highly regarded investigative reporter claims Pakistan moved nuclear weapons to its air bases and had its F-16 fighter aircraft on full alert during the height of the 1990 Indo-Pak crisis. Seymour M. Hersh, *On the Nuclear Edge*, New Yorker, Mar. 29, 1993, at 55, 65. Other U.S. observers doubt the claim that India and Pakistan came close to nuclear war. However, virtually everyone in Washington involved in those matters at the time was very concerned about the possible outbreak of conventional war and knew that an escalation to nuclear weapons was technically possible. See Douglas Jehl, *Did India and Pakistan Face Atomic War? Claim Is Debated*, N.Y. Times, Mar. 23, 1993, at A3.

52. It is likely, though not certain, that the existence of nuclear weapons in the hands of the United States and the U.S.S.R. and the knowledge that those weapons would in all likelihood destroy both societies if used, caused both states to be more cautious, reducing the risk of a conventional war breaking out between them.

On the other hand, it is also possible that even in the U.S.-Soviet context, it was less a matter of a nuclear balance providing real stability and more a matter of luck. See Robert S. McNamara, *A Retrospective View of the Cuban Missile Crisis*, in *In Retrospect: The Tragedy and Lessons of Vietnam*, annex (1995) (At a time when U.S. officials were urging President Kennedy to use force to destroy Russian missiles, there were already 162 warheads in Cuba, and the Soviet commander had authority to launch them at U.S. targets if attacked.)

Whether the spread of nuclear weapons to a single pair of enemy states would have a comparable stabilizing effect, or alternatively be destabilizing, is debatable. The possibility that it is stabilizing has led some academics to suggest that the further spread of nuclear weapons would be beneficial. The classic expression of that view is in Kenneth N. Waltz, *The Spread of Nuclear Weapons: More May Be Better* (International Institute for Strategic Studies, Adelphi Paper No. 171, Autumn 1981). More recently, John Mearsheimer has argued that proliferation by some states would be destabilizing,
argument with respect to nations such as India or Israel, few in the West would be content to rely on it with respect to Iraq, Iran, North Korea, or Libya.

Whether the possession of nuclear weapons increases or decreases the odds of armed conflict taking place, it is beyond dispute that if war does break out, and nuclear weapons are used, the human toll would be vastly higher if the states used nuclear weapons. Advanced proliferation makes that problem far worse. If states have and use large numbers of very high-yield weapons, far more will die than if they use only a few crude ones.

but that the great powers such as Germany and Ukraine should have them. John J. Mearsheimer, The Case for a Ukrainian Nuclear Deterrent, FOREIGN AFF., Summer 1993, at 50. But see Steven E. Miller, The Case Against a Ukrainian Nuclear Deterrent, FOREIGN AFF., Summer 1993, at 67. Others have doubted the transferability of the U.S.-Soviet experience to the case of further proliferation. See Robert J. Lieber, Existential Realism After the Cold War, WASH. Q., Winter 1993, at 152 (“[W]hat was applicable to the superpowers would, in all probability, be inapplicable for most others. The stabilizing characteristics of assured destruction, massive internal restraints, and geographic distance all acted as inhibitors. A world of growing nuclear proliferation, however, would be one of lethal danger.”).

The controversy is unlikely to be resolved, as the matter involves untestable theories and extrapolation from a very limited amount of data from the U.S.-Soviet context to draw conclusions about other potential cases. About the most that can be said with certainty is that we do not know the effect of further proliferation on the likelihood of war in the case of fairly evenly matched paired enemy states in the same region. In any event, there is no reason to assume that the case of two relatively symmetrical, geographically remote states represented by the United States and the U.S.S.R. is indicative of the risks where there are more than two concerned states, as with China, India, and Pakistan or with Israel, Iraq, and Iran.

When comparing two possible scenarios, one should multiply the odds of each undesirable event occurring by the consequences if it does. Suppose the likelihood of all-out war between two regional enemies sometime over the course of a decade, where neither is armed with nuclear weapons, is one in four, and the consequences of such a war would be one hundred thousand casualties. Suppose that both acquire nuclear weapons, and as a result, the chances of an all-out war drops to one in ten. But, if a war does break out there would now be four million casualties. One could correctly state that the acquisition of nuclear weapons had significantly reduced the risk of war, i.e., by a factor of two and a half. However, the likely fatalities over the decade increased by a factor of sixteen, i.e., $(1/10)\times(4,000,000)/(1/4)\times(100,000)=16$. Those who would argue that the chances of war would drop by a greater percentage than the percent increase in fatalities if there is war, and that further proliferation is accordingly beneficial, ought to bear the burden of proof and also some of the moral responsibility if they are wrong.

Suppose a state has five Hiroshima-type devices, deliverable only by obsolete light bombers. If three of the planes are shot down and one of the remaining devices is a dud, the one bomb which successfully detonates on a large city (which is assumed for these purposes to have an urban construction, density, and topography similar to the Japanese cities) might cause fatalities in the range of 100,000 (the Hiroshima and Nagasaki devices combined caused 200,000 deaths, about half of them by the blast or its immediate aftermath). On the other hand, suppose the state has twenty-five devices with yields of 120 kts., each deliverable by IRBMs. If only 60% of them land on similar cities and only 66% of those actually detonate with their expected yield, it would cause roughly 40 times as many fatalities, i.e., approximately 4,000,000 fatalities. Carnage on that scale with conventional weapons can probably only occur in circumstances similar to the two world wars.
2. Increasingly Serious Consequences in the Event of Accidental Nuclear War, Nuclear Civil War, or Nuclear Terrorism

Once armed with nuclear weapons, states have important security and economic reasons to protect their devices from sabotage and theft. Based on the limited experience to date, states which acquire nuclear weapons capability become conservative about allowing other countries or subnational groups to obtain them. But placing too much confidence in that tendency would be imprudent; with many more nuclear powers, the chances of something going wrong would greatly increase, perhaps exponentially.\(^5\)

Certainly, the consequences of an accidental nuclear war or a nuclear civil war would be far worse following advanced proliferation than if only crude, virtually undeliverable weapons were in the new nuclear states' arsenals. Additionally, if state-sponsored nuclear terrorism does take place, or if other terrorists are able to seize fabricated nuclear weapons,\(^6\) it will be far more deadly under conditions of advanced proliferation.\(^7\)

3. Reduction in the Relative Strength of the Major Powers

It is virtually certain that the relative strength of the larger powers, nuclear and non-nuclear alike, would erode if regional and lesser powers obtain

\(^5\) "The greatest danger to our security is that one of these covert proliferators may lose control of its nuclear weapons because of inadequate technical safeguards or domestic political turmoil." Joseph S. Nye, Jr., Arms Control After the Cold War, FOREIGN AFF., Winter 1989-90, at 42, 60. Of course, there are things we could do in the name of reducing those risks once a state deploys nuclear weapons. Some of those steps might reduce terrorist risks and should be considered. Others would involve actively assisting the new nuclear weapons states in improving the readiness and command and control of their nuclear forces and hardening them to be less vulnerable to attack. Those steps would make the new states' forces more effective, more of a threat to Western interests, and harder for us to attack. See also supra note 5 and infra note 229.

\(^6\) There is little reason to fear terrorists developing thermonuclear weapons, Tom Clancy, THE SUM OF ALL FEARS (1991) notwithstanding. On the other hand, if they are given nuclear weapons or can steal ones with inadequate security, the situation would be significantly worse if those are high yield weapons than if the terrorists attempt to construct their own crude fission devices. Incidentally, Clancy, whose information sources are superior to the intelligence services of many nations, appears to have deliberately put mistakes into his book to provide a great deal of verisimilitude in a riveting tale while avoiding providing nations with a textbook of how to construct thermonuclear weapons. In any event, his concluding remarks are correct to the extent that he makes clear that access to special nuclear material is the critical step in acquiring nuclear weapons. See id. at 913-14.

\(^7\) For example, if an irrational or irresponsible country wants to develop weapons similar to the U.S. man-portable atomic demolition munitions (ADM) (a kind of nuclear land mine in a backpack) it will discover that it involves a very difficult job of miniaturization. But if it succeeds and subsequently these ADMs were to fall into the wrong hands, they would make highly effective terrorist weapons. Consider the bombing of the World Trade Center. A much larger truck than that used by the bombers would be needed to bring in a crude Nagasaki-type device. Of course, even given a fizzle-yield of only 3 kts., the total force would have been roughly 3,000 times greater than the crude chemical explosive which was detonated, and it would have caused far more fatalities. In contrast, an ADM could be placed in the trunk of a compact car and, if detonated, would have destroyed much of southern Manhattan. In short, if it happens, nuclear terrorism could be terrible; with advanced proliferation it could be much worse.
nuclear weapons. As the only remaining superpower, this is a matter of no small consequence to the United States. Moreover, the problem greatly increases as nuclear forces become larger and more sophisticated. Thus, in all likelihood, the United States would tread much more carefully if North Korea possessed several dozen 100 kiloton devices deliverable on U.S. forces and our allies throughout the Pacific.

4. Harm to Prospects for Greater Reliance on International Peacekeeping

If a "new world order" does ultimately emerge, it will succeed largely because of the strength of new ideas, changing norms, and the increasing reliance on international legal and political institutions to resolve conflicts. However, at least initially, the common resolve and consensus of the international community in the realm of international security will have to be backed by the military power of the individual U.N. member states. Realistically, that will be done, as it was in Kuwait, Somalia, and Bosnia, by "deputizing" existing states to act on behalf of the United Nations Security Council under article 42 of the U.N. Charter.\(^{58}\) Thus, in the short term, strengthening and enforcing a new world order requires that the states which provide the military forces to back the decisions of the Security Council retain a large margin of strength over the likely international lawbreakers. An Iraq armed with a few nuclear weapons might have decided not to use them, much as it apparently chose not to use its stock of chemical weapons. But if Iraq's nuclear forces were identical to those of China (or even Israel), the enthusiasm in Western circles for the use of military force to throw the Iraqi forces out of Kuwait would have been greatly diminished. Thus, the more capable the nuclear force of threshold states, the more it will undermine prospects for the development of a new international security system.

5. Diminished Prospects for Further Arms Control

Widespread proliferation will virtually eliminate the chances for additional reductions in the arsenals of the existing powers. We only recently reached the point where deep cuts in the nuclear arsenals of the United States and Russia became both militarily prudent and politically possi-
However, few things in international politics can be predicted with greater certainty than that the United States and Russia will not reduce their nuclear forces to the point where they have fewer nuclear weapons than, for example, Pakistan, Iran, or North Korea. For that reason, the more powerful the nuclear forces of threshold states become, the more reluctant the two great nuclear powers will be to undertake further reductions.

6. Increased Pressure for Destabilizing, Expensive, or Dangerous Responses

The development of additional nuclear weapons states is likely to result in increased pressure in Western societies to find ways of protecting against those nuclear forces. This may result in destabilizing and expensive ballistic missile defense systems, more air defenses, and even nuclear war-fighting capabilities to destroy such forces, either preemptively or in retaliation. But, such “counter-proliferation” measures could be a “hard sell” with the public in democratic countries so long as the proliferating states’ capabilities remain modest. Demand for such protections is likely to be far greater, but the “counter-proliferation” measures are far less likely to be successful if states acquire significant nuclear forces.

7. Possible Decline in Civil Liberties

To be highly effective, the measures necessary to prevent “clandestine insertion” of a nuclear weapon by new nuclear weapons states and to

59. The U.S. Senate has voted its consent to ratification of the START I agreement which will require substantial reductions in strategic nuclear weapons. See START I, supra note 41. Thirty to fifty percent reductions in strategic systems are needed for the United States and the four relevant states of the former Soviet Union to meet the START I limits. The START Treaty: Hearings Before the Senate Comm. on Foreign Relations, 102d Cong., 2d Sess. 49 (1992) (prepared statement of Ronald F. Lehman II, Director, Arms Control and Disarmament Agency). The START I agreement entered into force December 5, 1994, following Ukraine’s accession to the NPT. Message to the Senate Transmitting the Strategic Arms Reduction Talks Treaty, 27 WEEKLY COMP. PRES. Doc. 1726 (Nov. 25, 1991) (President’s transmittal to Senate); Statement of Senate Ratification of the Strategic Arms Reduction Treaty, 28 WEEKLY COMP. PRES. Doc. 1836 (Oct. 1, 1992) (Senate ratification); Remarks at a Nuclear Agreement Signing Ceremony in Budapest, 30 WEEKLY COMP. PRES. Doc. 2464 (Dec. 5, 1994). U.S. and Russian leaders have reached agreement on a START II treaty, under which they will reduce their total strategic warheads to 3,500 and 3,000 respectively. START II was signed by U.S. President Bush and Russian President Yeltsin on January 3, 1993. The treaty provides for a further two-thirds reduction in the nuclear arsenals of each country. Treaty with the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, Jan. 3, 1991, U.S.-Rus., S. Treaty Doc. No. 1, 102d Cong., 1st Sess. (1993) [hereinafter START II]; see Ann Devroy, Bush and Yeltsin Sign Treaty to Slash Nuclear Arsenals, WASH. POST, Jan. 4, 1993, at A1; Keeping START’s Promise, WASH. TIMES, Jan. 6, 1993, at G2. That will be a dramatic reduction, certainly far better than even the most optimistic arms control advocates could realistically have hoped for only a few years ago.

60. Similarly, chances for future Chinese participation in arms reductions or limitations would be obliterated if it meant Chinese nuclear capabilities would have to be reduced below those of a rapidly growing Indian arsenal containing very high yield weapons which are readily deliverable on Chinese cities.

61. Clandestine insertion is a nuclear delivery system in which one state smuggles a fully fabricated nuclear device into a target country or smuggles in relevant compo-
reduce the increased risks of nuclear terrorism would almost certainly require security measures which would reduce civil liberties in the Western democracies. The more capable the nuclear systems of threshold countries, the worse these threats may seem, and political pressures to protect ourselves even at the cost of some privacy and liberty interests would be likely to grow.

In sum, every interest which would be harmed by further proliferation will be far more seriously harmed by advanced proliferation.

nents and then assembles the device in the target country. The bomb or the components are left in a secure location until needed and can then be detonated by the sending country or its agents. Given the severe porosity of borders in democracies—witness the largely unsuccessful efforts to slow international traffic in narcotics—the smuggling aspect would be hard to guard against.

Of course, the consequences to the sending country of getting caught could be severe. There are technical means which can sometimes detect nuclear materials, and the sending country also runs the more ordinary risks of detection by the police or intelligence services or having the plans come to light by bad luck. Clandestine insertion is more likely to appeal to states which do not have better delivery systems at their disposal, e.g., smaller states which conclude that being able to detonate one or two nuclear weapons on the territory of a larger nuclear power is better than no defense at all. It is also likely to be the delivery mode of choice for nuclear terrorists.

There has long been concern with the possible implications of intrusive arms control inspections on U.S. civil liberties. The classic work on the subject is Louis Henkin, Arms Control and Inspection in American Law (1958). A more recent work dealing with "open skies" confidence-building and verification provisions and their constitutional implications is David A. Koplow, Back to the Future and Up to the Sky: Legal Implications of "Open Skies" Inspection for Arms Control, 79 CAL. L. REV. 421 (1991). But those intrusions would be comparatively minor (though perhaps too intrusive to pass constitutional muster, especially if not limited to particular industries and government installations) when compared with the major intrusiveness needed to be highly effective against clandestine insertion and nuclear terrorism. In that regard, for many years, pundits asserted that terrorists only want publicity and concessions in response to threats, not mad death for its own sake. But the bombing of the Pan Am flight over Locherbie, Scotland, the bombing of the World Trade Center in New York, and the recent attacks on Jewish targets in several countries suggest that some terrorists may be interested in causing extensive fatalities. If they had nuclear weapons, they might actually use them, not merely threaten to do so.

As mentioned in note 61, supra, a country with advanced nuclear weapons programs and the capacity for accurate delivery at any desired distance is substantially less likely to be interested in clandestine insertion. However, if a country does decide to use clandestine insertion, small light devices will be easier to import and hide than large heavy ones. Moreover, a terrorist group, backed by a state with nuclear weapons, can cause vastly more damage with a thermonuclear weapon than with a crude Nagasaki-size device.

In times past, the greatest concern with proliferation was the possibility that regional conflicts, involving some participants who possess nuclear weapons, would increase the odds that the nuclear weapons states would become involved, resulting in a concomitant risk of global nuclear war. See Lewis A. Dunn & Herman Kahn, Trends in Nuclear Proliferation, 1975-1995, at 114-29 (1976); Albert Wohlstetter et al., U.S. Arms Control and Disarmament Agency, Moving Toward Life in a Nuclear Armed Crowd? 152-53 (1976). However, the risk of global nuclear war from an escalation of a regional conflict has apparently been greatly reduced by the demise of the Soviet Union.
D. Elements of Advanced Proliferation

This section outlines the various areas in which threshold states might seek to enhance the capabilities of their nuclear forces, and it provides public information on efforts by the nuclear weapons states and the threshold states to acquire or improve those capabilities. As will be shown, once a state nears the nuclear threshold, it is unlikely to be content with a small force of crude devices. Rather, it will want to acquire militarily more significant nuclear forces. This has been the case for the five current nuclear weapons states, the three states currently at the nuclear threshold, pre-Gulf War Iraq, and three of the four states which approached the threshold but then reversed course, instead choosing a non-nuclear weapons policy.\(^6\)

1. Increases in Arsenal Size

A prime characteristic of advanced proliferation is an increase in the number of nuclear weapons that a country has at its immediate disposal. Although the addition of ever more weapons to a nuclear arsenal might not be inevitable, none of the five nuclear weapons states halted production after initially acquiring a handful of devices. Instead they continued to establish arsenals with hundreds to tens of thousands of nuclear weapons.\(^6\)

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\(^6\) Argentina and Brazil were laying the groundwork for significant nuclear forces before they decided to place all their nuclear facilities under IAEA safeguards. See supra note 48. The same was true of the Swedish nuclear weapons program before it was abandoned. See infra note 207. In contrast, although South Africa had facilities capable of providing HEU for many nuclear weapons, it claimed that the handful it had was enough and that it did not need a more sophisticated design. See infra note 211. The South Africans maintain that they froze their device design with a relatively low yield and did not give serious consideration to more modern, survivable delivery vehicles. This may be correct, and if so, it is the sole case of a state with nuclear weapon capabilities wishing to acquire only a small, low-yield arsenal. On the other hand, some believe South Africa planned a much bigger, more sophisticated force. This theory draws support from reports of South African acquisition of tritium from Israel and work on Li\(_6\), implosion designs, and miniaturized neutron generators. Mark Hibbs, Top Secret Group Managed Swap of South African U\(_{235}\) for Israeli Tritium, NUCLEAR FUEL, Feb. 14, 1994, at 9 (South Africa obtained 30 grams of tritium, said to be enough to boost 12 weapons); Mark Hibbs, Evidence Builds of Advanced Weapons Work by South Africa, NUCLEONICS WEEK, Jan. 20, 1994, at 5; see infra note 211. The author’s guess is that both of these are true. The government only gave final approval to the seven weapons with the existing design. However, it also laid the groundwork for a much larger nuclear weapons program with far higher yields.

66. The existing nuclear powers have varied greatly in the ultimate size of their arsenals and the rate at which they have added weapons. A country’s perceptions of threat, its then-prevailing strategic doctrine, and its economic, scientific, and technical capabilities have been important factors. Recent estimates credited the United States with 11,000 strategic warheads in a total arsenal of about 25,000. David French, Expert Says START II Signing an Historic Occasion, CNN, Jan. 2, 1993, (Interview with Edward Warner, RAND Corp. analyst, Transcript #274-2), available in LEXIS, News Library, Script File.

The four states of the former Soviet Union with nuclear weapons still on their territory had a combined total of 10,000 strategic warheads, id., and perhaps 17,000 tactical nuclear weapons, supposedly all accounted for and under Russian control. Britain,
The manufacture of large numbers of weapons requires facilities for the large-scale production of special nuclear material. Countries interested in increasing their number of nuclear weapons will rarely be content with the amount of weapons-useable nuclear material supplied by a pilot-scale uranium enrichment facility or a research reactor and reprocessing plant.\(^6\)

The nuclear threshold states are already taking steps to increase the amount of nuclear material available to them. Pakistan is widely credited with having a handful of nuclear weapons.\(^6\) Although one highly respected nongovernment analyst says Pakistan can already produce enough highly enriched uranium for several devices a year,\(^6\) it has continued to increase the size of its centrifuge enrichment facilities.\(^7\)

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Whatever the exact numbers, the arsenals of the other three nuclear weapons states are substantially smaller than those of Russia and the United States, but they are growing at a time when the U.S. and Russian arsenals are shrinking. One report stated that France is increasing its total to 416 and Britain to 850. This is largely the consequence of putting multiple warheads on their respective submarine-based ballistic missiles. Jan Mather, The Cold War, U.S., Russia Agree to Cut Nuclear Weapons, but What About Britain and France?, GAZETTE (Montreal), Jan. 6, 1993, at B3.

67. Some will attempt to build larger enrichment facilities. Others will strive for much larger reactors, most likely heavy-water or graphite moderated reactors, and correspondingly larger reprocessing plants. Where acquisition of larger reactors is infeasible, states may try to increase the thermal output of their existing reactors. Some may acquire weapons-useable nuclear materials by illegal means. States with the largest nuclear ambitions can be expected to try to acquire large-scale facilities to produce both plutonium and highly enriched uranium because HEU is better for some nuclear weapons purposes and plutonium is better for others. The ability to produce both is desirable for the most common approach to attaining yields of a half a megaton or more.

68. Senator Pressler stated that the Pakistanis have seven devices which can be put together on short notice. Pakistan Says Nuclear Programme is Peaceful, REUTERS LIMITED, Dec. 2, 1992, available in LEXIS, News Library, Wires File. A Russian intelligence report, recently quoted by Senator Glenn, credits Pakistan with four to seven nuclear weapons. Restrictions Hurt U.S. Arms Makers, Congress Told, DEF. & AEROSPACE ELECTRONICS, Mar. 15, 1993, at 1. Senators Glenn and Pressler are two of the most knowledgeable and active Senate members regarding nuclear nonproliferation issues.


70. Doing so has been expensive in the face of a concerted Western effort to prevent Pakistani purchasing agents from clandestinely acquiring the needed equipment and materials. See LEONARD S. SPECTOR, NUCLEAR AMBITIONS 89-112 (1990). These efforts have forced them to take the slower, less certain, and more costly route of indigenous manufacturing of the centrifuge parts. Continuing to expand its enrichment facilities has also been costly in a political sense, further straining relations with the
India, not content with the plutonium generation available from the CIRUS reactor, which it used to produce the plutonium for its 1974 nuclear weapons test in the Rajasthan Desert, proceeded with the R-5 or "Dhruva" reactor, which is roughly capable of five times CIRUS' annual plutonium production. Although estimates of the total plutonium available to India vary considerably, it seems certain that the stockpile of separated, unsafeguarded, weapons-optimal plutonium in India is probably large enough for a dozen or more nuclear weapons, and it is growing.

71. On May 18, 1974, the Indian Government announced that it had successfully tested a 10-15 kt. nuclear explosive device. See Bernard Weinraub, India Becomes 6th Nation To Set Off Nuclear Device, N.Y. Times, May 19, 1974, at 1. The CIRUS reactor was supplied by Canada prior to the era of IAEA safeguards, and the heavy water was supplied by the United States with assurances from the Indian government that it, and the materials produced from its use, would be used exclusively for peaceful purposes. India claimed that its test was a "peaceful nuclear explosion," and therefore using plutonium from the CIRUS reactor for the explosion did not violate those assurances. The Canadians cut off nuclear supply in retaliation; the United States did nothing beyond a faint protest.

72. Like the CIRUS, the R-5 is not under IAEA safeguards, but in contrast to CIRUS, it is not subject to a peaceful use guarantee. See Gary Milhollin, Stopping the Indian Bomb, 81 AM. J. INT'L L. 595, 597 (1987). Dhruva, which began operations in 1985, is essentially a copy of Canada's NRU reactor. It is rated at 100 MW and, according to an Indian source, can produce 55 kg of "weapons-grade" plutonium per year. Brahma Chellaney, Indian Scientists Exploring UEnrichment, Advanced Technologies, Nucleonics WK., Mar. 5, 1987, at 9. However, there have been troubles at the reactor, id., and its total plutonium production is certainly far less than the roughly 430 kg. it could have produced by now if it had operated at rated capacity.

73. In the case of India, it is important to distinguish between total produced plutonium and produced plutonium not subject to IAEA safeguards. The amount of total plutonium is enormous, and that is probably what is behind one estimate that India could have enough nuclear material by the end of the century to have as many nuclear weapons as China currently possesses. Nordland, supra note 23. But under present political and military circumstances, India is not likely to violate IAEA safeguards when it has plutonium available which is not under safeguards. In that regard, in addition to its two big research reactors, India has indigenously-built heavy water power reactors which are not under IAEA safeguards. One should also distinguish produced plutonium from separated plutonium. Estimates of separated unsafeguarded plutonium in the Indian inventory range from a high of 400 kg., from a Pakistani source, to a reported "best guess" from Western intelligence sources of 285 kg. Mark Hibbs, Indian PUProduction Overstated, No Pit Production, Iyengar Says, Nucleonics WK., Apr. 9, 1992, at 6. Professor Milhollin's own estimates for produced (separated and unseparated) plutonium are more modest. He states that production from the CIRUS and R-5 research reactors and the Madras power reactors supply enough plutonium for 15 nuclear weapons per year. Milhollin, supra note 72, at 597. Finally, it is useful for some purposes to distinguish between "low burn-up" weapons optimal plutonium and less desirable "high burn-up" weapons-usable plutonium, as the Indians would look first to the former for its weapons. See infra note 74.

74. India's stockpile of separated, low burn-up plutonium not subject to IAEA safeguards is probably over 100 kg. and under 300 kg. If each device requires five to eight kilograms of plutonium, which should correspond roughly to India's presumed level of
The Indians also have a centrifuge enrichment program which could ultimately provide highly enriched uranium.\(^7\)

Israel has found it politically difficult to construct additional nuclear facilities for weapons purposes because of concern over the American reaction and the potential consequences which might flow from eliminating any residual doubts that it possessed nuclear weapons. Faced with these roadblocks, Israel has instead increased the thermal rating of its unsafeguarded Dimona reactor, thereby substantially increasing its annual plutonium production.\(^7\) In addition, there are persistent rumors that Israel purchased highly enriched uranium from South Africa and that it stole special nuclear material from the United States.\(^7\) It also smuggled large numbers of krytrons (triggering switches for nuclear weapons which have virtually no credible non-nuclear weapons applications) out of the United States, an act wholly inconsistent with the needs of a small nuclear arsenal.\(^7\)

Iraq's efforts were not aimed at acquiring a tiny handful of nuclear weapons. To the contrary, given the facilities it had in operation and under construction, or for which it had firm plans, it is clear that Iraq aimed at a production level of many devices per year.\(^7\) Moreover, the large number of krytrons Iraq attempted to smuggle out of the United States is consistent only with ambitious nuclear weapons plans.\(^8\) One estimate placed Iraq's expenditures on its various nuclear programs at $10 billion\(^8\) spread over twenty-four nuclear-related facilities,\(^8\) which is indic-

design sophistication, that would mean a potential arsenal in the range of 12 to 60 nuclear weapons. Of course, the fact that India could have an arsenal that large does not mean that it has fabricated all the plutonium into weapons and deployed them to its military forces.

\(^7\) India operated a 100 centrifuge cascade by 1985, and recently it announced that it had completed a second, multi-hundred centrifuge facility at Mysore. Mark Hibbs, Second Indian Enrichment Facility Using Centrifuges is Operational, NUCLEONICS Wk., Mar. 26, 1992, at 9. If so, in the absence of a crash effort, production of enough enriched uranium for either significant nuclear weapons production or to fuel the Tarapur reactors would still be a number of years away.


\(^7\) For a discussion of a possible diversion of HEU from the NUMEC plant in Pennsylvania, see SPECTOR, supra note 70, at 152-54.

\(^7\) In 1985, a California grand jury returned an indictment charging Richard Smyth with illegally exporting 800 krytrons to Israel. Indictment Charges Californian Illegally Sold Munitions List Triggering Devices to Israel, INT'L TRADE REP., May 22, 1985, at 704; Californian Indicted in Export of Triggers to Israel, N.Y. TIMES, May 17, 1985, at A8.

\(^7\) Iraq had both centrifuge and calutron enrichment programs and a program in chemical enrichment. It was in the process of producing the equipment and had partly completed a 100 calutron facility. SPECTOR, supra note 70. There have also been disputed reports that it had an additional uranium enrichment facility based on the Becker nozzle process, though the U.N. inspectors have not found such a facility. See Paul Lewis, U.N. Suspects Iraq Has a 4th A-Plant, N.Y.TIMES, Oct. 3, 1991, at A3. Reports have also persisted that Iraq had an underground plutonium production reactor, but the United Nations has not found supporting evidence.

\(^8\) See supra note 79.

ative of an appetite for many nuclear weapons.

Other states which had active nuclear weapons programs but turned away from those efforts include Sweden, Brazil, Argentina, and South Africa. All of these states acquired nuclear facilities capable of producing comparatively large amounts of special nuclear material, certainly more than enough for a handful of nuclear weapons. Even North Korea, though in most respects a nascent program, has taken major steps to increase its plutonium availability. If successful, these steps could give it enough plutonium to fabricate ten or more nuclear weapons per year by the end of the decade.

2. Increases in Explosive Power

The power of nuclear weapons is normally expressed as the equivalent weight of an equally powerful conventional high explosive. Therefore, since the Hiroshima bomb is thought to have been the equivalent of approximately 15,000 tons of TNT, it is considered a 15 kiloton device. The other four nuclear states also began with weapons of roughly the same explosive power.

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Documents Deal Ends Baghdad Bus Siege, INDEPENDENT, Sept. 28, 1991, at 1. Additional sites have been discovered since these estimates were made. Whatever the exact cost, it was a massive program.


83. See infra note 207.

84. See supra note 48.

85. See infra note 211. Although South African officials may be telling the truth in declaring that the six nuclear weapons fabricated and the one under construction were all they wanted, they had positioned themselves so that the two uranium enrichment facilities could be used in conjunction (at the expense of fuel for their civilian power reactors) to produce large amounts of highly enriched uranium. See id.

86. The North Korean reactor subject to the most press comment is a five megawatt natural uranium-fueled reactor which had been operating since 1986 with an unknown duty schedule. It takes approximately 25 megawatt years to produce enough plutonium for a single, simple nuclear weapon. This is apparently what is behind the oft-quoted CIA estimate that North Korea may have enough plutonium for one to two nuclear weapons, which they may have already fabricated. However, the North Koreans were obviously not content with obtaining plutonium for a device every four to six years. They have constructed a 50 MW reactor, which may have been ready to go on line shortly, and they also had a 200 MW reactor under construction which may be ready for commissioning in 1995. See Editorial Note, supra note 38, and sources cited therein.


88. Caution is needed when comparing the destructive power of nuclear weapons. The area which can suffer a given level of damage is not proportional to the kiloton rating of the device, but rather is an exponential function that varies roughly with the two-thirds power. Thus, a 4.1 megaton device will release over 500 times more force than an 8 kiloton device. However, it will destroy an area approximately 64 times as large, not 500 times.
However, all five states saw military utility in being able to destroy greater areas. Greater explosive yields also increase the kill probability for a particular target, especially those which have been hardened against a nuclear attack, such as missile silos and command bunkers. For these two reasons, all the nuclear weapons states put extensive effort into perfecting high yield devices, though the United States and the Union of Soviet Socialist Republics later reduced their emphasis on yield per se.

Going from simple fission devices to more sophisticated ones can increase the yield threefold or more. However, doing so requires a substantial effort in both weapons design and testing of at least the non-

\[
\left( \frac{4,096,000 \text{ t}}{8,000 \text{ t.}} \right)^{2/3} = 64
\]


90. Major improvements in accuracy meant that enormous weapons were no longer needed to assure the destruction of a target. Moreover, considerably more destruction can be caused by ten 500 kiloton devices than by one five megaton device, though the total explosive force is the same. Therefore, in an era of multiple, independently targeted reentry vehicles (MIRVs), whose number on any given missile is constrained primarily by total weight, yield has been sacrificed for the ability to add even more warheads. In addition, military planners were concerned with “fratricide,” the loss of incoming weapons due to the size of the fireball of one’s own weapons which had already been detonated in the same area. For threshold state programs, which cannot aspire either to MIRVing their missiles or to highly accurate delivery, these considerations would not apply for many years. In any event, they do not detract from the enormous attraction to the military of being able to increase yield from 10-20 kilotons into the 100 kiloton to one megaton range.
nuclear components.\textsuperscript{91} Beyond pure fission devices are "boosted" devices, which can greatly increase the yield, but they are no small accomplishment.\textsuperscript{92} Finally, even greater yields can be achieved through the development of true multi-staged thermonuclear weapons.\textsuperscript{93} It will not be easy for threshold countries to achieve major improvements in yield without assistance in weapons design.\textsuperscript{94}

The threshold states have all engaged in activities relevant to increasing the yield of their devices. India, which continues to have an interest in thermonuclear weapons,\textsuperscript{95} maintained a major research program in the physics and materials relevant to those weapons throughout the 1970s and 1980s.\textsuperscript{96} In the late 1980s it accelerated those efforts.\textsuperscript{97}

\begin{enumerate}
\item Improved fission yield devices may require both specialized non-nuclear materials and more sophisticated fabrication techniques. Nevertheless, for these devices, the dominant consideration is the availability of special nuclear material, followed by design sophistication.
\item In a boosted device, the tremendous temperature and pressure produced by the fission explosion can achieve a small fusion yield. The fusion adds very little of the total explosive power per se. However, it produces very high energy neutrons. When these neutrons collide with fissionable material, many more neutrons are released. This increased neutron flux causes far more nuclear material to fission, which significantly increases the yield of the device.
\item A thermonuclear weapon uses a fission stage (the "primary stage"), which is often itself boosted, to ignite a "secondary stage," which uses lithium deuteride as the fuel for a very large fusion yield. Often a further stage uses the high energy neutrons from fusion to fission more uranium, further increasing the yield. Far more complexity is involved than the preceding sentences suggest.
\item Development of those capabilities by the British, French, and Chinese was substantially aided by the mere fact that they knew from Soviet and U.S. successes that it could be accomplished. Nevertheless, extensive—and expensive—development and testing were required. For a more thorough discussion of these difficulties and their relation to a possible comprehensive test ban treaty, see \textit{infra} notes 347-53 and accompanying text. It is important to note that with respect to increases in yield (in contrast to increases in numbers of weapons) a critical change in emphasis has taken place: design sophistication is the single most important consideration, not the availability of nuclear materials.
\item \textit{Proliferation Threats of the 1990s: Hearing Before the Senate Comm. on Government Affairs,} 103d Cong., 1st Sess. (1993) (testimony of James Woolsey, Director of the Central Intelligence Agency)
\begin{quote}
(Sen. Glenn: Almost four years ago, one of your predecessors, Jim, Judge Webster, testified before this Committee that the Intelligence Community had, and I quote, "indicators that tell us that India is interested in thermonuclear weapons capability." Do you share that assessment? ... Mr. Woolsey: I believe Judge Webster's comment is unfortunately still valid, Mr. Chairman.).
\end{quote}
\item A 1985 German intelligence report stated that Rajiv Ghandi, who was Prime Minister at the time, had ordered P.K. Iyengar, then Director of the Bhabha Atomic Research Center (BARC) and later Chairman of the Indian Atomic Energy Commission, to develop a thermonuclear weapon in response to growing concern over Pakistan's nuclear efforts and to prepare to test it shortly after any Pakistani test. Mark Hibbs, \textit{India and Pakistan Fail to Include New SWU Plants on Exchanged Lists}, \textit{Nuclear Fuel}, March 30, 1992, at 6. Indian officials no longer deny they have pursued research relevant to thermonuclear devices, but they claim the German report overstates their interest in the H-bomb. Hibbs, \textit{supra} note 73. In any event, work relevant to developing higher yield fission devices at BARC is an open secret. \textit{Id}.
\item In 1987, India established a Centre for Advanced Technology (CAT) at BARC, the nuclear complex where its 1974 nuclear explosive was developed and prepared.
There are indications that Israel has been working on, or even possesses, boosted devices. Israeli interest in obtaining high speed computers, combined with their acquisition of advanced nuclear weapons-related materials and equipment, strongly suggests, but does not conclusively prove, that there is merit in these accusations. Certainly, if it is true that Israel's nuclear weapons program was primarily intended as a force de dissuasion against the then-Soviet Union, such a purpose would provide a powerful incentive to develop higher yield weapons.

Pakistan attempted, by clandestine means, to obtain specialty beryllium metal, which can increase the yield of fission devices without increasing the required amount of nuclear material. Evidence on the public record of active Pakistani interest in full-fledged thermonuclear weapons is scant, but the Pakistanis did attempt to acquire tritium separation equipment from Germany, which suggests an interest in boosting.

Finally, we know from the IAEA inspections following the Gulf War that Iraq had gone through five successive refinements in its device design. Even more ominously, it acquired a specially separated isotope of lithium (Li6) from China, had indigenously produced several

The CAT was to concentrate on the application of lasers and accelerators to create thermonuclear reactions. Science and Technology: Planned Research in Thermonuclear Energy, BBC SUMMARY OF WORLD BROADCASTS, FE/W1428/A/16, Feb. 18, 1987 (quoting a Press Trust of India report of Feb. 11, 1987), available in LEXIS, News Library, Intl File. While there has been hope that such inertial confinement fusion (ICF or "laser fusion") programs could someday provide useful electrical power, even the most advanced countries have had only modest successes and are decades away from commercializing civilian applications of ICF, if ever. On the other hand, the United States, Russia, France, and the United Kingdom use ICF to obtain information for their thermonuclear weapons programs. See infra notes 237-41 and accompanying text. Given the exceedingly remote chances that this technology will work in relevant time frames, any claim that India is pursuing this technology for bona fide peaceful purposes is highly doubtful, but it could be a substantial aid to its nuclear weapons-related research.

98. Mordechai Vanunu, who had worked at the Negev desert complex which contains the Dimona reactor, exposed Israel's success in producing tritium and lithium deuteride. Vanunu was later kidnapped by Israeli agents, charged, and convicted of revealing state secrets. See generally LEONARD S. SPECTOR, THE UNDECLARED BOMB 164-93, 381-402 (1988). See infra notes 250-53 and accompanying text for a discussion of the importance of tritium and lithium deuteride to advanced nuclear weapons.

99. In part because of Vanunu's revelations, SPECTOR, supra note 98, at 164-93, 381-402, a number of experts in and out of government privately believe the Israelis already possess boosted devices.


101. Retired Pakistani General Guilty in Exporting Case, ORLANDO SENTINEL TRIB., July 10, 1992, at A15 (In an unreported case, a federal court jury found General Inam Ul-Haq guilty of conspiring to export maraging steel and beryllium to Pakistan.).

102. There are exceedingly few peaceful uses for beryllium of this type, and those only require small amounts.


104. Pickering Testimony, supra note 40.

pounds of Li6, and had plans to make about 220 pounds per year. That is enough to produce tritium for many boosted devices or for direct use in a smaller number of thermonuclear weapons. This material has no peaceful uses in those quantities and is of no use to a simple fission device, but it is critical for boosted and/or thermonuclear weapons. We also know the Iraqis were engaged in relevant weapons physics. Although Iraq was attempting to construct a sophisticated nuclear force, it was still a considerable way from obtaining it when the Gulf War broke out.

It is beyond the purposes of this article to prove that each of these states has an active program to obtain thermonuclear weapons. In terms of a major program aiming at early acquisition and distribution of those weapons to its forces, it is probably not the case for all of them and certainly not the case for some. Rather, the critical point is that threshold states have a strong motivation to develop and deploy weapons of much higher yield.

3. Reduced Requirements for Special Nuclear Material

For planning purposes, the IAEA assumes that eight kilograms (about 17.5 pounds) of plutonium or twenty-five kilograms of HEU (about fifty-five pounds) are needed for a typical first nuclear explosive. However, weapons designers in the existing nuclear weapons states can make devices of equal or greater yield with substantially less material. Thus, improvements in design sophistication can allow a state to increase the number of nuclear weapons it can produce from any given inventory of special nuclear material. These improvements can be a vital consideration if the size of a country's prospective arsenal is primarily constrained by the amount of special nuclear material at its disposal, as would be the case for Israel and Pakistan. In fact, U.N. inspectors discovered that the Iraqis were investigating designs which would have improved yields with lower

106. Pickering Testimony, supra note 40. According to reports, China also sold Iraq seven tons of lithium hydride, a possible feedstock for Li6 separation. Chemical Sale to Iraq Reported, FACTS ON FILE WORLD NEWS DIGEST, Oct. 12, 1990, at 765.

107. One former U.S. nuclear weapons designer, Dr. Theodore Taylor, stated that 220 pounds of Li6 would be enough for dozens to thousands of boosted devices, depending on the reactor used to irradiate it. Lewis, infra note 112.

108. Id.

109. Li6 is essential to efficient tritium production and is directly used in thermonuclear devices. See infra part III.A.3.

110. William J. Broad, U.N. Says Iraq was Moving Toward More Potent Bombs, N.Y. TIMES, Oct. 15, 1991, at A1. According to U.N. inspectors, Iraqi documents showed they were working on what they called "two-dimensional hydrodynamic and neutronic models" to "simulate the behavior of nuclear weapons." Id. These days, such computer models of the forces in a detonating nuclear weapon are essential to efficient weapon development.

111. IAEA inspectors who had access to the design for Iraq's intended first device reported that it was an implosion device utilizing a solid-core of HEU, a polonium neutron initiator, and a natural uranium reflector/tamper. That is a level of sophistication approximately equal to the Nagasaki device. Even that design was probably two years from completion, as Iraqi documents indicate that there were a number of areas which required further work. Mark Hibbs, Iraqi Execution of Bomb Design 'Two Years Away,' Data Suggests, NUCLEAR FUEL, Oct. 14, 1991, at 8.
fissile material requirements than that required for a typical first fission device.  

4. Enhanced Deliverability

A fourth major effort of the five declared nuclear weapons states has been to improve the deliverability of the nuclear weapons themselves, making them easier and safer to deliver. The first major change was to reduce the weight. The Trinity device, the first nuclear explosive, weighed approximately 10,000 pounds. A nuclear weapon of that size is far too heavy to be delivered effectively at extended range by fighter planes; indeed many fighters could not carry such a device at all. Limiting a device to bomber delivery substantially reduces its utility, as the state may not possess modern bombers and thus is dependent on older, less capable aircraft. A 10,000 pound device wholly precludes delivery by small, difficult to detect, cruise missiles and is also too heavy to be delivered by nearly all intermediate range ballistic missiles (IRBMs). Bringing the weight below 1300 pounds, the size of the larger of the two Swedish nuclear weapons designs completed by 1958, provides a major benefit in deliverability, while further reductions in weight for any given yield are also possible. Reduced weight is especially important for placing multiple warheads on a single missile and for man-portable atomic demolition munitions. Finally, major weight reductions could help countries get around restrictions built into the current Missile Technology Control Regime (MTCR).

112. Iraq had been working on a fission device with an "air-gap" design capable of increasing the amount of explosive force for a given amount of special nuclear material. Paul Lewis, Iraq Is Said to Have Hidden Nuclear Records From U.N., N.Y. Times, Oct. 14, 1991, at A6. This information was confirmed to the author by an individual who took part in the U.N. inspections and who wishes to remain anonymous.


114. There used to be commerce in small and/or obsolete bombers, particularly sales by the Soviets and British. However, no state has sold state-of-the-art heavy bombers, and none has sold medium bombers for some time. For a discussion of the need to control the sale of bombers, see infra notes 306-10 and accompanying text.

115. According to one report, the U.S. Tomahawk cruise missile has twice the cruising range with a nuclear payload than it has with a 1,000 lb. conventional bomb because the nuclear warhead is lighter. Eric Nalder, Warfare Has Never Had Weapon Like Navy's Tomahawk Missile, SEATTLE TIMES, Jan. 16, 1991, at A1 (citing as sources United States Naval Intelligence Military Database and Janes Weapons Systems). Another source states that the difference in range between the nuclear and conventional versions is considerably greater, crediting the T-LAM-N version and the GLCM version, each armed with a 200 kiloton nuclear warhead, with 2,500 km ranges but the LAM-C and TASM conventional versions with only a 450 km range with a 450 kg (i.e., 1000 lb.) high explosive warhead. Ian Curtis, Missile Technology in the Glasnost Era, DEFENSE & FOREIGN AFF., Mar. 1990, at Special Supplement: World Missiles 2.


117. Weight reduction, like improvements in yield, is largely a function of design capability, including computer modeling and extensive testing of both non-nuclear and nuclear components. Access to exotic low-weight materials can also be important.

118. The MTCR is a nonbinding undertaking initially entered into by selected Western states to halt the spread of ballistic missiles and technology along with space launch technology, which could be used for ballistic missiles. See Guidelines for Sensitive Missile—Relevant Transfers, 26 I.L.M. 599, 600 (1987) [hereinafter MTCR Guidelines]. It
Other major improvements in deliverability include the construction of implosion devices which occupy shapes other than spheres, in order to make them sufficiently rugged for supersonic flight (if carried externally by fighter or supersonic bomber) and re-entry (if used in missiles) and to optimize them for various kinds of fusing options and delivery techniques. These improvements are especially important for advanced nuclear programs and require considerable testing, advanced engineering, and in some cases, sophisticated materials and manufacturing capabilities.

Evidence of substantial work on improvements in the deliverability of nuclear devices by the threshold states is sketchy at best. However, a German intelligence report asserts that Pakistan has designed a nuclear warhead that can fit under an F-16 and has undergone wind-tunnel tests.

5. Greater Safety and Survivability

Because nuclear weapons are very valuable and because an accidental detonation would be both a radiological hazard and a political disaster, countries have an incentive to make those weapons reasonably safe from accidental explosion. Similarly, they will also want to make them rugged enough to withstand accidental detonation or destruction from near misses during hostile attack.

A common goal has been to make them “one point safe,” meaning that if the high explosives used in the device to start the chain reaction are detonated at a single point there will not be a nuclear explosion; instead only the conventional explosives will go off. One point safety requires considerable design work and testing. Both the efforts by several threshold states to acquire advanced diagnostic equipment and computers (suitable for testing the ruggedness of warheads) and the acquisition of exotic materials by those states are consistent with an interest in the safety and survival of their weapons, but they are not strong enough evidence to prove that those states are actively pursuing such an objective.

6. Acquisition of Better Delivery Systems

Nuclear explosives are high-value weapons. For a state with a nascent program, considerable time, effort, money, and diplomatic costs have gone

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119. Missile nose-cones and the outer cases of bombs are not ideally sphere-shaped. An efficient design must conform the nuclear weapon shape closely to the ideal shape of the bomb or warhead. Although this is important for single warhead devices, it becomes critical for multiple warhead missiles.

120. Hersh, supra note 51.

121. Nordland, supra note 23.
into the creation of the first few devices. The state may have risked pre-
emption by an existing nuclear power or conventional attack by a neigh-
boring regional power. In military terms, nuclear weapons are useless
unless they reach their designated targets with reasonable accuracy. In
deterrence terms, the possession of nuclear weapons will be substantially
discounted by an adversary who doubts that the devices can be delivered
successfully.

Threshold states thus have powerful incentives to acquire delivery sys-
tems with greater weight-carrying capability, range, accuracy, and
survivability than the fighter aircraft which all nations of potential
advanced proliferation concern already possess. Certainly the existing
nuclear weapons states put tremendous emphasis on the acquisition of
delivery systems and, until the demise of the Soviet Union, were spending
billions of dollars per year on their development, testing, deployment,
maintenance, and improvement.122

Nuclear-capable delivery systems can take several forms, including
advanced fighter aircraft,125 bombers (especially those whose survivability
can be enhanced through supersonic speed, electronic counter measures,
very low altitude capability, "stealth,"124 and "stand-off" capability),125

122. Deploying just one ICBM can be a very considerable expense, and the quest to
put on more warheads with greater accuracy has increased that cost. A 1988 analysis
showed that the first U.S. ICBM, the Atlas, cost $8 million, while its successor, what is
now called the Minuteman I, cost $11 million per copy. The three-warhead Minuteman
III cost $13 million, while the purported cost of one MX missile was $63 million. (All
figures were adjusted to 1988 dollars.) Missiles, Accuracy and Several Kinds of Overkill,
CHI. TRIB., Apr. 1, 1988, at C13. Whether or not these figures are accurate (cost
accounting, having a number of accepted methods, can give several "correct" answers),
it is clear that the total costs increased even though the cost per delivered warhead
decreased.

While constructing these advanced delivery systems and their warheads and keeping
them manned and operational are very expensive, it should be noted that strategic
systems have always been a fairly small fraction of total U.S. defense expenditures.
Some of the early fascination with nuclear weapons, particularly on the U.S. side, was
because they seemed to be much less expensive than maintaining sufficient conven-
tional forces to deter a Soviet attack in Europe. In the long term, however, it is doubt-
ful that nuclear weapons saved money. Once the Soviets had a large nuclear force
deliverable at intercontinental range, the threat of nuclear attack to counter Soviet con-
ventional capabilities lost most of its credibility. NATO was then forced to maintain a
vigorous conventional defense, in addition to the cost of the nuclear weapons, largely
negating any savings caused by the nuclear weapons themselves. Also, early on, little
thought was given to the eventual cost of environmental clean-up from the production
of the special nuclear materials and the weapons, which at Department of Energy facili-
ties alone could be as much as $155 billion according to the General Accounting
Office. Earl Lane, Cleanup Costs at Nuclear Sites Soar, NEWSDAY, June 24, 1990, at 13.

123. All nations of interest have fighter aircraft. Those especially appropriate for
ground attack are sometimes called fighter-bombers, attack aircraft, or strike aircraft.
A more militarily significant force can be achieved by increasing their numbers, range,
weight-carrying capability, penetration aids, and electronic optimization for nuclear
delivery.

124. Stealth is the capacity of certain design features, including the use of exotic
materials, to make an aircraft virtually undetectable by normal anti-aircraft radar. The
United States has a stealth bomber, the B-2, and a stealth fighter, the F-117. The latter
saw action during the Persian Gulf War.
naval delivery systems (especially aircraft carriers carrying fighters or
attack aircraft and submarines or surface vessels carrying ballistic or cruise
missiles),\textsuperscript{126} cruise missiles employed as stand-alone, ground-based weap-
on systems (especially those of considerable range, accuracy, and mobil-
ity), and ground-launched ballistic missiles.\textsuperscript{127}

The enormous cost of developing, testing, deploying, and maintain-
ing advanced delivery systems is a major constraint on advanced proliferation.
Indigenous development and manufacture of a delivery system is
nearly always more expensive and takes far longer than purchasing an
identical system from a nation which has already developed and deployed
it.\textsuperscript{128} The delivery system problem is thus far more pressing if the coun-
tries already possessing them are prepared to sell whole delivery systems,
major components, or relevant technologies to the threshold states.

Although no current threshold state could match the United States or
Russia in expenditures for advanced delivery systems, there is conclusive
evidence that each of them is acquiring capabilities that cannot be fully
explained either in terms of peaceful programs for space research or for

\begin{itemize}
\item A bomber attains stand-off capability if it carries nuclear-armed ballistic missiles
  (such as the former U.S. "Skybolt" program) or cruise missiles (such as the air launched
  cruise missile (ALCM) currently carried on many B-52s) such that it can attack a target
  while remaining some distance from the target country's air defenses.
\item The military utility of both aircraft carriers and submarines is greatly enhanced
  if they have nuclear propulsion, which increases their range. The utility of submarines
  as a nuclear weapons carrier platform is also enhanced if they are very quiet and thus
to detect.
\item Ballistic missiles are the delivery system most sought by the nuclear threshold
  nations. They can vary greatly in terms of their range, weight-carrying capability, and
  accuracy. They may also differ in survivability, with the odds of the missile surviving a
  preemptive conventional attack or nuclear near-miss improved by the use of solid prop-
  ellants, by basing the missiles in hardened silos, or by making them mobile. Some
  ballistic missiles also have the capability of launching multiple warheads at the same
  general target. It is even possible for a missile to attack wholly separate targets
  (MIRVs), though that is a very sophisticated technology not likely to be mastered
  quickly by new nuclear powers. For example, the current French M-4 sea-launched
  ballistic missile is a multiple warhead missile, but the different warheads cannot be sepa-
  rately targeted. Only with the M-5 missile now coming on line will the French have
  MIRV capabilities. No current state of proliferation concern could reach the level of
  technical sophistication currently achieved by France for many years. Also, the Chinese
  ICBMs are not believed to be MIRV-capable.
\item Indigenous development of delivery systems will nearly always be far more
  expensive than purchase of the identical system because the selling state often wishes to
  recover a portion of its sunk costs and, accordingly, is frequently willing to sell for a
  figure above the marginal cost but below the fully amortized unit cost. In some cases,
countries will even sell below the marginal cost of the weapons. Countries may do so
for political reasons. Countries with inconvertible currencies may be willing to sell
below their marginal cost to earn hard currency. The Soviet Union and several of its
allied states apparently sold arms well below their marginal cost with the twin objectives
of gaining political influence and hard currency. Even if weapons are sold at or above
their full cost, economies of scale often make purchased systems cheaper and allow
them to be obtained far sooner than could be achieved with indigenous development,
testing, and production.
\end{itemize}
the delivery of conventional weapons.\textsuperscript{129} A number of other countries also have such programs.\textsuperscript{130}

India has a substantial space program.\textsuperscript{131} In economic terms, the considerable expenditures for that program are highly unlikely to provide cost-effective benefits to India's development, because satellite launch services can be purchased from others for as little as $20 million.\textsuperscript{132} This suggests that there are other motives, such as domestic politics and international prestige. In addition, there are clearly nonpeaceful motivations to aspects of the Indian space program, particularly the close connection between its SLV-3 space-launch vehicle and its 2500 kilometer Agni IRBM prototype, which India successfully test-fired in 1989.\textsuperscript{133} According to one estimate, the program could give India an intercontinental ballistic missile (ICBM) capability in less than twenty years.\textsuperscript{134} Also, India has shown a

\textsuperscript{129} Of course, some of these delivery systems may currently be intended for non-nuclear weapons of mass destruction, \textit{i.e.}, chemical or biological weapons. That a country was acquiring bombers or IRBMs for that purpose, rather than for nuclear weapons, would provide little comfort and would in no way preclude the nation from using those delivery systems at a later date for nuclear weapons carriage.

\textsuperscript{130} Several other countries possess ballistic or cruise missiles or have active programs for their development, though most are thought to be less advanced in terms of how soon they could have both a nuclear warhead and a functioning missile delivery system, if they decided to build one, than the countries already discussed. These include, roughly in decreasing order of current capability, South Africa, Brazil, North Korea, Saudi Arabia, Iran, Syria, and Libya.

Until recently, Argentina also had an active and disquieting ballistic missile program until President Menem displayed both wisdom and domestic political courage by scrapping its Condor II missile program. \textit{Argentina: Defence Minister Says Decision to Dismantle Condor-2 is "Definitive," BBC WORLD BROADCASTS MONITORING REP., ME/1715/111, June 15, 1993, available in LEXIS, News Library, Intl File.} Argentina had been developing the two-stage, 600 mile range Condor II in conjunction with Egypt and Iraq. Alan Friedman, \textit{US Failures Led to Missile Data Reaching Iraq, FIN. TIMES, Nov. 21, 1989, at 1; Aharon Levran, Iraq's Non-conventional Capabilities, JERUSALEM POST, Apr. 13, 1990, at 7, available in LEXIS, News Library, Intl File.} Another report stated that the range of the Condor II varied from 600 to 750 km (about 375 to 465 miles) depending on the warhead, but that it was more accurate than other third-world developed missiles in its class. \textit{Control Efforts Fail To Prevent Ballistic Missile Proliferation, DEF. ELECTRONICS, Aug. 1988, at 17.}

\textsuperscript{131} It is difficult to get a good estimate of total Indian space and missile expenditures. In 1981, Indian officials stated that they had spent $664.5 million on their space program. Stuart Auerbach, \textit{India Hitches its Future Development to a Homemade Satellite, WASH. POST, Dec. 4, 1981, at C1.} If so, and given the subsequent increase in the pace of Indian space and missile activity, it seems likely that total expenditures to date in 1995 dollars could be several billion dollars. For a good overview of the program, see \textit{Indian Missiles: Threat and Capability, RISK REP., Jan.-Feb. 1995, at 3.}

\textsuperscript{132} As of 1988, the Chinese offered satellite launch services at a cost of approximately $20 million per launch. Mark Clayton, \textit{Space-Launch Firms Come Down to Earth, CHRISTIAN SCI. MONITOR, Sept. 22, 1988, at 1.} In current dollars, the cost of Russian space launch services could drop below that.

\textsuperscript{133} \textit{Nuclear Proliferation in Southeast Asia, NAT'L SECURITY REP., June 1989, at 3, available in LEXIS, Exec Library, H'pds File.} The Agni reportedly has a range of greater than 2500 km. (1500 mi.) with a 1000 kg. (2200 lb.) payload. K.K. Chadha, \textit{India Joins a Private Circle, AEROSPACE AM., Nov. 1989, at 6.} The Agni's first stage is said to be similar to, or even identical to, that of the SLV-3 space-launch vehicle. \textit{Id. at 7.}

\textsuperscript{134} Mahnken, \textit{supra} note 118, at 7. That estimate strikes the author as very conservative. India has a very large scientific, technical, and industrial base. It seems
strong interest in other long range, nuclear-capable, delivery systems.\textsuperscript{135}

Pakistan's current delivery capabilities are more modest. It possesses forty U.S.-supplied F-16 fighters, which provide a good regional nuclear weapons delivery system.\textsuperscript{136} Indian officials profess not to be too concerned over the F-16s, declaring that they are vulnerable to India's air defense, at least for long range combat missions.\textsuperscript{137} India has expressed greater concern over Pakistan's efforts to acquire nuclear-capable missiles.\textsuperscript{138} Evidently Pakistan's indigenous Hatf I and II ballistic missile development plans have exceeded its technical and industrial capabilities as it has turned to China for assistance, in the form of M-11 missiles and related technology.\textsuperscript{139}
Israel’s U.S. supplied F-15 and F-16 aircraft are nuclear-capable and are outfitted in ways which greatly increase their effective combat range and/or weight-carrying capabilities, as demonstrated by the 1981 raid on the Iraqi OSIRAQ reactor and the 1985 raid on the PLO headquarters in Tunisia. Israel has also developed the Jericho missile, version I of which has a reported warhead capability of 1000-1500 pounds and a range of 300 miles and version II of which has been credited with a range of more than 620 miles. Both Jericho I and Jericho II missiles are believed to be capable of carrying nuclear warheads. Seymour Hersh, in his book The Samson Option, written before the demise of the Soviet Union, credits Israel with a strong interest in ICBMs in order to threaten Soviet territory with nuclear weapons.

Iraq had active ballistic missile programs, although they were far less capable than those of Israel or India. Iraq concentrated on large-scale

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[C]ertain sensitive Chinese exports raise questions about PRC compliance with [its commitment to the MTCR]. At present, the greatest concern involves reports that China, in November 1992, transferred MTCR-class M-11 missiles or related equipment to Pakistan. Such a transfer would violate China’s MTCR commitment and trigger powerful sanctions under U.S. missile proliferation law.


140. Israeli fighter planes bombed the French-supplied Iraqi reactor at Tuwaitha, over 600 miles from Israel on June 7, 1981, destroying the $100 million facility just prior to its scheduled start-up. See William Claiborne, Israeli Planes Bomb Major Iraqi Nuclear Facility, Wash. Post, June 9, 1981, at A1; Thomas O’Toole, Plant Was to be Ready Within Month, Wash. Post, June 9, 1981, at A12.


143. Israel Shrugs Off Soviet Charge over Jericho Missile, L.A. Times, July 25, 1987, at A27; Michael R. Gordon, U.S. Urges Talks on Missiles in Mideast, N.Y. Times, Dec. 27, 1988, at A3. One source estimates that if the Jericho II were outfitted with the same additional stage Israel used to launch two space satellites, its range would increase to 7,500 km. Mahnken, supra note 118, at 7.

144. One survey of missile systems world-wide credits the Jericho I with having both nuclear and high explosive (i.e., conventional) capabilities, while the Jericho II is said to have a 750 kg. nuclear warhead with a range in excess of 820 km. Curtis, supra note 115.

145. Hersh, supra note 100, at 174-81, 220-21.
importation of SCUDs\textsuperscript{146} and was working on a substantially extended range version, which it tested in April 1988 to a range of 900 kilometers.\textsuperscript{147} It was also participating, along with Egypt, in the development of the more sophisticated—and potentially far more accurate—Argentine Condor II missile.\textsuperscript{148} Iraq is credited with still having eight subsonic Tu-16 Badger/B-6D medium bombers and five supersonic Tu-22 Blinder light bombers in its inventory.\textsuperscript{149} Finally, it had a "supergun" program whose aim was to hurl a one-thousand plus pound shell several hundred miles.\textsuperscript{150}

II. The Nuclear Nonproliferation Regime and International Law

A. The Legality of Advanced Proliferation

The question of whether to undertake new and legally binding instruments in order to reduce the risk of advanced proliferation would be partially moot,\textsuperscript{151} if, as some have argued, it were illegal for nations to possess nuclear weapons.\textsuperscript{152} The argument that nuclear weapons possession is

\begin{enumerate}
\item[147.] Control Efforts Fail to Prevent Ballistic Missile Proliferation, supra note 130.
\item[149.] \textit{Iraq—Air Forces}, \textit{Flight Int’l.}, Nov. 27, 1991, available in LEXIS, News Library, Archive File. Four of the Badgers may have been Chinese-made copies. The Badgers are obsolete, and in the Gulf War the Iraqis never risked the more capable Tu-22s against the U.N. Coalition. But against less capable foes, these bombers would have given Iraq a capacity to deliver nuclear weapons on targets throughout the region. Before the war Iraq also possessed modern fighters including F-1 Mirages, MiG-29 Fulcrums, and possibly Su-24MK Fencer strike aircraft. \textit{War in the Gulf: The Balance of Power in the Air}, \textit{N.Y. Times}, Jan. 17, 1991, at A15.
\item[150.] The "supergun," a weapons concept developed by a Canadian, Gerald Bull, could have been used to deliver a large shell as far as 400 miles. Five of the guns were destroyed, under U.N. supervision, just north of Baghdad in October of 1991. \textit{Spiking the Big Guns}, supra note 105. Bull was later discovered murdered in Belgium, widely rumored to be the victim of Israeli agents.
\item[151.] Even if possession of nuclear weapons were judged on balance to be illegal under customary international law, a treaty to that effect might still be useful to eliminate any doubt on the point and to make clear exactly what conduct is prohibited (e.g., if nuclear weapons are prohibited, what about "peaceful nuclear explosives?" Is only the deployment prohibited or also the testing of devices? May a state possess delivery systems which make sense only for nuclear weapons if they do not possess the nuclear warheads themselves?). Additional purposes of such a treaty might be to set forth decision-making and dispute resolution procedures and to provide for mutual or international inspection and other verification measures.
\end{enumerate}
already illegal under international law usually starts by pointing out that a multilateral treaty already prohibits military attacks which unnecessarily or disproportionately harm civilians. Therefore, it is argued, any use of nuclear weapons would be a violation of the convention. Thus, there is no lawful object to their ownership. However, that reasoning will not withstand close scrutiny. If a party to Protocol I were to make civilians the object of an attack using nuclear weapons (or any other weapons), it would probably violate the terms of the treaty. But it does not follow

(1988). For a treatment sensitive to the argument of per se illegality, but which recognizes the potentially severe international relations consequences of acting unilaterally on that view, see Francis A. Boyle, The Relevance of International Law to the Paradox of Nuclear Deterrence, 80 Nw. U. L. Rev. 1407 (1986).

A more recent work is one of the few which recognized publicly the apparent role reversal that had military planners who wanted large increases in nuclear weapons stockpiles arguing for more emphasis on international law, while arms control advocates favored Mutually Assured Destruction. See Richard Falk, Revitalizing International Law 114 (1989) ("The ironic result seems to be that taking international law seriously, given the accompanying implausibility of getting rid of nuclear weapons or of transforming international relations in a more pacific direction, may actually clear the path for nuclear-war fighting doctrines, policies and capabilities."). For a compilation of articles expressing various viewpoints on the legality of the possession and use of nuclear weapons, see Nuclear Weapons and Law (Arthur Selwyn Miller & Martin Feinrider eds., 1984).

153. Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts, U.N. GAOR, 32d Sess., Agenda Item 115, U.N. Doc. A/32/144 (1977), 16 I.L.M. 1391 (1977) [hereinafter Protocol I]. Article 52 of this agreement (sometimes also called the "1977 Protocol I" or the "Additional Protocol") forbids making "civilian objects" the object of attack and states that "attacks shall be limited strictly to military objectives." Article 51 forbids attacks on the civilian population as such, and it also bars indiscriminate attacks that would cause incidental civilian losses that are excessive relative to the anticipated concrete military advantage.

154. A similar but even less convincing argument seeks to derive the illegality of the possession of any nuclear weapons from the Nuremberg principles, defining "inchoate crimes" as including preparations to commit a crime against humanity. See, e.g., Christopher Phelps, Nuclear Arms Will Lead to War, Not Prevent It, N.Y. Times, June 30, 1987, at A30 (letter to the editor) ("Associations of lawyers, legal scholars and judges find the current preparation for nuclear war to be illegal under the provisions of the Nuremberg Judgments and other international accords."). Because, according to this view, any use of nuclear weapons would be a crime against humanity, the acquisition of the weapons would constitute such preparation. No doubt some possible uses of nuclear weapons would constitute crimes against humanity but that would be true of chemical weapons as well. It should follow, if this reasoning is correct, that possession of chemical weapons violates the Nuremberg principles. Yet no charges were brought against German officials for acquiring the chemical weapons that Germany possessed but decided not to use. The "Nuremberg defense" has been attempted in some criminal cases brought against antinuclear protest actions. In United States v. Kabat, 797 F.2d 580, 589 (5th Cir. 1986), the court rejected the defense on the grounds that the defendants at bar, in contrast to the defendants at Nuremberg, did not need to break domestic law in order to avoid taking steps which would violate international law. Accordingly, the court did not need to reach the argument that nuclear weapons were themselves illegal. See id. at 590 n.11.

155. Of the nuclear weapons states, only China is a party to Protocol I, though the United States, the United Kingdom, and the former U.S.S.R. are signatories. See Protocol I, supra note 153. At the time the United States signed Protocol I, it stated in part that "[i]t is the understanding of the United States of America that the rules established by this Protocol were not intended to have any effect on and do not regulate or prohibit
that the possession of nuclear weapons by a party also violates the Protocol. First, Protocol I does not, by its terms, make the possession of any class of weapons illegal. Second, it does not follow that possession presupposes use: a country could wish to maintain nuclear weapons for deterrence, hoping never to have to use them, while also believing, somewhat less clearly, that it would have the right to use them if another state first used nuclear weapons against it. Third, it is not the case that any use would bring about the prohibited levels of civilian casualties. For example, among the highest priority targets for U.S. military planners were Soviet ballistic missile silos which, like U.S. silos, were often constructed in extremely remote locations. Few civilian deaths would be expected from attacking them. The same could be said for attacks on naval vessels at sea. Fourth, the line of reasoning that possession of nuclear weapons is illegal because their use would be illegal would apply with even greater force to the possession of chemical weapons, the use of which is prohib-

the use of nuclear weapons." JOHN A. BOYD, DEPARTMENT OF STATE, DIGEST OF U.S. PRACTICE IN INTERNATIONAL LAW 1977, at 919, 920 (1977). Of course, to a substantial degree, Protocol I recodified existing treaty obligations, such as those in the Hague Convention of 1910, and codified then-existing customary international law. Moreover, to the extent that Protocol I broke new ground on this point, some of those principles may well have become customary law with the passage of time.


157. There is nothing approaching a political consensus that nuclear weapons may never be used, let alone a legal prohibition on their possession. Seventy-two nations voted in favor of a U.N. General Assembly resolution that “solemnly declares ... the permanent prohibition of the use of nuclear weapons.” G.A. Res. 2936, U.N. GAOR, 27th Sess., Supp. No. 30, at 6, U.N. Doc. A/8730 (1972). But the U.S.S.R. was the only nuclear power which voted for it. China voted no, and the three Western nuclear powers, joined by virtually all other Western nations, abstained. This split vote was also seen on a resolution a decade earlier which declared, inter alia, that “[a]ny state using nuclear and thermo-nuclear weapons is to be considered as violating the Charter of the United Nations, as acting contrary to the laws of humanity and as committing a crime against mankind and civilization. ...” G.A. Res. 1653, U.N. GAOR, 16th Sess., Supp. No. 17, at 4, U.N. Doc. A/5100 (1961). The vote on that resolution was 55 yes, 20 no, and 26 abstentions. The Soviets voted for it; all the other nuclear powers, joined by most NATO countries, voted against it. The European neutrals, often the strongest proponents of nuclear arms control, abstained. Even strongly supported U.N. General Assembly resolutions are generally not thought to create international legal obligations (though they may be evidence of a consensus tending to support a claim that customary international law exists on a matter), let alone one not supported by most of the relevant states.

158. A party to Protocol I might further believe that so long as it did not attack first with nuclear weapons, it would have a right to retaliate if nuclear weapons were used against its civilian population, although the exercise of that right would be subject to a requirement of proportionality and would have to be consistent with the Protocol’s terms. But see supra note 155.

159. Of course, the fallout from a large enough attack, even if limited to remote military targets, may pose a serious radiological hazard if the civilian population is downwind of the target. That consequence might be difficult to reconcile, in a proper case, with Article 51 of Protocol I. See Protocol I, supra note 153. However, the proposition at issue here is that the possession of any such weapons is against international law, irrespective of how many are possessed and how they might be used.
ited under the 1925 Geneva Protocol\textsuperscript{160} and customary international law. Yet if mere possession of a weapons system whose use was barred by international law constituted a violation of international law, then the recent conclusion of the new chemical weapons convention, to make possession unlawful, was unnecessary.\textsuperscript{161} Fifth, the conduct and expressed views of most of the major powers is inconsistent with the claim that Protocol I is violated by a nation merely possessing nuclear weapons.\textsuperscript{162} Finally, and perhaps most importantly, the Protocol is not binding as a matter of law on nonparties, though as signatories, the United States, the United Kingdom, and Russia would be obliged not to take steps to defeat the object and purpose of the Protocol.

It might alternatively be argued that the mere possession of nuclear weapons is contrary to customary international law. However, this view is even less likely to withstand close scrutiny. First, the steps necessary for the development and recognition of customary international law cannot be met when all the major powers possess nuclear weapons, claim to do so as a matter of right, and are supported in that view by many other nations.\textsuperscript{163} Indeed, the NPT, whose more than 170 parties make it one of the most widely adhered-to treaties on any subject,\textsuperscript{164} expressly grants

\begin{itemize}
\item \textsuperscript{160} Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, June 17, 1925, 26 U.S.T. 571, 94 L.N.T.S. 65.
\item \textsuperscript{161} Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, Jan. 13, 1993, 32 I.L.M. 800 (1993). However, see supra note 151 for some of the reasons why a convention might be needed to better implement a prohibition on a class of weapons, even if the possession of those weapons is already contrary to international law.
\item \textsuperscript{162} It should be recalled that the United States, in signing Protocol I, took the position that it did not preclude the use of nuclear weapons. \textit{Supra} note 155. It did not, apparently, even see a need to address the question of its right to possess them.
\item \textsuperscript{163} Customary international law generally has two elements: (i) there must be a practice of states and (ii) states must believe that the practice is binding under international law. \textsc{Anthony D'Amato}, \textit{The Concept of Custom in International Law} 47-72 (1971). This is the view taken in Article 38(1) of the Statute of the International Court of Justice: "The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply . . . international custom, as evidence of a general practice accepted as law." Statute of the International Court of Justice, June 26, 1945, 59 Stat. 1091, T.S. No. 993, 3 Bevans 1153, 1187. The conduct of most major states, nuclear and non-nuclear alike, explicitly negates the existence of such a practice, let alone one accepted as law.
\item \textsuperscript{164} Telephone Interview with John Zylman, Office of Treaty Affairs, U.S. Department of State (Feb. 28, 1995). In keeping with the terms of NPT art. IX(2), \textit{supra} note 2, the United States is one of the three depositary governments for the NPT, and therefore the Treaty Office at the Department of State keeps the official lists of NPT parties. In the author's experience, it is virtually impossible to get a good count from published sources, and in any event, it would not be as authoritative. An accurate count is rendered yet more difficult because of the status of Taiwan and Yugoslavia. That said, Mr. Zylman's best current count of parties is 171. Notable additions in the past few months include Ukraine, Argentina, and Algeria. Except for certain "constitutional" treaties such as those which established the United Nations, the International Bank for Reconstruction and Development, and the International Monetary Fund, neither Mr. Zylman nor the author could think of a treaty with as many parties as the NPT, nor did a cursory survey of \textit{Treaties in Force} reveal any.
nuclear weapons state status to five states.\textsuperscript{165} Second, even if there were such a custom, the United States and the four other nuclear weapons states would certainly fall under the "persistent objector" exception to the applicability of customary international law.\textsuperscript{166}

Whatever its abstract merits, the claim that the possession of nuclear weapons is already illegal, and that accordingly no further steps are needed to render advanced proliferation illegal, reflects a profoundly pessimistic vision. It would amount to a confession that international law is both irrelevant and impotent when nations' central security interests are at stake. Although the five nuclear weapons states have agreed to bar the deployment of nuclear weapons in specific locations,\textsuperscript{167} and in recent years the two largest of them have made serious progress in reducing the number of strategic and intermediate range nuclear weapons,\textsuperscript{168} they still possess them. The three threshold states which are the primary focus of

\textsuperscript{165} Someone might argue that under the law of treaties, nations cannot create rights by treaty which violate peremptory norms of international law, and therefore the NPT's allowance of five states to possess nuclear weapons violates that norm. But a bootstrap argument of that kind will not work. The relevant treaty provision of the Vienna Convention declares a treaty "void if, at the time of its conclusion, it conflicts with a peremptory norm of general international law." Vienna Convention on the Law of Treaties, May 23, 1969, art. 53, 1155 U.N.T.S. 381, 8 I.L.M. 679, 698 (1969) [hereinafter Vienna Convention] (emphasis added). It is difficult to find anything to point to that would suggest that there was such a norm in 1968 when the NPT was opened for signature, i.e., nearly a decade before the conclusion of Protocol I. Of course, article 64 of the Vienna Convention also declares that if a "new peremptory norm of general international law emerges, any existing treaty which is in conflict with that norm becomes void and terminates." This is one of the controversial provisions of the Treaty. \textit{Cf.} RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 331 reporters' note 4 (1987) (noting that the United States agreed to the inclusion of arts. 53 and 64, but insisted such claims be determined by the ICJ or arbitration, and noting that the United States "is likely to take a particularly restrictive view of these doctrines . . ."). Even today one cannot demonstrate that there is a norm against the possession of nuclear weapons, let alone a peremptory norm. Moreover, it would not make for a better world to declare the NPT void on any grounds, even on the theory that it lets some nations possess nuclear weapons in derogation of a peremptory norm of international law.

\textsuperscript{166} Ted L. Stein, \textit{The Approach of the Different Drummer: The Principle of the Persistent Objector in International Law}, 26 HARV. INT'L L.J. 457 (1985) ("[A] state that has persistently objected to a rule of customary international law during the course of the rule's emergence is not bound by the rule.").


\textsuperscript{168} \textit{See supra} note 59.
this article have some nuclear weapons capabilities and seem intent on ultimately acquiring much larger and more sophisticated nuclear forces. Perhaps five or six other states are taking steps to make it possible for them to possess nuclear weapons in the future. Thus, if the mere possession of nuclear weapons is already illegal under international law, international law is having no impact on the leaders of the nations which matter most.

A far more hopeful view is that states, including the most powerful of them, give weight to international law even in matters close to their fundamental security interests. For this reason the nuclear weapons states have been extremely cautious in undertaking new obligations to restrict their nuclear forces. This view of the relationship between international law and nuclear weapons leaves open the possibility that these nations will agree to ever-more stringent restrictions on nuclear weapons and will feel bound to abide by those legal norms. Thus, although there is no prospect that we will ban nuclear weapons in the near future, establishing new treaty instruments by which the threshold states would not become full

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169. The author is one who doubts the wisdom of reducing nuclear weapons levels to zero under conditions of the current international order, even if an agreement to do so could be reached. If all nuclear weapons are banned, the nation which clandestinely preserves a handful, or subsequently acquires them, becomes extremely powerful relative to the unarmed states. No verification mechanism could be so effective that the risk can be completely excluded. See Leonard S. Spector, Repentant Nuclear Proliferants, FOREIGN POL'Y, Fall 1992, at 21 (An illuminating discussion of the difficulties of determining whether a state which had nuclear weapons, or at least weapons-usable materials, has actually placed all of them under IAEA inspection.). Flawless verification has been difficult for the IAEA in a state like South Africa, which had six fabricated nuclear weapons and a few hundred kilograms of HEU. The exact amount of past production of highly enriched uranium in South Africa is unknown, and one cannot state with certainty that all HEU has been accounted for, even after dozens of IAEA visits. S. Africa's Nuclear Cache Questioned, MIAMI HERALD, Feb. 28, 1993, at 21A. Consider then how much more severe the problem would be for the United States or Russia, each of which had tens of thousands of nuclear weapons and inventories of special nuclear material a thousand-fold or more greater than South Africa's (i.e., in multi-hundred ton quantities).

In contrast, at around 300-500 devices each in the United States and Russia, small scale cheating or development of nuclear weapons by other states would not easily destabilize the global power balance. See HARVARD NUCLEAR STUDY GROUP, LIVING WITH NUCLEAR WEAPONS (1983) (setting the safe level at 1,000 on each side). The author believes that a lower figure is justified by the demise of the Soviet Union but that the logic of the Harvard study is sound. A level of 300-500 on each side still requires dramatic reductions from presently agreed levels and would require agreement on the part of the other three nuclear weapons states as well, something likely to be very difficult to obtain. Reductions beyond that would have to await more fundamental changes in the international order. Cf. Robert S. McNamara, Nobody Needs Nukes, N.Y. TIMES, Feb. 25, 1993, at A21:

It can be confidently predicted that the combination of human fallibility and nuclear arms will inevitably lead to nuclear destruction. Therefore, insofar as it is achievable, we should seek a return to a non-nuclear world. I say 'insofar as achievable' because one or more declared nuclear powers—or an international agency—would have to retain a small nuclear force, at most 100 to 200 warheads, as protection against blackmail by nations that would develop such weapons in secret.

Id.
fledged nuclear weapons states would be highly beneficial in moving the world, perhaps asymptotically, toward that goal.

Although there is no bar to the possession of nuclear weapons by the five declared nuclear powers, it might be argued that there is already an international norm against the spread of nuclear weapons. If that view were correct, one could perhaps argue a fortiori that the further development of nuclear weapons by states at the threshold would violate existing nonproliferation norms. Whether such a norm already exists is a close call. The NPT now has more than 170 adherents, including all the nuclear weapons states and the vast majority of the non-nuclear weapons states with peaceful nuclear power programs. Furthermore, two additional states of potential proliferation concern, Brazil and Argentina, have entered into binding treaty arrangements with each other and the IAEA that bar them from having nuclear weapons and require them to place all their nuclear materials and equipment under IAEA safeguards. In addition, they have become full parties to the Treaty of Tlatelolco, which for all practical purposes imposes the same or stronger obligations on parties than the NPT. Nevertheless, few nations would affirmatively assert

170. Anthony D'Amato takes this one step further and asks whether the harm caused by proliferation creates rights at international law enforceable by other states. He sees this as a possible justification for Israel's bombing of the OSIRAK reactor, which was difficult to justify at the time as a legitimate act of self-defense under article 51 of the U.N. Charter (though there was no question that the Iraqis were laying the groundwork for nuclear weapons). Anthony D'Amato, Israel's Attack upon the Iraqi Nuclear Reactor, 77 AM. J. INT'L L. 584 (1983); ANTHONY D'AMATO, INTERNATIONAL LAW: PROCESS AND PROSPECT 83-87 (1987).

It would be difficult to see how the international community could accept the notion that such a norm exists and then agree that one of the few unambiguous norm breakers should be allowed to enforce the norm by unilateral decision and action against a state which at that time had not yet violated international safeguards or produced any nuclear material for weapons purposes. The widespread condemnation of the attack even by countries who knew there were reasons to distrust Iraq's nuclear intentions seems to suggest that at that time there was no such legal norm, or alternatively that there was such a norm, but that only those nations who then were upholding the norm had the right to enforce it.

171. See supra note 164.

172. India has the largest nuclear power program of any state not a party to the NPT. See LEONARD S. SPECTOR, NUCLEAR PROLIFERATION TODAY 65-67 (1984). India now has 10 operating power reactors that have 1940 MW of installed capacity. KAPS-2 Unit Goes Critical, POWER ASIA, Jan. 23, 1995, available in LEXIS, News Library, News File. Pakistan has a small heavy water power reactor, KANUPP, which is under IAEA safeguards. See SPECTOR, supra, at 108-09. No other non-nuclear weapons state as defined in the NPT operates a nuclear power plant without an obligation to have all its nuclear facilities under IAEA safeguards.

173. For a discussion of these treaties, see supra note 48 and accompanying text. The Treaty of Tlatelolco is superior to the NPT in that it wholly prevents nuclear weapons in a country, not just those weapons under national control. See infra note 188 for an explanation of why that distinction can be important. It also provides for a system of challenge inspections. See infra notes 284-88 and accompanying text (discussion of such challenge inspections and their potential utility in prohibiting and detecting advanced nuclear weapons design). The Tlatelolco treaty was inferior to the NPT because it was ambiguous as to whether states could develop "peaceful nuclear explosions" (PNEs). Because both the materials and the design technology for such PNEs are the same as for nuclear weapons, ambiguity on this point would leave a seri-
that states not party to these treaties have already violated an international legal norm if they acquire nuclear weapons or take steps to advance that option.\textsuperscript{175} Of course, a treaty norm can eventually become a rule of customary international law, binding even on non-parties.\textsuperscript{176} One would hope that increasingly universal NPT adherence, the passage of time, and further strengthening of the nonproliferation regime would some day allow the international community to declare that such a norm truly exists and that states which have not accepted the norm by treaty are nonetheless bound to adhere to it. In the author's view, this point has not yet been reached.

Alternatively, as the norm becomes more nearly universal, it may become progressively less acceptable \textit{politically} for a state to acquire nuclear weapons or to enhance existing nuclear capabilities, and it may become more likely that such action will be viewed as a threat to international peace and security. The U.N. Security Council (UNSC) could make that judgment at any time; it would not be a legal decision, in the sense of judging whether a particular course of conduct is legal under existing international law. However, once decided, the Council would then have the legal authority to enforce its decision under chapter VII of the U.N. Charter. We may get to the point where the UNSC becomes an effective enforcement mechanism against further proliferation,\textsuperscript{177} but we are not

\begin{itemize}
  \item \textsuperscript{175} This assertion is difficult to prove. The consideration of U.N. Security Council Resolutions 687 and 715—requiring the destruction of facilities and equipment which contributed to Iraq's nuclear weapons program and establishment of a comprehensive long-term intrusive monitoring program thereafter—would have been an opportune time to assert such a general legal obligation, if nations thought there was one. S.C. Res. 687, U.N. SCOR, 2981st mtg., U.N. Doc. S/RES/687 (1991); S.C. Res. 715, U.N. SCOR, 5012th mtg., U.N. Doc. S/RES/715 (1991). The resolutions were instead based on the \textit{political judgment} that the continued possession of weapons of mass destruction by Iraq, or the means for their construction in Iraq's hands, represented a threat to international peace and security, and were not based on a \textit{legal determination} that possession of them was illegal for all nations and therefore illegal for Iraq.
  \item \textsuperscript{176} Such a customary rule would be subject to the persistent objector exception, unless, perhaps, the customary rule had also become a peremptory norm. Interestingly, the three threshold states might have difficulty qualifying for that exception, as they have not generally argued that they have the right to acquire nuclear arms but rather that the NPT is unacceptable because it is discriminatory. For a discussion of some of the complexities of the persistent objector doctrine, see Stein, \textit{ supra} note 166, and David A. Colson, \textit{How Persistent Must the Persistent Objector Be?}, 61 \textit{Wash. L. Rev.} 957 (1986).
  \item \textsuperscript{177} The Council has taken halting steps in that direction. Among those steps are Resolutions 687 and 715 on Iraq. U.N. Security Council Resolution 687 (Apr. 3, 1991) was the basic cease fire resolution, accepted by Iraq, which required the destruction of its nuclear, chemical, biological, and ballistic missile programs and required special IAEA inspections to be carried out as part of the work of the Special Commission also established by the Resolution. United Nations Security Council Resolution 715 (Oct. 11, 1991) has not been accepted by Iraq, but it is binding on it, having been adopted under chapter VII of the U.N. Charter. It establishes a permanent system of monitor-
\end{itemize}
there yet. The difficulties are likely to be far greater for advanced proliferation than for the nascent variety. 178

B. Nature of the Existing Nonproliferation Regime

The nuclear nonproliferation regime179 is a complex one. 180 Its centering, in part by the IAEA, to ensure that Iraq continues to live up to the requirements of Resolution 687.

Another important Security Council step was the call on North Korea to reverse its decision to pull out of the NPT. See supra note 98. A third Security Council step was the Summit Declaration of the Council (with 13 members of the Council represented by heads-of-government) that additional proliferation would be threatening and pledging that the Council would take "appropriate action" to prevent it. But that declaration does not constitute a binding decision of the Security Council to take strong action against additional proliferation.

178. For example, it is hard to imagine the Council taking vigorous action in the near future against India for continuing to add to its nuclear capabilities (particularly if it does nothing dramatic like test a thermonuclear device or announce that it had deployed nuclear weapons to its forces). Security Council action against India would be a major political battle given that it is a leader of the third world and that the Soviet Union, France, and the United Kingdom at times have had close relations with India. One would not expect countries to volunteer to carry out military sanctions against India, given that it is a country with considerable military capabilities. Even less likely would be chapter VII sanctions against Israel, given its political relations with the United States, absent some egregious act. China can be expected to block vigorous action against its ally Pakistan.

Of course, the Council might take less drastic steps someday. For example, the Security Council could give all states with nuclear facilities not under IAEA safeguards a reasonable time to enter into arrangements with the IAEA for safeguards, after which, if there was not compliance, the international financial institutions (the International Bank for Reconstruction and Development, for example) would no longer be permitted to make certain classes of loans to them. Such a measure would be politically far more acceptable if the nuclear states had already placed all their nuclear facilities under IAEA safeguards. See infra part III.C.1.

179. Regime theory is a key component of current international relations scholarship with significant implications for our understanding of international law and its role in the international system. In the past two decades, international relations scholars have spent considerable efforts seeking to explain international cooperation in a world order which earlier Realpolitik theory portrayed as Hobbesian at best. The realist school held that the conduct of states is dictated solely by their perceptions of their immediate national interest, usually construed largely in terms of their physical security. Yet across apparently insurmountable gulfs of superpower rivalry, ideology, nationalism, and competition for influence, resources, and markets (in such diverse areas as telecommunications, international trade, and multilateral arms control) states would often act (or refrain from acting) in ways which were the opposite of what one would expect of them in the narrowest definition of their national interest. The response to this puzzle which gained the greatest attention was the theory of "regimes." A detailed discussion of the early literature on regimes is beyond the purposes of this article. The concept apparently arose first in international law, where it was used to describe particular legal arrangements for special geographic areas or features, as in the "regime" for Danzig or the "regime" for navigation on the Rhine. It was further elaborated by L.F.E Goldie, Special Regimes and Pre-emptive Activities in International Law, 11 INT'L & CoMP. L.Q. 670 (1962). The most commonly quoted definition in international relations theory is Krasner's: "[r]egimes can be defined as sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations." Stephen D. Krasner, Structural Causes and Regime Consequences: Regimes as Intervening Variables, in INTERNATIONAL REGIMES 1, 2 (S.D. Krasner ed., 1983). For one analysis of the nonproliferation regime in theoretical terms, see
piece is a major legally binding instrument, the Nuclear Non-Proliferation Treaty. The NPT obliges the five nuclear weapons states not to transfer nuclear weapons to states that did not possess nuclear weapons as of the effective date of the treaty, and it also obliges them not to assist or encourage states to acquire nuclear weapons.\textsuperscript{181} Non-nuclear weapons states agree not to acquire them,\textsuperscript{182} and they agree to allow the verification of that pledge by placing all of their nuclear materials and equipment under the safeguards system of the IAEA.\textsuperscript{183} This is bolstered by an obligation placed on all parties not to provide nuclear materials and equipment for peaceful purposes to any non-nuclear weapons state, including nonparties, unless safeguards will be applied.\textsuperscript{184} State parties have a right to utilize nuclear energy for peaceful purposes, and parties in a position to do so pledge to assist non-nuclear weapons states, especially the developing countries, in peaceful uses.\textsuperscript{185} In exchange for the non-nuclear weapons states' pledge not to acquire nuclear weapons, the nuclear weapons states promise to pursue good faith negotiations toward halting the arms race and pursuing disarmament.\textsuperscript{186}

There are several other bilateral or regional treaty arrangements which support the same general norms. The most significant is the Treaty

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180. Classic regime theory appears to assume that the fundamental features of regimes are the same irrespective of subject matter. In contrast, the author has previously speculated that certain regimes, those which could be designated as "complex," have major differences in kind from "simple" regimes. Richard L. Williamson, Jr., \textit{Building the International Environmental Regime: A Status Report}, 21 U. MIAMI INTER-AM. L. REV. 679, 740-43 (1990). In brief, complex international regimes frequently deal with topics that have far greater potential for conflict, including those which deal with vital international security or core economic interests. They generally cover a number of inter-related problems, unlike simple regimes which usually deal with a single issue area. Complex regimes are often highly controversial. The parties to such a regime may well have a common set of values or interests. Yet unlike simple regimes, where the problems are usually extrinsic to the governments of the various participating states, the problem to be dealt with by complex regimes is often the behavior of the holdouts, the countries which have not joined the regime. Building a consensus which will make the regime more nearly universal and restraining or at least influencing the behavior of the nonparticipants are often self-conscious objectives of the regime participants.

In complex regimes, the legal arrangements may be far more detailed than in simple regimes. Complex regimes often involve the use of several treaty instruments and/or established bodies of customary international law. Often, one or more international organizations play an important role. They are sometimes given decision-making powers in areas otherwise thought to be matters of national sovereignty. In furthering the norms of the regime, major actions may sometimes be taken by the participant states which they have no legal duty to perform. These nonlegal mechanisms may include the provision of financial or other practical assistance, diplomatic coordination, intelligence sharing, the imposition of export controls, discretionary sanctions, or even military force.

181. NPT, \textit{supra} note 2, art. I.
182. \textit{Id.} art. II
183. \textit{Id.} art. III(1) & (4).
184. \textit{Id.} art. III (2).
185. \textit{Id.} art. IV.
186. \textit{Id.} art. VI.
of Tlatelolco, the goal of which is the creation of a nuclear weapons free zone in Latin America. Under this Treaty, the parties agree, inter alia, not to receive or acquire nuclear weapons, not to allow nuclear weapons belonging to other states on their territory, and to place their nuclear materials and equipment under IAEA safeguards. Protocol I of the Treaty obliges the states with dependent territory in the zone to apply the Treaty's denuclearization provisions in those territories. Protocol II, the first nuclear arms control agreement entered into by all five nuclear weapons states, obliges those states to respect and not undermine the purposes of the Treaty and not to use or threaten to use nuclear weapons against the parties to the Treaty. A somewhat similar nuclear weapons free zone agreement has been established for the South Pacific, and serious discussions are being held to establish such a zone for Africa. There is also an international convention on the physical protection of nuclear materials.

188. Nuclear Weapons Free Zones (NFZs) can potentially support the nonproliferation regime in several ways. First, in contrast to the NPT, parties to such a zone agree not to allow any other nation to position nuclear weapons on their territories. From the perspective of mutual confidence in certain regions, that may be preferable because country A may not find a situation acceptable if its neighbor, country B, remains true to its NPT obligations and acquires no nuclear weapons but B's ally, C, stations nuclear weapons on B's territory that are aimed at A. Second, NFZs can contain specific features which go beyond those of the NPT, such as supplemental inspection rights or assurances by the nuclear powers that they will not use or threaten to use nuclear weapons against the states in the zone. Third, the NFZ provides supplemental assurance of nonproliferation in a particular region in the event the global NPT were to collapse. While this proposition remains to be tested, it seems likely that compliance with the overall nonproliferation regime will be enhanced when there is a web of legal obligations and relationships at various levels—global, regional, and bilateral—all supporting the same norm. A state which has bilateral arrangements with its neighbors by which it gives up nuclear weapons, is a party to an NFZ, and is a party to the NPT might conclude that it risked offending too many countries in too many different ways if, for example, it violated or abrogated IAEA safeguards.  
189. Treaty of Tlatelolco, supra note 48, art. 1.  
190. Id.  
191. Id. art. 13.  
192. Under Protocol I of the Treaty, the United States is obliged to keep nuclear weapons out of Puerto Rico and the Virgin Islands and to apply IAEA safeguards to any nuclear facilities which may someday be located in those territories. Id. Protocol I.  
194. South Pacific Nuclear Free Zone Treaty, Aug. 6, 1985, 24 I.L.M. 1440, 1442 (entered into force Dec. 11, 1986); Status of South Pacific Nuclear Free Zone Treaty (SPNFZ) and Final Text of the Three Protocols to the SPNFZ Treaty, opened for signature Aug. 6, 1985, 28 I.L.M. 1599 (1989) (entered into force Dec. 11, 1986) [hereinafter Treaty of Rarotonga]. Although the Treaty of Rarotonga is in effect, the United States, the United Kingdom, and France have not ratified any of the Protocols which serve to apply the zone to dependent territories and oblige the nuclear weapons states to respect the zone (analogous to the two Tlatelolco Protocols) as well as forbid the nuclear weapons states from testing nuclear weapons in the zone. Id. Obtaining the agreement of the nuclear weapons states to these provisions, especially French agreement to cease nuclear testing at its Pacific test site, was a substantial part of the motivation for establishing the zone.  
195. Interviews with ACDA and Department of State officials, in Washington, D.C. (June 3, 1994).
The International Atomic Energy Agency plays a critical role under all of these treaties. Various treaty arrangements grant it the right to carry out nuclear safeguards, i.e., to inspect nuclear facilities and account for nuclear materials. These are activities otherwise thought to be a matter of national sovereignty. Regional organizations also play a role. In the event of a violation of IAEA safeguards, the U.N. Security Council will become involved because the IAEA Statute requires the organization to report safeguards violations to the Security Council, as was done in the North Korean case. These features of the regime meet most sensible definitions of international law. In addition, as a discretionary matter, the U.N. Security Council could determine that certain proliferating activities constitute a threat to international peace and security, thereby requiring mandatory enforcement actions under chapter VII of the U.N. Charter.

These primary features of the nonproliferation regime are supplemented by a series of subordinate implementing measures which are legally binding in various ways. One is the safeguards agreements negoti-
ated with the IAEA. Although their negotiation is often required by other treaties, they have the status of international agreements in their own right.\textsuperscript{201} These safeguards agreements are supplemented by subsidiary arrangements and facility attachments which draw their legal authority from the safeguards agreement itself. Also implementing the regime's primary treaties are certain decisions of the IAEA Board of Governors, which do not take the form of international agreements but sometimes have binding effect as a practical matter.\textsuperscript{202} These implementing measures are further supplemented by commonly accepted interpretations of certain treaty provisions. Again, these are not in the form of treaty instruments, but they are agreed to by member nations and derive their authority from the treaty, as they involve an elaboration of an important treaty term.\textsuperscript{203}

Although much of the regime rests on legally binding measures or instruments which derive their legal force from legally binding docu-

\begin{itemize}
\item \textsuperscript{201} Many safeguards agreements, particularly in recent years, have been entered into pursuant to the NPT. See infra note 202. Some others were entered into pursuant to the Treaty of Tlatelolco by those states that were parties to that treaty but not yet parties to the NPT. Recently, the IAEA, Brazil, Argentina, and a control authority created by those two nations entered into a safeguards agreement similar in concept to those under the Treaty of Tlatelolco and the NPT. See supra note 48. Many earlier agreements were entered into by non-nuclear weapons states that were not parties to the NPT, to meet conditions imposed by a supplier of nuclear materials or equipment because of the NPT safeguards obligation on the export of nuclear material, see infra note 203, or because of a supplier's unilateral policy. These agreements were entered into pursuant to a decision of the Board of Governors commonly referred to as INFCIRC/66. \textit{The Agency's Safeguards System (1965, As Provisionally Extended in 1966 and 1968)}, IAEA Doc. INFCIRC/66/Rev.2 (Sept. 16, 1968). Another class of safeguards agreements are those entered into between the IAEA and the nuclear weapons states to place certain of their facilities, or in the case of the United States, all of their civil nuclear facilities, under IAEA safeguards. See infra note 204. These serve to reduce claims of discrimination while also giving the IAEA inspectorate experience in applying safeguards to larger or more exotic nuclear facilities.
\item \textsuperscript{202} See \textit{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 (May 1971) [hereinafter INFCIRC/153]. A party to the NPT with nuclear materials on its territory must place them under the safeguards system. Id. at 1. INFCIRC/153 tells the IAEA staff the terms which must be contained in such agreements. A country cannot effectively meet its NPT obligations except by following the terms of INFCIRC/153. On the other hand, if the Board of Governors were to change INFCIRC/153, the changes would not automatically apply to existing agreements.
\item \textsuperscript{203} Following the entry into force of the NPT, the NPT Exporters Committee was established under IAEA auspices and chaired by Professor Claude Zangger of Switzerland. (The committee was always informally called the Zangger Committee. In a rare display of sentiment, the official name was recently changed to the Zangger Committee in his honor.) The purpose of the committee was to establish a list of materials and equipment which could not be exported by an NPT party without IAEA safeguards, consistent with the terms of article III (2) (b) of the NPT. The Zangger list was derived in part from a list which had been used quietly by some Western nations. See Gary K. Bertsch et al., \textit{Multilateral Export Control Organizations}, in \textit{International Cooperation on Nonproliferation Export Controls} 41, 41-44 (Gary K. Bertsch et al. eds., 1994). The Zangger list later served as the nucleus for the Suppliers' Guidelines, see infra note 204.
\end{itemize}
ments, other aspects of the regime depend on nonbinding agreements. Finally, there are critical elements of the regime which are not international agreements at all. Among these elements are cooperation in export control matters, diplomatic pressure, military or covert action, international studies (to change countries' perceptions and broaden consensus), and intelligence sharing arrangements. Other efforts include material assistance to the peaceful nuclear programs of developing countries which are parties to the NPT, cooperation in finding safe repositories for excess special nuclear material, and unilateral export limitations. All of these measures have been used or are currently under active consideration to bolster the nonproliferation regime.

C. Vitality of the Nonproliferation Regime

The existing nonproliferation regime is alive and well, even though it has been declared dead or certain to fail on numerous occasions. A quarter of a century after the NPT entered into force, no nation has yet declared itself to possess nuclear weapons beyond the five nuclear weapons states, although prior to the NPT (and even since that time) many experts predicted that there would be dozens of nuclear powers. More than 170 countries are now party to the NPT, making it one of the most widely adhered to treaties on any subject. Early adherents included several states which could have readily acquired a nuclear weapons arsenal if they had chosen to do so, including Sweden, Canada, and several EC member states.

204. See Communications Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, IAEA Doc. INFCIRC/254/Rev. 1/Part I (July 1992), 31 I.L.M. 1232 (1992) [hereinafter Suppliers' Guidelines]. These are in the form of a series of identical letters to the Director General of the IAEA and purport to be unilateral statements of national policy. They are not thought to be an international agreement in a legally binding sense, though they have some of the features of an international agreement.

205. From time to time, there has been considerable interest in establishing some kind of international storage repository for surplus separated plutonium. Recently, there has been interest in finding a safe storage site for spent research reactor fuel, which still contains considerable HEU even though it is no longer usable in the reactor. Interview with a Department of Energy official, in Washington, D.C. (June 6, 1994).

206. See supra note 164.

207. Sweden ratified the NPT in 1970. ACDA, supra note 198, at 97. However, Sweden had an active nuclear weapons program until 1968, the last aspects of which were finally terminated in 1972. The following account is based on conversations the author had with Swedish defense officials while he was in government and on the account in Spector, supra note 116, at 65-79 (which Spector said he based in good part on an expose in a Swedish technical journal by Christen Larssen. Build a Bomb, Ny Teknik, Apr. 25, 1985).

Sweden could readily have had several nuclear weapons by the mid-1960s, had it decided to do so openly. It had completed a design substantially more sophisticated than the Nagasaki device by 1958, and in 1963, the Agesta reactor, which could produce enough plutonium for about three weapons per year, began operations. Spector, supra note 116, at 66-71. However, after years of contentious debate, in 1958 the Parliament decided to postpone the decision on whether to acquire nuclear weapons and in the meantime ordered a halt to further nuclear weapons research except for "protective research." Id. at 68. This drove the program underground, but the Defense Ministry made considerable progress on further refinements in weapons design under the pro-
Some of the adherents that have joined more recently are states whose financial and/or technical resources would give them the wherewithal to acquire nuclear weapons given enough time and whose security concerns or regional aspirations led some observers to suspect they had an interest in the ultimate acquisition of nuclear weapons. Spain, Turkey, Egypt, Indonesia, Saudi Arabia, South Korea, and several others fall into this category. By far the most notable of the recent additions to the NPT as a non-nuclear weapons state is South Africa. It is a protective research rubric, apparently without the knowledge of the public or the Parliament. Id. at 69. The immediate goal of the program was probably modest, a handful of devices. But the Marviken reactor, which was completed but never operated, was designed with the specific goal in mind of producing enough plutonium for 10 nuclear weapons per year. Id. at 71. Had it operated at design capacity (something reactors generally do not accomplish), the Swedes would have had enough plutonium by now from that reactor for about 250 nuclear weapons, a weapons force roughly comparable with that of China. Instead, for the past two decades, the Swedes have been among the strongest nonproliferation advocates.

Canada deposited its instrument of ratification of the NPT in 1969, ACDA, supra note 198, at 95, being one of the first Western democracies to do so. The Canadians had been participants, along with the United States and the United Kingdom, in the wartime Manhattan Project to produce nuclear weapons. Possessing vast quantities of natural uranium and excellent scientists, and having focused on heavy-water moderated reactors which can be superior plutonium producers, the Canadians could have had nuclear weapons, had they chosen to do so and made it a high priority, by the early 1950s. Fortunately, they had better sense and have gone on to be among the most effective advocates for nonproliferation, often serving as the conscience of the international community on nuclear export matters.

The non-nuclear weapons states which were members of the European Community at the time, Germany, Italy, and the BENELUX countries, all deposited their instrument of ratification on the same date in 1975. Id. at 95-97.

Japan deposited its instrument of ratification in 1976, id. at 96, after nearly all the other Organisation for Economic Co-operation and Development (OECD) countries had done so. Japan's U.S.-written constitution forbids the acquisition of nuclear weapons, and as a result of its experience with Hiroshima and Nagasaki, nuclear weapons are profoundly disturbing to most Japanese. However, it took some time for a consensus to build in favor of the NPT, particularly given concerns that NPT adherence and the associated IAEA safeguards would interfere with Japan's ambitious nuclear power program. In any case, as is typical of that society, once Japan ratified the treaty, it took the obligation very seriously. In the author's experience, Japan was the only country (excepting the United Kingdom, Australia, and Canada, with which the United States has special standing arrangements for intelligence sharing) which could be counted on without exception to act with dispatch to block exports of items sought by known or suspected nuclear weapons programs, once the United States told Japanese officials about the export and its significance.

South Africa had always been a state of proliferation concern. It possessed vast supplies of natural uranium and a largely indigenously developed enrichment technology. It had completed a pilot plant using that technology, which was capable of producing enough highly enriched uranium for several nuclear weapons per year if it ran in that mode at full capacity. In 1981, South Africa announced the successful production of highly enriched uranium. Kurt M. Campbell, What About South Africa's Bomb?, CHRISTIAN SCIENCE MONITOR, Jan. 22, 1987, at 13; Paul Lewis, Pretoria Willing to Discuss Atom Ban, N.Y. TIMES, July 15, 1988, at A3.

South Africa also had a substantial scientific research base. It possessed much of the equipment for nuclear weapons development and engaged in experiments in relevant physics which had no peaceful applications. In 1977, a Soviet satellite detected what appeared to be a nuclear test site in the Kalahari Desert. The U.S.S.R. told U.S. authori-
the only country that previously possessed nuclear weapons under its sole control but stepped back from that posture and established itself as a non-nuclear weapons state. South Africa’s adherence to the NPT is important because many observers assume proliferation is a one-way street: that once a state acquires nuclear weapons, it will never reverse course. Moreover, because of its considerable resources in the nuclear field, South Africa would have been a prime example of a state with a nascent program poised to become an advanced proliferator if it chose to do so.

Another important development was the decision by China and France to join the NPT. Thus, all five nuclear weapons states are now parties to the treaty. Before becoming a signatory France declared in recent years that it would behave as if it were a party despite its earlier resistance, and China abandoned its former open hostility toward the concept of nonproliferation. Nevertheless, in the absence of a legally binding obligation, the possibility always existed that France or China could reverse their unilaterally declared policies. The nonproliferation regime could quickly unravel if an existing nuclear weapons state were to transfer nuclear weapons, or the expertise for their design and construction, or to begin selling HEU, plutonium, or facilities and technology for their production or separation without international safeguards.

One other important consequence of near-universal NPT membership is that all potential “turn-key” suppliers of power reactors, enriched
ties that South Africa was preparing to test a nuclear device. After confirming the information, the U.S. and other Western governments warned Pretoria of the severe repercussions which would follow such a test. The site was abandoned shortly thereafter. Murray Marder, *Carter Says S. Africa Denies Intent to Develop Any Nuclear Explosives*, WASH. POST, Aug. 24, 1977, at A1.

South Africa was also widely, though not universally, accused of setting off a very low yield nuclear device somewhere over the South Atlantic, either on its own, or in conjunction with Israel. Nordland, *supra* note 23. For these reasons, it was generally assumed either to have several nuclear weapons, or to have the components readily available to fabricate nuclear weapons on short notice. Bill Keller, *South Africa Says it Built 6 Atom Bombs*, N.Y. TIMES, Mar. 25, 1993, at A1. Indeed, subsequently, South African President De Klerk revealed that South Africa had six fully fabricated nuclear weapons which it could deliver with its British-supplied Buccaneer bombers and was working on a seventh. The full text of De Klerk’s March 24, 1993, statement to the South African parliament can be found in *De Klerk Tells World South Africa Built and Dismantled Six Nuclear Weapons*, NUCLEAR FUEL, Mar. 29, 1993, at 6.

A fascinating account of the South African bomb program, including details on weapons type, the nature of the development program, the reasons for its creation, the reasons why it was abandoned, and some lingering questions can be found in a two-part series: Mark Hibbs, *South Africa’s Secret Nuclear Program: From a PNE to a Deterrent*, NUCLEAR FUEL, May 10, 1993, at 3; Mark Hibbs, *South Africa’s Secret Nuclear Program: The Dismantling*, NUCLEAR FUEL, May 24, 1993, at 9.

212. Belarus, Kazakhstan, and Ukraine, which recently joined the NPT as non-nuclear weapons states, see *supra* note 41 and accompanying text, have nuclear weapons on their territory, but those weapons are actually under Russian control pending their dismantlement and/or transfer to Russia.

213. *See supra* note 47.

214. *See supra* note 46.
uranium fuel, and commercial-scale sensitive nuclear technology now have a treaty obligation not to transfer nuclear materials or equipment unless the facilities and materials will be under IAEA safeguards. Most of the major nuclear suppliers have taken an even more significant step and declared a policy of full-scope safeguards, i.e., a requirement that as a condition of supply of nuclear materials, reactors or sensitive nuclear technology, the recipient country must have all its nuclear facilities under IAEA safeguards. Closely related to this development has been the

215. As the term is generally understood and as used in the Suppliers' Guidelines, supra note 204, "sensitive nuclear technology" is equipment, material or technology for nuclear fuel reprocessing, for uranium enrichment, or for the production of heavy water. Extra restraint in the supply of reprocessing and enrichment technology must be exercised because it gives a state direct access to weapons-usable materials. The rationale for inclusion of heavy water production technology within that term is that it is comparatively easy to make reactors which are excellent producers of plutonium and which are not likely to be subject to the sanction of a fuel cutoff, see supra note 28, if a state has access to heavy water not subject to IAEA safeguards.

216. India, Israel, and Pakistan possess sensitive nuclear technologies but not on a commercially useful scale. India has "indigenous" power reactors (largely modifications of early Canadian CANDU reactor designs), see supra note 172, but it is not marketing them for sale. Even if it did, it is questionable whether a state seeking nuclear weapons could obtain enough heavy water to charge an Indian-made reactor without having to agree to an IAEA safeguards obligation. India has been a significant net importer of heavy water, much of it from the Soviet Union. Mark Hibbs, Nonproliferation Policy on Hold, Kiev's Heavy Water Is at Issue, NUCLEAR FUEL, Aug. 17, 1992, at 8, available in LEXIS, News Library, Nwlttrs File. Recently, India sold 100 MT of heavy water to South Korea, suggesting that in the future, it may be able to provide enough for a reactor's initial charge. Shekhar Hattangadi, KEPCO and DAE Sign Deal for Woliang Heavy Water Supply, NUCLEONICS Wk., Apr. 14, 1994, at 5, available in LEXIS, News Library, Nwlttrs File.

217. The primary advantage of a full-scope safeguards policy is its ability to force recipient nations to choose between having nuclear power programs and nuclear weapons programs. As long as countries could continue to obtain nuclear materials, equipment, and technology from more advanced suppliers subject to safeguards, they did not need to abandon the possibility of constructing a parallel program free from safeguards. Over the years, despite the free rider problem (countries such as Germany and Switzerland taking commercial advantage of the market created for them by the full-scope safeguards policies of others), the United States, Canada, Sweden, Japan and a number of the smaller nuclear suppliers in both Eastern and Western Europe had adopted some form of full-scope safeguards policies. A substantial breakthrough toward a more nearly universal policy was finally achieved at the 1990 NPT Review Conference. In what has been described as a dramatic gesture, German Foreign Minister Gencher personally announced that the German government was reversing its prior stance and would henceforth require full-scope safeguards as a condition of supply for all new contracts. See Leonard Spector & Jacqueline Smith, Treaty Review: Deadlock Damages Nonproliferation, 46 BULL. ATOM. SCI. 39, 41 (1990). In less than a year, the United Kingdom and France followed suit. Ann MacLachlan & Ralf Seiddiqui, France, U.K. Launch Full-Scope Safeguards on Nuclear Exports, NUCLEONICS Wk., Oct. 1991, at 5; France Pledges to Respect Full-Scope Safeguards of its Nuclear Exports, AGEANCE FRANCE PRESSE, Sept. 24, 1991, available in LEXIS, News Library, Wires File; David White, Nuclear Safeguards Shaken: Iraq Reveals Revelations Expose Weaknesses, FIN. POST, Oct. 8, 1991, at 47. A consensus on full-scope safeguards by all the states adhering to the Suppliers' Guidelines was reached at the Warsaw meeting of the Nuclear Suppliers' Group, which brought the Swiss, Russians, and several minor suppliers fully into the full-scope fold. The policy is contained in Part II to the Suppliers' Guidelines, IAEA Doc. INFCIRC/254/Rev.1/Part 2 (July 1992), 31 I.L.M. 1094 (1992) [hereinafter Suppliers' Guidelines, Part II).
decision of the same suppliers not to supply certain dual-use items unless the recipient nation has such a full-scope safeguards obligation.

A final major development has been the mutual decision of Argentina and Brazil to renounce nuclear weapons, place all of their nuclear facilities under IAEA safeguards, and bring the Tlatelolco Treaty into effect. Argentina and Brazil took these steps outside the NPT but within the confines of the nonproliferation regime.

These examples do not suggest that all motion has been forward. First, as noted, Iraq has exposed to public view how far a determined state could progress toward the acquisition of nuclear weapons production capabilities while seeming to abide by its NPT obligations. Clearly, the NPT is a necessary but far from sufficient answer to the nascent proliferation problem, and the IAEA safeguards system can, at best, only make a partial contribution to the resolution of the clandestine nuclear facility problem. More generally, several of the states of current proliferation

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218. The concept of dual-use technologies is explained in greater detail infra note 245.

219. The new list, Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Material and Related Technology, was adopted on April 3, 1992 in Warsaw by 27 states (the United States, Australia, Canada, Japan, and nearly all of Europe). It was derived in good part from the nuclear items on the U.S. commodity control list administered (with interagency input) by the Department of Commerce under the Export Administration Act. The new list is contained in Part II of the Suppliers' Guidelines. See supra note 217.

220. See supra note 48 for a more thorough discussion of this development. Very recently, Argentina adhered to the NPT. See supra note 164.

221. In addition to the changes noted in text, some of the most important positive developments include: (a) further improvements in the technical efficacy of IAEA safeguards, (b) submission of all known nuclear facilities in all the non-nuclear weapons states, other than Israel, Pakistan, India, and apparently North Korea, to those safeguards, (c) improvements in the international "trigger lists" of items which require IAEA safeguards as a condition of supply, (d) voluntary offers of varying kinds by which each of the existing nuclear weapons states have placed certain of their peaceful nuclear facilities under IAEA safeguards, (e) improvements in the physical protection of nuclear facilities and materials, including progress in lowering the enrichment level of fuel used in research reactors, (f) improvements in intelligence-sharing and technical means of intelligence collection on nonproliferation matters, (g) a reduction (though hardly the elimination) of the over-politicization of the IAEA on North-South lines, which has hobbled some other international organizations, and (h) very recently, the IAEA's use of sophisticated means of environmental sampling to assist the detection of undeclared facilities and nuclear materials. A full listing of the improvements in the nonproliferation regime since its establishment is beyond the purposes of this paper.

222. Some observers, including the author, believe the IAEA has always had a right to inspect undeclared nuclear facilities in NPT member states if necessary to verify that all nuclear material in the state complies with IAEA safeguards. See Lawrence Scheinman, The Current Status of IAEA Safeguards, in A New Nuclear Triad 17 (David Fischer et al. eds., PNN Study Three, 1992); George Burn, Does the NPT Require its Non-Nuclear Weapon Parties to Permit its Inspection by the IAEA of Nuclear Activities that Have Not Been Reported to the IAEA?, in A New Nuclear Triad, supra, at 47-49. The issue was largely a theoretical one until the Iraq case. In practice, the IAEA never concerned itself with undeclared nuclear facilities. However, the draft final declaration of the 1990 NPT Review Conference noted the existence of rights to carry out special inspections in INFCIRC/153, supra note 202, and called on the Agency to study "the possible scope, applications and procedures of such inspections." See Spector & Smith, supra note 217.
concern in addition to Iraq are parties to the NPT, including North Korea, Libya, and Iran. Some would add Algeria and Taiwan. Furthermore, while the status of several countries of the former Soviet Union as non-nuclear weapons states under the NPT has finally been resolved, the actual elimination of all nuclear weapons from their territory will take considerable time.\textsuperscript{223}

In sum, while many problems remain,\textsuperscript{224} and new ones have arisen,

The IAEA Board of Governors recently endorsed a declaration by the Director General that the Agency has the legal authority to undertake special inspections anywhere in an NPT state if reasonably necessary to verify that all nuclear material is under safeguards. \textit{IAEA Board of Governors Strengthens Nuclear Safeguards Inspection Regime}, IAEA Doc. No. PR 92/12 (Feb. 26, 1992) (press release); \textit{IAEA Board of Governors Reviews Agency's Inspections in the Democratic People's Republic of Korea (DPRK)}, IAEA Doc. No. PR 93/5 (Feb. 25, 1993) (press release). The Board of Governors' resolution is somewhat vague as to the kind of information the Director General may consider sufficiently reliable to trigger the right, but apparently intelligence information unilaterally supplied by a member state would suffice. This authority was severely tested in the North Korean case, where much of the initial dispute was over the IAEA's right to carry out special inspections of two suspected nuclear waste disposal sites. At least on this score, the North Koreans won a partial victory, as the agreement with the United States does not require it to allow access to those sites until most of the benefits to North Korea under that agreement have already occurred, \textit{i.e.}, several years from now. In any event, the IAEA does \textit{not} have a clear mandate in the text of the NPT or subsidiary documents to search out clandestine nuclear weapons-related activities or facilities unless there is reason to suspect a diversion of nuclear material or unless the facility in question is one where nuclear materials are customarily located. Thus, the Board of Governors' resolution would not cover factories for the production of enrichment equipment (which have been much at issue in Iraq) or design and test facilities for the development of nuclear weapons per se, so long as they contain no nuclear materials. Furthermore, if a country allegedly obtains fully fabricated nuclear weapons by clandestine purchase or theft, the IAEA has no authority to investigate under the NPT, though it does have that authority in states that are party to the Treaty of Tlatelolco. \textit{See} Treaty of Tlatelolco, \textit{supra} note 48.

The clandestine nuclear facility problem affects the entire nonproliferation regime, but it is comparatively less important for some aspects of advanced proliferation. The facilities needed for the large-scale production of special nuclear material are harder to hide from foreign intelligence services than are smaller facilities which might suffice for nascent proliferation. The same could be said for the possession (though not necessarily the precise location) of long-range delivery systems. Finally, the development of ICBMs, SLBMs and IRBMs cannot be accomplished (except by outright purchase) without flight-testing. Development of true thermonuclear devices requires extensive assistance or nuclear testing.

\textsuperscript{223} See \textit{supra} note 41. The prolonged uncertainties caused by the breakup of the Soviet Union were not a shortcoming of the NPT itself so much as an illustration of the severe weakness of the current successor state doctrine. \textit{See} \textit{supra} note 3. However, the situation has certainly posed a major set of challenges to the nonproliferation regime which no one foresaw a decade ago.

\textsuperscript{224} The adverse developments listed in the text are not intended to be a full listing of the steps backward which have occurred over the past two decades in dealing with proliferation. Among the others are: (a) increasing commerce in weapons-usable nuclear materials, especially plutonium, without anything approaching adequate protection against seizure by an aggressive country (virtually all the protective measures required by the Physical Protection Convention, \textit{see} \textit{supra} note 196, and nearly all steps currently taken are aimed at avoiding environmental contamination and prevention of seizure by terrorists, not seizure by a substantial military force), (b) the continued lackadaisical attitude of certain nuclear supplier states toward implementation and enforce-
the nonproliferation regime is a considerable success, not only because of
the wide-spread adherence to the legal instruments of the regime but
because the regime itself has gradually transformed perceptions of legiti-
macy and made possible concerted actions that were barely conceivable
when the NPT was first negotiated.

III. Legal Instruments To Restrain Advanced Proliferation

Some observers have argued that the international community is helpless
to deal with the spread of any technology, even where that spread can
greatly decrease international peace and security. Certainly, the technol-
yogy for producing special nuclear material and fashioning it into devices
like those dropped over Japan is now a half-century old, and it has become
easier to master. Every year, the list of countries which could have a few
simple nuclear weapons within five years of a decision to do so becomes
longer. Yet the history of the existing nonproliferation regime to date
does not support so pessimistic a view. As explained above, although there
continues to be a long list of problems, far fewer states currently possess
nuclear weapons than would have if the international community had
decided thirty years ago that the situation was hopeless and had done
nothing. The reason is that a complex regime like the nonproliferation
regime can help to transform international society and gradually change
perceptions of legitimacy, at least within its sphere. 225

The international community has not yet taken all of the steps it
could within the framework of the existing international order to reduce
the advanced proliferation problem. First, as explained infra in section A,
additional features can be added to the nonproliferation regime itself to
deal with advanced proliferation, most notably in staunching and deter-
ring the flow of nuclear weapons design information and relevant technol-
yogy, equipment and materials. Second, as outlined in section B, access to
long-range delivery systems can be impeded by new multilateral arms con-
trol limits on ballistic missiles, by strengthening the existing MTCR, and
by entering into new agreements to prevent the sale of other strategic deliv-
ery systems. Third, threshold states need to be offered politically attractive
means to keep their existing capabilities “in the basement.” Those meas-

225. It should be noted that something less than 100% success can be a great deal of
success in this field. To the extent that there may be additional proliferation, we can
probably cope better with less of it. Those who advocate aggressive “counter-prolifera-
tion” postures rather than vigorous efforts to prevent proliferation are also unlikely to
be 100% effective, but again, that is not a reasonable standard by which to measure
their proposals.
ures would not require the threshold states to abandon their nuclear capabilities at this time, but they would assure that those states cannot continue adding to the size of their arsenals or significantly improving their nuclear weapons design sophistication. Two arms control measures which would assist in that regard, while having broader utility for international security, are discussed in section C.

Finally, although beyond the purposes of this article, efforts must continue to deal with regional problems and underlying causes of tension, to improve the existing regime to deal with nascent proliferation problems, to make it politically more attractive to join and remain in

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226. Proliferation motives, especially those which provide an impetus for advanced proliferation, often arise out of regional rivalries and other security concerns, though considerations of prestige and influence can be important as well (as they were with the United Kingdom and France in acquiring nuclear weapons and Brazil and Argentina in coming to the brink of doing so). Cf. Gerard Smith & George Rathjens, Reassessing Nuclear Nonproliferation Policy, 59 Foreign Aff. 875, 888 (1981) ("[T]he best hope of stemming nuclear proliferation lies in dealing effectively with the motives that lead nations to want to have nuclear weapons."). For example, nuclear issues will probably be resolved in the Middle East only when other security concerns in the region are resolved. A full discussion of regional security measures which might help reduce the threat of advanced proliferation is well beyond the scope of this paper. However, advanced proliferation cannot be dealt with in a political and security vacuum or treated as largely a technical problem of the nuclear fuel cycle.

States may be wholly mistaken in believing that nuclear weapons will increase their security. North Korea's efforts to acquire nuclear weapons is a good example of a foolish quest. In the long run, if sustained, these efforts would probably lead to a nuclear weapons race on the Peninsula which no one would really win, because it would diminish the real security of both states. Yet South Korea, with its larger population, vastly greater financial resources, larger and far more advanced technology base, and a very large and efficient natural uranium fueled nuclear power reactor at Wolsung, would hold all the high cards. (For now the Wolsung reactor is under IAEA safeguards both by virtue of South Korea's NPT status and as a condition of its supply by Canada, but it is technically capable of producing many scores of nuclear weapons' worth of plutonium for every one weapon's worth of plutonium produced in the North.) Such factors have not kept North Korea from playing a very dangerous game.

227. In order to deal with proliferation generally and incidentally improve prospects for reducing the risks of advanced proliferation, we need to continue to strengthen the existing nonproliferation regime, including efforts to make the NPT virtually universal, thereby isolating the hold-out nations. Doing so will contribute to non-acquisition becoming a norm of international behavior. Numerous other steps are needed to strengthen the existing regime. Among the most important of these are: (a) the negotiation of an African nuclear weapons free zone, providing a fallback in the event that the NPT itself unravels, or key Arab states pull out over the Israeli nuclear weapons issue, (b) the agreement of China and the few remaining other hold-outs among the current nuclear suppliers to require full-scope safeguards, (c) the expansion of efforts to involve emerging suppliers in the growing consensus on conditions which should apply to nuclear commerce and to dual-use items, and (d) further improvements in the existing nuclear export controls, including further elaboration of existing controls on less common enrichment technologies such as calutrons and nozzle processes, strong encouragement of end-use controls, and a clearinghouse of information on the supply of nuclear and dual-use items to states of concern. These measures would help with both the nascent proliferation and the advanced proliferation problem. It is easy to state such objectives, but they are in actuality far harder to accomplish. Work has continued on them, generally out of the public eye, and in some cases literally for decades. Further progress can be expected, but not overnight.
the treaty,\textsuperscript{228} and to take no steps in the name of "counter-proliferation" to weaken it.\textsuperscript{229}

A. Strengthening the Existing Nonproliferation Regime To Deal with Advanced Proliferation

Most measures taken by the nonproliferation regime to deal with the nascent proliferation problem are also helpful on the advanced proliferation

\textsuperscript{228} In the context of the 1995 NPT renewal conference, new political initiatives to strengthen the existing regime should be explored. One step might be for the five declared nuclear weapons states to provide a qualified non-use guarantee to the non-nuclear weapons states which are parties to the NPT. Such a "negative security assurance" would guarantee as a matter of international law that nuclear weapons would not be used or threatened against the non-nuclear weapon states so long as they remained in compliance with their obligations under that treaty and undertook no military actions in concert with a nuclear power. Such a pledge would not apply to: (i) nuclear weapons states, (ii) states which are outside the NPT and would thus not qualify for the pledge, e.g., India or Pakistan, and/or (iii) states that would not qualify because they are seeking nuclear weapons, such as North Korea.

From time to time, the United States and other countries have made highly qualified unilateral and nonbinding non-use pledges. The United States made such a pledge during the 1978 U.N. General Assembly's Special Session on Disarmament. ACDA, \textit{ARMS CONTROL AND DISARMAMENT AGREEMENTS: TEXTS AND HISTORIES OF THE NEGOTIATIONS} 94 (1990). This issue received much attention at the 1990 NPT Review Conference. Spector & Smith, \textit{supra} note 217, at 42. Converting such unilateral statements into treaty obligations would give them far greater appeal and legal force. Doing so in the context of the 25 year review required by the treaty would be far more meaningful now that all five nuclear weapons states are parties to the NPT. Of course, no vast changes in eliminating the risks of further proliferation should be expected from such a measure. It might, however, give additional incentives for some states to remain within the NPT and would indicate to the non-nuclear weapons states that their long-standing concerns about the fairness of the NPT are finally being addressed. It would also weaken an Indian argument against adherence to the treaty or to other non-proliferation agreements if China were to make such a pledge in legally binding form.

India has recently reiterated that it supports a global agreement barring the first use of nuclear weapons. \textit{India Calls for Global Ban on Nuclear Testing}, UPI, Jan. 12, 1993, available in LEXIS, News Library, Wires File. Doing so in the NPT context would tell India, in effect, that obtaining its rights to the benefits of such a pledge rests in its own hands.

\textsuperscript{229} For a list of such measures, see \textit{supra} note 5. While no one would suggest that the U.S. government take no steps to plan for the contingency that additional nations will acquire nuclear weapons in the future, some of what is being considered will seriously exacerbate the advanced proliferation problem. For example, the international community has some interest in assuring that if additional countries acquire nuclear weapons, such weapons cannot be seized and used by terrorists or by other countries. Thus it might be in our national security interest to provide carefully selected information (based on our own experience with PAL devices), which countries could use to construct devices which will prevent or at least delay unauthorized use of any class of weapons, conventional or nuclear. But to go further than that and help countries make their devices not only secure but also safe would severely damage the nonproliferation regime by legitimizing the acquisition of the weapons. Worse yet, virtually everything one does to make nuclear weapons "one-point" safe also makes them more rugged and less susceptible to failure or to being destroyed by conventional or nuclear attack. The United States has no incentive to make would-be proliferators safer from their own poorly designed devices. The risks of accidents and preemption are among the constraints against proliferation. Help with weapons design would make acquisition of nuclear weapons more attractive by minimizing those risks.
issue. Nevertheless, some targeted measures aimed more specifically at the advanced proliferation problem are essential.

1. **Obliging All States Not To Assist the Acquisition of Nuclear Weapons**

To deal with the advanced proliferation problem, the obligations under article I of the NPT should bind all NPT parties, not just the nuclear weapons states. Article I as currently worded precludes nuclear weapons states from transferring nuclear weapons, or "in any way" assisting, encouraging or inducing the manufacture of nuclear weapons or other nuclear explosive devices by any non-nuclear weapons state. The NPT placed no such obligation on the non-nuclear weapons states. The drafters assumed only the nuclear weapons states knew how to design and manufacture nuclear weapons, so they imposed a general nonassistance obligation only on the nuclear-weapons states. The drafters assumed everyone else knew nothing about nuclear weapons, per se. Moreover, imposing that

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230. Article I of the NPT provides:

Each nuclear-weapons 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-weapons State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.

NPT, supra note 2, art. I.

231. See George Bunn, *The Nuclear Nonproliferation Treaty*, Wis. L. Rev. 766, 779 (1968) ("The treaty draft prohibits nuclear parties from helping any non-nuclear country, party or not. But an express prohibition on assistance by non-nuclear parties was thought unnecessary.") Bunn, who was General Counsel of ACDA during the negotiation of the NPT and Deputy Chairman of the U.S. delegation to the Eighteen Nation Disarmament Conference (ENDC) (the forum where the NPT was being negotiated), has remained one of the most respected lawyers in the arms control field. His article continues: a non-nuclear-weapons state which accepts the treaty's restrictions on itself would have no reason to assist another country not accepting the same restrictions to gain advantage from that fact in the field of nuclear-weapon development. If a non-nuclear-weapons party did nevertheless attempt to provide such assistance in the territory of a non-party, the presumption would immediately arise that these acts had the purpose of developing nuclear weapons itself in violation of the treaty.

Id. (quoting ENDC statement of ACDA Director Foster, in ENDC/PV.370, at 51, 56 (Provisional, Feb. 27, 1968)) (emphasis added).

The Soviet reply, in contrast, said that assistance by one non-nuclear weapons state to another in acquisition of nuclear weapons would be a blatant violation of the treaty. Id.; see also ACDA, *INTERNATIONAL NEGOTIATIONS ON THE TREATY ON THE NONPROLIFERATION OF NUCLEAR WEAPONS* 101 (1969). The Canadian representative in an earlier debate had labeled the United Arab Republic (UAR) concerns as a "theoretical loophole" but doubted that the situation would actually arise. Id. at 81.

232. In contrast, many of the non-nuclear weapons states possessed nuclear materials and technology for peaceful purposes. It was accordingly considered necessary under article III, paragraph 2 of the NPT for both the non-nuclear weapons states and the nuclear weapons states to agree not to transfer nuclear materials or equipment especially designed or prepared for the production of nuclear materials to any non-nuclear weapons state, unless the nuclear material so supplied or produced would be placed under the IAEA safeguards system. The Soviet Representative at ENDC thought incorrectly that the UAR concerns were met by this provision. See ACDA, supra note 231, at 101.
obligation on all states seemed unverifiable and thus unenforceable.

That line of reasoning was probably correct when applied to the world as it existed at the time the NPT was being negotiated, but the world has changed. Switzerland, Canada, Japan, Germany, Italy, and several other non-nuclear weapons states have reached such a high level of technical development that their scientists and advanced technology firms could readily assist less advanced countries in many of the technologies relevant to advanced proliferation, despite their governments' lack of experience in the design of nuclear weapons. The same would also apply to technologies directly relevant to more sophisticated nuclear weapons such as boosted devices and aspects of thermonuclear weapons development.

The twenty-fifth anniversary review conference of the NPT, scheduled to take place in New York beginning in April 1995, presents the best opportunity to bring about this change through the adoption of a sepa-

233. At the time of the Foster statement, Bunn, supra note 231, no one (except perhaps the UAR's representative) had contemplated the current situation, where individuals or firms provide the assistance, not the governments. The presumption Foster stated—that a government which assists nuclear weapons development in another state is itself developing nuclear weapons and thus violating the NPT—should also arise even where such assistance is being provided by private entities rather than the government. However, in that case, it should be understood that it would be a rebuttable presumption. No one could reasonably argue that Germany was acquiring nuclear weapons itself because of the extensive assistance its firms provided Iraq's nuclear weapons programs. The author believes that some kinds of assistance by a non-nuclear weapon state would violate article II of the treaty, see infra note 234 and accompanying text, and that the Soviet interpretation of that article may have been the better one. But it is obvious that the matter is not clear enough from the negotiating record that one can say with certainty that the kind of assistance we have seen to date is a violation of the NPT. Greater clarity would be helpful to the purposes of the treaty.

234. Flagrant, large-scale assistance to the nuclear weapons program of a non-nuclear weapons state by another non-nuclear weapons state might be so clearly contrary to the object and purpose of the NPT as to render the conduct illegal under international law, even in the absence of textual support forbidding the particular acts done by the offending country. For a more detailed analysis using this line of reasoning in a different context, see infra notes 296-99 and accompanying text. Thus, if the government of Switzerland were to assume the sole responsibility for designing nuclear weapons for Libya or Iran, in the author's view, Switzerland's action would be incompatible with the NPT, even if the Swiss themselves thereby never acquired nuclear weapons in violation of article II of the NPT and never supplied anything which would violate article III (2). An article I-like obligation for non-nuclear weapons states would eliminate any ambiguity on the point. But more importantly, expanding the obligations of article I to cover the non-nuclear weapons states would also preclude far less significant forms of assistance, e.g., where the government of Switzerland turns a blind eye, as it often does, to what its companies are doing.

235. See supra note 44. The proposed change could be achieved by a protocol. In the past, the United States has strongly resisted protocols to the NPT, fearing that reopening the treaty, even for purposes the United States might support, could result in a process which could weaken the treaty. See, e.g., Lewis Dunn, It Ain't Broke—Don't Fix It, 46 BULL. ATOM. SCI. 19 (1990) (arguing that the treaty contains a careful balance of obligations between nuclear and non-nuclear states, suppliers and recipients, etc., and that attempting a new balance would undermine support for the existing treaty without much prospect of reaching consensus on a new one). A separate treaty would be easier to accomplish, because the only necessary parties would be non-nuclear weapons states. They could negotiate and enter into such an agreement without the involvement of the
A treaty undertaking which broadened article I to all NPT parties would greatly facilitate subsidiary agreements and institutional arrangements to give the provision more “teeth.” The export controls and information controls discussed below would thus become a logical derivative of the treaty obligation. Irrespective of whether a protocol or separate agreement is used, widespread adherence to the agreement is not essential for it to be effective. The important element is that many of the most advanced non-nuclear weapons states—those whose scientists and industry are in the strongest position to assist in the development of more sophisticated nuclear weapons—become parties to the agreement.

2. Information Controls for Boosted and Thermonuclear Weapons

We need to develop a consensus on the control of certain information relevant to advanced weapons. Publication of detailed information on any kind of nuclear weapon, such as blueprints of simple fission weapons, would prove harmful as that would be of considerable assistance to nascent proliferators. However, information controls are far more important in the case of advanced proliferation. Some basic physics, such as detailed equation-of-state data on nuclear and other materials used in advanced nuclear weapons designs, computer codes on implosion hydrodynamics and neutronics, other computational aspects of weapons modeling, and aspects of inertial confinement fusion (ICF or laser fusion), could be invaluable to a rapidly advancing nuclear weapons design program.

nuclear weapons states. On the other hand, consistency with the language of the two instruments might be better fostered by use of a protocol. Of course, a protocol is a new treaty, and as such it is only binding on those states which separately adhere to it. But the same result is obtained with respect to a separate treaty or a treaty amendment, as the amendment only becomes binding on those states which indicate their adherence to it. Vienna Convention, supra note 165, at 40, § 4. If a separate treaty is used, there is no problem with inconsistency of purpose; the willing non-nuclear weapons states would simply assume an additional obligation (or clarify an existing obligation, see supra note 234) which the nuclear weapons states had already accepted. Their doing so would be entirely in keeping with the object and purpose of the original treaty.

In theory, this goal could be achieved by a change to the text of the NPT itself. However, the treaty’s amendment provisions were drafted so that it is exceedingly difficult to make amendments as a practical matter. Article VIII of the NPT requires the submission of proposed amendments to the Depository Governments for circulation to all parties to the treaty. At least one-third of the parties must request a conference for consideration of the amendment. A majority of the parties, including all the nuclear weapons states and members of the IAEA Board of Governors, must then approve the amendment, which can only enter into effect once the approving states have deposited their instruments of ratification of the amendment. NPT, supra note 2, art. VIII.

The National Academy of Sciences has reviewed the Department of Energy’s inertial confinement fusion (ICF) program and labeled it “an extraordinary tool for exploring the physics of thermonuclear weapons.” Dan Fenstermacher, Arms Race: The Next Generation, BULL. ATOM. SCI., Mar. 1991, at 29, 31 (quoting National Academy of Sciences, Review of the Department of Energy’s Inertial Confinement Fusion Program (1986)). ICF differs from the magnetic confinement fusion being explored in many countries. In ICF, energy from very large lasers or electron beams is directed at a pellet, which implodes. The simplest kind of pellet contains a mixture of deuterium and tritium, which if compressed and heated enough, will fuse, releasing energy. In theory, it
The international development and implementation of this consensus probably cannot be achieved by ad hoc means. These have been tried, with only modest success.\textsuperscript{238} Of course, the nuclear weapons states are already under such an obligation because of article I of the NPT, and presumably they already possess the legal authorities to uphold that obligation.\textsuperscript{239} In some of the non-nuclear weapon states, the only individuals or entities likely to possess such information are government employees or laboratories. In other countries the government uses legal sanctions or informal means to keep such information in private hands under adequate control.\textsuperscript{240} Nevertheless, countries exist that are reluctant to restrict the free flow of scientific information,\textsuperscript{241} no matter how dangerous, except pursuant to some kind of international agreement. The expansion of NPT article I to non-nuclear weapons states willing to undertake the obligation would provide the needed legal framework, and it would greatly

could create a useful form of energy, with only modest radiation problems, for which we have virtually unlimited fuel. Unfortunately, such simple pellets have one defect: they do not work. Pellets which work better are classified. They involve many of the same concepts, utilize the same processes, and generally require the same materials as multi-staged thermonuclear weapons.

\textsuperscript{238} The author participated in bilateral and trilateral consultations with the British and French governments on ways to allow ICF research to go forward without the relevant information becoming a proliferation hazard. Some consultations on the subject have resumed between American officials and their counterparts in certain allied countries, but they appear to be more oriented toward declassification than toward better controls. See David Kramer, Watkins Says He Hopes To Approve Declassification of Fusion Program, \textit{Inside Energy}, Dec. 21, 1992, at 6.

\textsuperscript{239} Under the Atomic Energy Act of 1954 the United States may classify information concerning nuclear energy, including nuclear weapons design and production information, as "restricted data," a category of classified information which cannot be revealed to other nations except pursuant to an agreement for cooperation and which subjects individuals to punishment if revealed. 42 U.S.C. §§ 2014(y), 2161, 2162, 2164, 2168 (1988 & Supp. V 1993).

\textsuperscript{240} Japan, for example, has no statutory authority to control information flows but has been generally circumspect about publishing certain data after the sensitivities were explained in general terms to Japanese officials. Unfortunately, one Japanese researcher continues to publish quite harmful details on inertial confinement fusion. Interviews with Department of State and Department of Defense officials, in Washington, D.C. (Nov. 1992). Legal controls imposed domestically to uphold an international treaty obligation may prove to be the only effective solution, even in as tightly homogeneous a society as Japan.

\textsuperscript{241} The United States is not the only country with a heavy bias in favor of free speech, academic freedom, and the free flow of ideas. That bias is particularly strong among scientists, even those from countries without a strong free speech tradition. But most of the information of the types listed in the text are not useful for anything except boosted and thermonuclear weapons. As the information is genuinely dangerous, it should be restricted in the common interest. To the extent that such work has some useful purpose, or might have at some time in the future, e.g., for ICF, the work can still continue, and most aspects can still be published. Exchanges of information and joint projects should actually be encouraged but only with those states that provide the sensitive information with adequate control. Unfortunately, we seem to be headed in the opposite direction. Energy Secretary O'Leary recently announced a major declassification of ICF materials, reportedly allowing 80% of all ICF work to be unclassified, in contrast to 30% before the change. David Krauer, \textit{DOE Announces Major Declassification; Suggests More Will Follow}, \textit{Inside Energy}, Dec. 15, 1993, at 5.
assist negotiation of an agreement on such controls.\textsuperscript{242} Of course, a fair amount of that information has already been leaked or released in the past fifteen years.\textsuperscript{243} But a great deal of detailed information still exists that continues to warrant protection.

3. Special Export Controls for Advanced Proliferation

The existing international nonproliferation export controls are aimed primarily at assuring that nuclear materials, and equipment and technology especially designed or prepared for the production of special nuclear material, are not exported unless the nuclear material in question is under

\textsuperscript{242} It will be difficult for the international community to reach a consensus as to what information it should conceal from would-be advanced proliferators, without thereby revealing important information to them, but it will not be impossible. Comparable concerns were expressed with each major improvement of the U.S. export control lists, as many of the technical details and the purposes to which such equipment could be put were sensitive. However, in each case, nonclassified ways were found to describe the equipment well enough that manufacturers, exporters, and customs officials could identify it, without revealing sensitive information.

\textsuperscript{243} The most serious release of information to the public which could aid advanced proliferators transpired in The Progressive affair. Howard Morland, an investigative journalist, planned to publish an article entitled The H-Bomb Secret; How We Got It, Why We're Telling It. When this came to the attention of the U.S. government, the executive branch sought to have the publication restrained. In a case which pitted vital arms control interests against the longstanding free press objection to any prior restraint of publication, a federal judge ruled in the government's favor, issuing a preliminary injunction against the publication of portions of the article. United States v. Progressive, Inc., 467 F. Supp. 990 (W.D. Wisc. 1979), \textit{mot. denied sub nom.} Morland v. Sprecher, 443 U.S. 709 (1979). However, before the government could obtain a permanent injunction or the defendants could get the preliminary injunction vacated by the Seventh Circuit, some of the same information was published in a letter to Senator Percy (the Hanson letter), and other portions of the information were found sitting on a shelf in the unclassified library at the Los Alamos National Laboratory (one of the two primary locations where U.S. nuclear weapons are designed). The Seventh Circuit then dismissed the matter with the consent of both sides. 610 F.2d 819 (Oct. 1, 1979) (decision without reported opinion). Considerable information concerning the case was published by The Progressive in its May and November 1979 editions. \textit{See} Samuel H. Day, Jr., The Other Nuclear Weapons Club, \textit{The Progressive}, Nov. 1979, at 32 (explaining the view of the magazine as to why publication was beneficial). Morland's original piece finally appeared in the November edition. Howard Morland, The H-Bomb Secret, \textit{The Progressive}, Nov. 1979, at 14. Morland and his supporters believed that once the H-bomb's secret was revealed, there would be more public scrutiny of nuclear weapons and of the government's claimed need to keep producing them. If so, it would be hard to document success. Heightened domestic scrutiny did not come until the demise of the Cold War and growing awareness of the severe environmental mess nuclear weapons production had caused. Morland and his supporters may also have believed that elimination of the secrecy would lead to greater international pressure for disarmament. It did not. Within government, we perceived literally no increased pressure for more vigorous arms control in the wake of the article. When that pressure finally did come, it was instead the consequence of the 1980 election results and the push that gave the "Freeze" movement. In the meantime, the British and French governments broke off useful consultations we had been holding (in which the author was a participant) on preventing critical information on thermonuclear weapons from falling into the hands of threshold states.
IAEA safeguards. Recently, this has been supplemented with controls on "dual-use" items relevant to nascent nuclear weapons design and manufacturing efforts. The new list contains a few items relevant primarily or exclusively to more advanced nuclear weapons. The United States controls several additional items and technologies solely because they are useful to advanced proliferation. The following provides illustrations of what can be done and what still needs to be done.

A state seeking more advanced nuclear weapons would make "boosting" a likely objective. Boosting requires tritium, a radioactive isotope

244. North-South hostility is still common in the international community. Many are concerned that protective measures desired by some in the international community might harm development efforts (e.g., exploitation of Amazonian resources versus the impact such exploitation may have on unique habitats and/or its impact on global warming). One accordingly might ask whether measures to keep "dual-use" items (defined in the next footnote) out of the hands of threshold states will interfere with economic growth in developing countries. With respect to dual-use items relevant to nuclear weapons, such measures might have some impact on the handful of threshold states but not on any other developing countries. From the author's perspective, if the two developing countries which are currently advanced proliferation threats have their development impeded because they will not join treaties serving the common interest, then that is a choice they made, and they should live with any adverse consequences for their development.

One should also note that existing export control measures have had an impact on threshold countries which are not developing countries. South Africa's power costs were increased because the owner of its power reactors had to pay more for indigenously-produced enriched uranium power reactor fuel than would have been the case if it had been an NPT party. The Electricity Supply Commission of South Africa, the owner of South Africa's two power reactors, felt that continuing to receive indigenously enriched fuel from the Z-Plant at Valindaba was unattractive because the costs for "separative work" were high by international standards, and it thus preferred enrichment abroad, something it could not obtain without South Africa first putting all its nuclear facilities under IAEA safeguards. Mark Hibbs, *Centrifuges or Lasers May Replace South Africa's Present SWU Plant*, Nuclear Fuel, Jan. 7, 1991, at 4.

245. The concept of dual-use equipment and technology is highly useful, if sometimes amorphous. For nuclear, ballistic missile, and chemical technologies, the term is sometimes used in two quite different senses, which complicates the issue. Most nuclear items have an inherent duality, in that nuclear materials can be used either for nuclear power or nuclear weapons. A similar duality exists for ballistic missiles, the technology for which largely overlaps the technology for space launch vehicles. An analogous duality also exists in aspects of chemical weapons production, which uses some of the same equipment and raw materials as pesticide manufacture and other peaceful uses of organic chemical synthesis. Equipment and materials useful for either the peaceful or the non-peaceful nuclear, missile, or chemical purpose could be said to be "dual-use." However, the term "dual-use" is more commonly applied to items which have uses in wholly different applications, i.e., outside either the peaceful or the non-peaceful applications in a particular field. Thus, a high speed camera normally associated with nuclear weapons design and testing could be used for a few wholly non-nuclear uses. Supercomputers have many peaceful applications but are particularly important to the design of the most sophisticated thermonuclear weapons. Indeed, some items might be considered "treble-use" or even "quadruple-use," but fortunately that terminology has not caught on.

246. See supra note 219.

247. The examples picked for discussion in the text are unclassified and are already well known to would-be proliferating nations.

248. In a boosted device, the weapon is designed so that the heat and pressure of the fission explosion also causes a small amount of fusion to take place. The fusion does
Tritium is most easily obtained by the irradiation of an isotope of lithium (Li\textsubscript{6}) in a nuclear reactor, followed by a separation and purification process. At present, significant quantities of tritium are available only from the nuclear weapons states and Canada.\textsuperscript{250} The new dual-use list covers both tritium gas itself, and equipment and materials for its production and separation.\textsuperscript{251}

Another example is Li\textsubscript{6} itself. Efficient tritium production requires that the Li\textsubscript{6} be first separated from the more common Li\textsubscript{7} before irradiation takes place, making control of Li\textsubscript{6} essential to an effective long-range tritium control strategy.\textsuperscript{252} More importantly, lithium deuteride\textsuperscript{253} is the prime material used in true thermonuclear weapons to provide the fusion yield. In contrast to tritium, Li\textsubscript{6} has no important peaceful uses per se,\textsuperscript{254} making a country's efforts to acquire it a particularly good indicator of an interest in advanced nuclear weapons. Concerned nations should agree to a categorical ban on assisting in any way the acquisition or production of Li\textsubscript{6}.\textsuperscript{255} Such a ban would be a logical derivative of the expanded coverage not by itself contribute importantly to the yield, but the high energy neutrons from the fusion cause many additional atoms of plutonium or highly enriched uranium to fission. The result is a considerable increase in yield.

\textsuperscript{249} Tritium has some peaceful uses, such as for luminous watches, but that need is decreasing as better batteries and alternative lighting methods become available. For over two decades, the United States has had export controls and informal re-export understandings for tritium with the few countries which need it for peaceful purposes. The specifics of those controls cannot be found in any law or regulation. While the export by a private person of significant quantities of tritium would require a Nuclear Regulatory Commission (NRC) license, 10 C.F.R. § 110.5 (1994), the real control is derived from the fact that the only U.S. producer of significant quantities of tritium is the U.S. Department of Energy. Peaceful uses of tritium are likely to expand only if controlled fusion becomes an important power source. That possibility has prompted growing interest in tritium technology.

\textsuperscript{250} Tritium is also created as the incidental by-product of a reactor's neutron flux on the light water or heavy water moderator and coolant. The Canadians, with the world's largest heavy water power reactor program, remove the tritium from the heavy water for occupational health reasons, leaving tritium which is commercially competitive with other techniques.

\textsuperscript{251} Suppliers' Guidelines, Part II, supra note 217, §§ 8.3-.5. The elaboration in these sections is less than one might like, but they are a big step forward in international control of tritium.

\textsuperscript{252} Li\textsubscript{6} constitutes about seven percent of naturally-occurring lithium.

\textsuperscript{253} Lithium deuteride is a compound formed from Li\textsubscript{6} and the deuterium isotope of hydrogen. The deuterium gas for this purpose is usually obtained by the electrolysis of heavy water.

\textsuperscript{254} Li\textsubscript{6} is sometimes used in tiny quantities for dosimeters, and the new dual-use list allows the transfer of these dosimeters without safeguards assurances. But that does not involve the quantities of Li\textsubscript{6} needed for weapons purposes. Indeed, for that reason Li\textsubscript{6} cannot really be considered a dual-use item. It and several other items on the new list logically belong on a list of their own, namely non-nuclear materials needed for nuclear weapons and nothing else. As obtaining international agreement on yet another approach would have occasioned delay, we are fortunate that practicality triumphed over terminological precision.

\textsuperscript{255} Li\textsubscript{6} itself is on the new international dual-use control list. See supra note 219. Equipment designed for its separation from natural lithium is not. The reason for this omission may be because the United States has largely classified the technology for separating the isotopes of lithium. See 10 C.F.R. § 725, app. A (1994) (access to
of NPT article I recommended above.

Agreement by the nuclear suppliers on the new dual-use list is a significant accomplishment. However, in addition to Li6 separation technology, other key dual-use items relevant to advanced proliferation remain uncontrolled. For example, the new dual-use list does not cover supercomputers. The computational requirements for advanced designs, especially thermonuclear weapons, far exceed those for simple weapons. Moreover, only a handful of countries can produce such highly advanced computers. The fact that top-of-the-line supercomputers are not on the new dual-use list is not due to the U.S. delegation's failure to try. The placement of supercomputers on the dual-use list should be attempted again soon, this time with political support from the highest levels and using advanced proliferation, not proliferation in general, as the rationale.

As discussed above concerning article I of the NPT, firms and scientists in a number of non-nuclear weapons states are now in a position to assist in some aspects of nuclear weapons programs even though their governments do not possess nuclear weapons. The number of these potential suppliers will continue to grow, as will the number of areas in which they are capable of assisting other countries' advanced proliferation programs. Thus, a consensus on the need for export controls must be reached with all states possessing relevant technologies, not just those

Restricted Data on separation of lithium isotopes by counter-current flows of lithium amalgam and aqueous lithium hydroxide in packed columns can be approved to U.S. persons under certain conditions. Thus the equipment used in that process is not on the lists of controlled dual-use items whose export requires a Commerce Department license. There are also no international controls on the technology for forming lithium deuteride into shapes with the consistency and density ideal for thermonuclear weapons. Of course, production of tritium and Li6 is significantly easier than production of HEU or plutonium. That fact does not detract from the advantages of their international control.

256. As a result of this agreement, a number of other materials which are not important to initial proliferation, such as high purity beryllium metal, and specialized items, such as certain ultra-high speed detection and diagnostic equipment, have now finally been controlled for advanced proliferation reasons.

257. Controlling other mainframe computers would be useful to nascent proliferation but would not preclude the development of simple devices and is accordingly controversial. Because they are used for so many other purposes, existing controls on many computers may have outlived their utility except to particular end-users. Attempting international controls on personal computers and work-stations—which could be helpful though not ideal for designing an initial nuclear explosive—would be a quixotic quest in light of their widespread availability.

258. For example, other than the United States, the countries in the strongest position to supply supercomputers to states of advanced proliferation concern are not the other four nuclear weapons states (though both the United Kingdom and France have some capabilities) but rather Japan and Germany. The United States has had a quiet, unpublicized understanding with the Japanese on supercomputers. Interviews with Department of State and Department of Energy personnel, in Washington, D.C. (June 3-6, 1994); William J. Long, Global Security, Democratization, and Economic Development After the Cold War: New Goals for U.S. Export Control Policies, in INTERNATIONAL COOPERATION ON NONPROLIFERATION EXPORT CONTROLS, supra note 203, at 59, 72. This needs to be broadened into an international agreement.
states currently adhering to the Nuclear Suppliers' Guidelines.259 A binding international obligation, such as the broadening of coverage of NPT article I discussed above, which would provide the juridical basis for such lists, would facilitate that consensus.260

We cannot expect countries with existing nuclear weapons programs who wish to obtain more advanced nuclear weapons to be stymied forever by improved international export controls. The equipment and material unique to advanced proliferation is easier to obtain by indigenous efforts than special nuclear material, which is the pacing item for a nascent program. However, effective export controls will lengthen the process of acquiring advanced nuclear weapons, and buying time is of great importance as favorable changes may take place in the interim.261 Even if no favorable change takes place, the delay itself may be valuable.262 Moreover, effective export controls will make the acquisition of a significant nuclear weapons force substantially more costly and difficult than if the materials, equipment, and technical assistance can be freely purchased.

259. The most important nonparticipant is China, which is governed by the NPT, though it has joined no consensus on what it may and may not supply consistent with that treaty. There are a number of non-nuclear weapons states which have not yet adhered to the Suppliers' Guidelines, including South Korea, Taiwan, Singapore, Turkey, Brazil, and Mexico. In addition, although Russia is a participant, most of the other former Soviet republics are not. All of these are capable of manufacturing some items on the current dual-use list, if only by reverse engineering. Some of these may resist early adherence on the grounds that the Guidelines go beyond the requirements of the NPT (or the Treaty of Tlatelolco) or because they did not participate in their formulation. These factors may decrease the legitimacy of the enterprise in their eyes. Others are likely to have an antipathy to the new rules in the correct belief that the Guidelines were once aimed at them.

260. The new controls would then stand in the same posture to the new article I-like agreement as the current Zangger list does to the NPT: not binding undertakings under international law in their own right, but rather a consensus statement of the actions that a state cannot take and remain in compliance with the treaty obligations the country has undertaken. See supra note 203.

261. There is, after all, an antithesis to Murphy's law which says that occasionally things go right, as they did in the South African and Argentine/Brazilian cases. It was certainly easier for those states to give up a few weapons, and the capability to have a few in a matter of months respectively than it would have been for them to give up large sophisticated forces. In the nuclear weapons context, if export controls and related measures delay the acquisition of far more significant nuclear forces by five or ten years, the possibility always exists that during that time political conditions will change or regional tensions will fade and countries of concern can reverse or halt their nuclear weapons programs.

262. While this proposition has not been tested, and with luck never will be, the international community can better adjust politically and militarily to a trickle of new nuclear weapons states than it could to a sudden flood of them. Even Waltz, who favors additional countries acquiring nuclear weapons, believes that the spread should be slow. See Waltz, supra note 52. After all, outside the nuclear weapons context, history shows that rapid changes in relative military and political power can often be quite destabilizing, as was the case with the rapid rise of Prussia or the rapid decline of the Ottoman Empire.
Perhaps the most frightening aspect of the break-up of the Soviet Union and the related decline in funding of the former Soviet nuclear weapons establishment is the possibility that rich but less technologically-advanced countries might hire highly qualified nuclear weapons designers to assist their nuclear weapons programs. Comparable problems exist for chemical and biological weapons and for conventional arms. However, the problem is more acute with respect to various aspects of advanced nuclear proliferation, such as ballistic missiles. Perhaps the most severe risk is with nuclear weapons design per se. When moving from simple nuclear weapons to more sophisticated designs, the mental aspects—basic physics, modeling and other computational skills, and conceptual design—are relatively more important than either precision manufacturing or access to exotic materials. A country that could assemble a team of experienced nuclear weapons designers could greatly compress the design and testing phase, obtaining sophisticated nuclear weapons far more quickly and probably at much lower cost.

Although the specific problem of nuclear weapons design experts making a major contribution to advanced nuclear weapons programs in other countries is (hopefully) so far only a potential problem, there have already been examples of the advent of a new kind of mercenary, one who aids in the acquisition of weapons of mass destruction for gain. In several recent cases, nations attempting to acquire nuclear, chemical, or biological weapons and ballistic missiles have hired experts from firms or individuals in more developed countries. It is possible that some of those individuals and companies were duped and had no idea that the assistance they were providing would be used for weapons of mass destruction. However, we know that some of them were aware of the true purpose but engaged in the activity anyway. Often, the individuals or companies assisting other countries in the design and construction of weapons of mass destruction committed no crime under the laws of their country of nationality. Moreover, unlike the United States\textsuperscript{263} some countries which control the export of listed equipment and materials do not control technology.

\textsuperscript{263} Except for the areas of weaponry and nuclear energy, technology controls are not common under U.S. law, unless the transfer of the intangible technology is incidental to the export of tangible equipment. In the nuclear arena, U.S. controls on technology and information not contained in exported equipment are far stronger. See Atomic Energy Act, 42 U.S.C. § 2077(b) (1988); 10 C.F.R. Part 810 (1994). These provisions make it unlawful for any person to engage directly or indirectly in the production of special nuclear material outside the United States without the authorization of the Department of Energy. (The export of special nuclear material itself requires a license from the NRC. 10 C.F.R. Part 110 (1994)). The Department of Commerce also requires a validated license for the export of "software" and "technology" for selected items on the Commodity Control List, including many listed for nuclear proliferation and missile technology control. See generally 15 C.F.R. § 799.1, Supp. No. 1 (1994). Authority also exists under 22 C.F.R. § 125 (1994) (control of technical data for items listed on the Munitions List, 22 C.F.R. § 121 (1994) (implementing the Arms Export Control Act, 22 U.S.C. § 2778 (1988 & Supp. V 1993))) for the State Department to...
To reduce that aspect of the problem involving former Soviet nuclear weapons designers, the United States, the European Union, and Japan are providing funds to establish a science center in Russia and negotiating for another in Ukraine to keep the experts occupied at peaceful tasks. The effort should be commended, but the odds against being 100% successful are overwhelming. In the past, Soviet restrictions on the freedom of travel and the right to emigrate, backed by the totalitarian power of the state, proved the most important restraint against such risks. As a matter of human rights, we can be delighted that those odious restrictions have largely been lifted. But lifting them has made this aspect of the control the export of technologies directly relevant to weapons and their production, apart from the export controls on the weapons themselves.

264. One can infer from the terms of the new dual-use section of the Suppliers' Guidelines that this poses a problem for some countries. The section declares "[t]he transfer of 'technology' directly associated with any items in the list will be subject to as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation." See Suppliers' Guidelines, Part II, supra note 217, annex, iii (emphasis added). The provisions dealing with equipment contain no such national legislation savings clause, suggesting that the participating nations did not foresee legal difficulties in controlling equipment.

265. See The START Treaty: Hearings Before the Senate Comm. on Foreign Relations, 102d Cong., 2d Sess. 390 (1992) (testimony of Robert Galucci, Director, Bureau of Political-Military Affairs, Department of State) (United States to contribute $28,000,000, with substantial contributions from the EC and Japan, and in-kind contributions from Russia). Other kinds of scientific collaboration also help in that effort: "American physicists believe that a secondary benefit of [Russian assistance on the supercollider] and other high-energy research is in providing peaceful pursuits for Russia's former military laboratories and scientists, thereby reducing possible temptation to seek employment in countries like Libya and Iraq." Malcolm W. Brune, Building a Behemoth Against Great Odds, N.Y. TIMES, Mar. 23, 1993, at B5.

266. The former Soviet nuclear weapons complex was a multi-billion dollar operation, with tens of thousands of scientists, engineers, and technicians. For the Western countries to provide enough money to keep even three quarters of the roughly 2,000 key former Soviet nuclear weapons design experts gainfully employed would be a major accomplishment. But the remaining quarter of an enterprise of that size is an enormous pool of talent. Moreover, even if they could all be offered some kind of science-related job in Russia or Ukraine, the salaries offered for their services by the likes of Libya or Iraq might be far more than they could make at home. One report claims unnamed "third world" countries have offered Russian scientists three-year contracts at salaries of up to $400,000 per year, while another claims Libyan agents offered two scientists at the prestigious Kurchatov Institute $100,000 per year. Whatever the merits of these reports, it would not take much to exceed the current exceedingly low Russian salaries. Nigel Hawkes, Threats to Soviet Science, TIMES (London), Feb. 3, 1992, available in LEXIS, News Library, Int'l File. The following illustrates the problem, though it deals with missile expertise, rather than nuclear weapons: sixty-four Russian missile experts were stopped at Sheremetyevo airport bound for North Korea. Howard Witt, Soviet Nuclear Threat Defies Usual Solutions, CH. TRIB., Jan. 24, 1993, at 1. The experts, who were making 15,000 rubles (less than $20) per month had been offered $3,000 per month by North Korea. Jack Kelley, Russia Losing a Nuclear War—to Highest Bidders, U.S.A. TODAY, May 21, 1993, at 4A.

267. One of the author's research assistants, a Russian citizen studying for a juris doctorate in the United States, relates the following information, which we have been unable to confirm or refute because recent laws and decrees of the Russian government are difficult to obtain even in Russian: since the beginning of 1993, Russian law has
advanced proliferation problem much worse.

It should be possible to reduce, though not eliminate, the problem if a new treaty required the state parties to criminalize knowingly acting as a mercenary of mass destruction. The international community would, in the words of one U.S. court, speaking of torturers, declare them "hostis humani generis, an enemy of all mankind."\textsuperscript{268} The idea would be similar to earlier international law efforts intended to prevent piracy and slavery and the more recent successful international efforts in negotiating conventions which require states to make specified conduct illegal and also to prosecute or extradite offenders in cases of aircraft hijacking,\textsuperscript{269} attacks on diplomats and senior-most government officials,\textsuperscript{270} and hostage-taking.\textsuperscript{271} Parties reached agreement on those treaties fairly quickly despite the high potential for political disagreement, and they are now widely adhered to.

The keys to broad international acceptance of the mercenary concept in the area of weapons of mass destruction are: (1) the person or company is a true mercenary, namely, a national or business concern of one country providing substantial services, equipment, or materials to another nation for profit,\textsuperscript{272} (2) the only prohibited acts are those done with the knowledge that they provide direct assistance in the acquisition of weap-
ons of mass destruction, and (3) the prohibited acts are very carefully defined, forbidding a narrow core set of types of assistance to programs developing weapons of mass destruction.

Under the proposed treaty, a natural or juridical person who knowingly engages in the prohibited acts would be subject to punishment by the state party of which it is a national or resident or by any other state which is party to the treaty. Each state party would be obliged to criminalize such behavior and prosecute offenders. States party to the treaty into whose hands accused natural persons fall would have the option of extraditing the offender to the state of nationality or residence for trial or of trying the guilty persons themselves. Because any state party could either try or extradite an alleged violator who came within its jurisdiction, irrespective of whether that person's home country or employing country was a party to the treaty, widespread adherence would not be essential for the treaty to be substantially effective, so long as several leading industrial states and states which are key transportation hubs became parties. Violations by individuals should be punished as major crimes. The minimum punishment against corporations or other juridical persons should

273. There may be a place for strict liability crimes in the domestic law of some countries, but there is no prospect for international acceptance of the concept in this context.

274. Careful definition of prohibited acts is essential. First, most of us believe that where criminal prosecutions are possible, considerations of fundamental fairness demand that the prohibited conduct be clearly defined. Moreover, maintaining a short, clearly defined list of prohibited conduct will increase prospects that nations would ratify such a convention. Finally, to the extent that private causes of action may be possible, the violation of international law needs to be very clear, at least in U.S. practice. See Banco Nacional de Cuba v. Sabbatino, 376 U.S. 398, 428 (1964) (act of state doctrine applicable to foreign expropriation).

275. In the author's tentative view, the areas of assistance for which criminal penalties should apply under the treaty should be limited to (i) the design, testing, or production of ballistic missiles and their launchers, (ii) the design and construction of nuclear, chemical or biological weapons or their critical components, and (iii) the construction of facilities to produce the critical materials for nuclear weapons (i.e., for the enrichment of uranium or the production and/or separation of plutonium at facilities not under IAEA safeguards or for the production of tritium or Li6).

276. One might wonder whether a multinational tribunal to try such cases might not be more just and more efficient, particularly when many different companies and individuals have aided a program of weapons of mass destruction. However, the trend in recent treaties is the one discussed in the text, authorizing or even obliging the state into whose hands the accused person falls to extradite or prosecute in national courts, rather than to create new international tribunals. Although there have been some efforts to establish new international criminal courts, they have been unsuccessful. See Harold Hongju Koh, Transnational Public Law Litigation, 100 Yale L.J. 2347, 2359 n.70 (1991).

277. Suppose a Russian expert in the electronics of triggering nuclear weapons, whose prospects for continued employment in that field in Russia are not good, is offered $400,000 a year by Libya. The expert might expect to save enough in just a few years to retire to Nice or San Diego. Such a future would be very tempting, no matter what one's personal qualms. However, a future where setting foot outside Libya might involve arrest and a long stint in a French or American prison would be far less appealing.
be a high multiple of the amount of profit earned.\textsuperscript{278}

It might also be possible to use transnational lawsuits to accomplish some of the same purposes. Private litigants could bring "traditional" suits against persons responsible for causing them harm, e.g., for injuries or property damage caused by weapons of mass destruction.\textsuperscript{279} Alternatively, by analogy to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),\textsuperscript{280} a new treaty could create a right for any person, including the United Nations, governments, and private entities, to recover "response costs" for remedying the situation caused by persons or firms who provide assistance to countries acquiring weapons of mass destruction.\textsuperscript{281} One advantage of imposing civil liability would be

\textsuperscript{278} Suppose a company stands to earn a net profit of $10 million for sending its experts to help another country design a MIRV "bus" to put multiple warheads on ballistic missiles. It may be hard to resist the temptation to agree if the consequence of being discovered and convicted were only a $1,000 fine. On the other hand, if the \textit{minimum} penalty for doing so knowingly, if convicted, were 10 times the amount earned (i.e., $100 million), amoral but prudent companies would decline to become involved.

\textsuperscript{279} This intriguing idea comes from the author's colleague, Bernard H. Oxman. In municipal law, the tort system is designed not only to make the injured parties whole but also, \textit{inter alia}, to discourage undesirable behavior. In the past, the use of private law as a major element of a control strategy would have seemed implausible, due to foreign sovereign immunity and other jurisdictional limitations and the act of state doctrine, although there had been occasional attempts, especially in maritime matters. Yet in recent years, private litigants have had some success bringing transnational law suits in U.S. courts, especially for violations of their human rights by foreign officials. See \textit{generally} Koh, supra note 276. In theory, this could provide an additional vehicle for upholding community norms in the arms control field with the very considerable advantage that suits could be brought against corporate entities, many of which may have substantial assets. Being multinational corporations, they could be tried in a variety of jurisdictions. This could have important deterrent effects. If a company knew that its assistance to an Iraqi chemical weapons program could make it liable to surviving family members of Kurds gassed by the Iraqis, or that its assistance to Iraq's SCUD missile program could make it liable to persons in Saudi Arabia and Israel who suffered losses, it would make providing such assistance seem exceedingly risky, even if there was no real risk of prosecution in the company's home jurisdiction.

In theory, such suits could be brought now. In practice, such litigation would face many difficulties even in the United States. There could be difficulties with jurisdiction, doubts as to whether such exporters owed duties to the injured parties, and doubts as to whether the harm was foreseeable. Above all, the U.S. courts are likely to find the offending government more culpable. The situation with courts in other countries, which generally have a less expansive notion of their jurisdiction, would be even less promising. These practical litigation problems could be reduced by an international convention which held private persons strictly and jointly and severally liable for any harm resulting from assistance to programs of weapons of mass destruction supplied after the convention entered into force. Affirmative defenses could be allowed, with the burden on the exporter asserting the defense to prove that the export was without knowledge that it assisted a prohibited weapons program.

\textsuperscript{280} Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. §§ 9601-75 (1988 & Supp. V 1993) (more commonly referred to as CERCLA or "Superfund"). CERCLA makes any of several statutorily-designated classes of responsible parties liable for response costs undertaken at facilities or vessels from which there has been a release of hazardous substances, subject only to a very narrow set of defenses. 42 U.S.C. § 9607.

\textsuperscript{281} If the several score of German firms which provided critical assistance to Iraq's nuclear, chemical, and biological weapons and ballistic missile programs had known
that courts could impose a less stringent "knowledge" test than would be appropriate where criminal sanctions may result. Another advantage is that private parties might be willing to bring suit under circumstances where governments would eschew imposing discretionary sanctions for political reasons.

5. Adopting a System of Challenge Inspections

Another step which could be taken in the context of the 1995 NPT renewal conference would be to adopt a system of challenge inspections, along the lines of article 16 of the Treaty of Tlatelolco, which allows any state to trigger a challenge inspection based on an assertion that another party is violating its obligation under the treaty. An international body, rather than the challenging party, conducts the inspection. This feature reduces legitimate concerns the inspected country may have about the challenges being a mere pretext for military or industrial espionage. Moreover, the challenging state must pay for the cost of the inspection, a feature designed to discourage frivolous charges.

Although challenge inspections would also be helpful in the case of nascent proliferation, they would take on special importance in dealing with advanced proliferation in those cases where a state proceeds somewhat along the lines of the Swedish model, i.e., the state abides by its NPT obligations to keep its nuclear material under safeguards, though perhaps adopting fuel-cycle approaches which involve access to large amounts of separated weapons-usable materials. Separately, the state before they provided the assistance that they would be civilly liable to the United Nations for the costs of investigating those programs and destroying the equipment they provided and the facilities they constructed, they might have eschewed the transactions in the first place or at least greatly raised their prices.

282. The details of a treaty along the above lines, and the possible use of transnational law to bolster it, need further elaboration and will be the subject of a future article.

283. This is apparently one of the reasons why private litigation has been so attractive in human rights cases. See Koh, supra note 276.

284. Article 16, §1(b)(i) provides for inspection “[w]hen so requested, the reasons for the request being stated, by any Party which suspects that some activity prohibited by this Treaty has been carried out or is about to be carried out, either in the territory of any other Party or in any other place on such latter Party’s behalf . . . .” Treaty of Tlatelolco, supra note 48. An even broader challenge inspection system is provided for in the Chemical Weapons Convention. Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and Their Destination, S. Treaty Doc. No. 21, 103d Cong., 1st Sess. (1993), reprinted in 32 I.L.M. 800 (1993).

285. As originally adopted, challenge inspections under the Tlatelolco Treaty were to be carried out by the Agency for the Prohibition of Nuclear Weapons in Latin America (OPANAL), the regional organization established by the treaty. However, OPANAL remained very small and without significant expertise of its own. Argentina and Brazil both objected to the fact that there was no assurance that trade secrets would be protected in an OPANAL-led inspection. Both of these problems were resolved this past year when the Treaty of Tlatelolco was modified to provide for the challenge inspections to be carried out by the IAEA, which has most of the needed expertise and a good record of protecting trade secrets. 3 Latins Support No-Nuke Treaty, WASH. TIMES, Aug. 27, 1992, at A2.

286. See supra note 207.
begins a major nuclear weapons design effort so that it can have substantial and sophisticated weapons as quickly as possible following a decision to do so. Proving that suspected facilities, which may be confined within or disguised as ICF programs, were engaged in weapons-related activities would be difficult and probably impossible if they were detected, unless there was a right of access.\textsuperscript{287} On the other hand, with full access to equipment and documents, a program oriented toward advanced proliferation would be hard to disguise, because substantial facilities and sophisticated equipment would be required.\textsuperscript{288}

B. Adopting Additional Restraints on Strategic Delivery Systems

The advanced proliferation problem will be ameliorated if threshold countries are unable to obtain highly-survivable, accurate, long-range delivery systems except by wholly indigenous construction. A more realistic near-term goal should be to prevent outright purchase of such systems and to delay and increase the cost of indigenous development.

1. \textit{Multilateral Treaties To Constrain Ballistic Missile Development and Deployment}

It would be helpful to multilateralize the basic undertaking of the Intermediate-Range Nuclear Forces (INF) Treaty,\textsuperscript{289} the U.S.-Soviet treaty banning the possession of intermediate range ballistic missiles with ranges from 500 to 5500 kilometers.\textsuperscript{290} Former ACDA Director Ken Adelman, writing prior to the demise of the Soviet Union, pointed out that it is strange that under the INF treaty, the United States and the Soviets may not legally possess such missiles but countries like Libya and North Korea

\textsuperscript{287} As explained in note 222, \textit{supra}, the IAEA would have the right to conduct special inspections under existing safeguards agreements only if the facility contained nuclear materials or if it were a facility where nuclear materials are normally used or produced. Nuclear weapons design facilities containing no nuclear material fall outside the scope of the IAEA's current authority.

\textsuperscript{288} A challenge inspection system would also reduce the undeclared nuclear facilities problem with NPT parties, which was a key aspect of the problem in Iraq. While recent steps taken by the IAEA Board of Governors to assert its right to carry out special inspections in NPT parties have been helpful, \textit{see supra} note 222, a treaty instrument establishing a challenge inspection scheme would be desirable. Doing so would make the IAEA's rights to carry out such special inspections far clearer than they are at present.


\textsuperscript{290} The INF treaty itself is not open to adherence by other nations, and the creation of a multilateral agreement having identical substantive provisions to those of the INF agreement would not make sense, if for no other reason than it is highly improbable that each party would allow the intrusive inspection rights granted under the treaty to be carried out by every other party. But a multilateral treaty repeating the nonpossession and nontransfer provisions of the INF treaty, but with an international organization carrying out the inspections, should not be too difficult to negotiate. \textit{See id.}
can. Adelman therefore advocated globalization of the INF agreement.\textsuperscript{291} A world-wide undertaking not to acquire IRBMs or the technology for their development and deployment could be significantly bolstered by a provision in a new multilateral treaty or a separate treaty that would be open to all states, under which the parties agree to freeze their ICBM numbers at present levels. Even stronger would be a ban on new ICBM types, bolstered by a ban on flight-testing ICBMs. Those undertakings would leave some countries with ICBMs and most others without them and would thus repeat some of the discrimination inherent in the NPT. However, the discrimination would be less onerous than under the NPT, in that every state would have an identical obligation not to acquire additional ICBMs.\textsuperscript{292}

2. \textit{Strengthening the Missile Technology Control Regime}

The Missile Technology Control Regime (MTCR) was flawed from the beginning and needs improvement.\textsuperscript{293} As its weaknesses have been discussed at length in other literature,\textsuperscript{294} they will be repeated here only in summary form. First, there is an urgent need to broaden participation and encourage states that are in passive agreement to support the regime through active cooperation.\textsuperscript{295} Second, the caliber of export controls

\textsuperscript{291} Ken Adelman, \textit{Curing Missile Measles}, WASH. TRMEs, April 17, 1989. Others have argued that a multilateral agreement would not be helpful, as it would make little sense to allow those countries to have ICBMs and not IRBMs (because the INF agreement does not limit ICBMs). See INF Treaty, supra note 289. Although that is correct, it is not a conclusive argument against multilateralization. First, virtually everything needed to design, test, build, and deploy ICBMs is also needed for IRBMs. Restraining the latter will have the effect of making development of the former far more difficult. Second, in some regional contexts, it is IRBMs we are most worried about. Third, an acquisition ban could be supplemented by a provision barring flight testing, without which the development of IRBMs is far less feasible. Space launch vehicle tests can give a country some of the information it needs for the launch vehicle. But the accurate return of the missile warhead to earth is not ideally tested through space launches, and with modern communications technology, there is no real reason to return capsules of film to earth, which would provide some experience with re-entry techniques and ablative materials. Fourth, even though development of IRBMs is difficult to separate from nominal space launch technologies, the actual deployment of IRBMs could be restrained. A categorical ban on such deployments would be relatively easy to verify. The greatest difficulty may be in getting China and France to agree, as each has IRBMs, and China’s IRBMs constitute a major part of its arsenal.

\textsuperscript{292} By way of analogy, it would have been far easier for some non-nuclear weapons states to accept the NPT if the nuclear weapons states had been obliged to put a ceiling on the number of nuclear weapons they had, so that every country, nuclear weapons state and non-nuclear weapons state alike, would have had an obligation to construct no additional nuclear weapons.

\textsuperscript{293} MTCR Guidelines, supra note 118.


\textsuperscript{295} In February 1990, the Soviet Union announced it would follow the guidelines of the MTCR and subsequently applied for membership in the group. \textit{Soviets Apply to Join Missile Technology Control Regime Group}, AEROSPACE DAILY, Nov. 30, 1990, at 357. However, there is an urgent need to assure the active participation of Russia and adherence
needs to be improved under the existing regime. When compared to the international nuclear controls, the MTCR guidelines are less detailed and precise. Lack of clarity in international agreements can lead to ambiguities and disputes, particularly where there is no treaty, but only a statement of national policy. For example, suppose a company from an MTCR supporting state was hired to design movable blast shields over missile silos, to design the MIRV "bus" to put multiple warheads on existing ICBMs in another country, or to supply highly precise ground-contour data to allow another country to make its own terrain-following guidance systems for cruise missiles. Nothing in the MTCR expressly forbids any of these kinds of cooperation. One would hope that countries would not allow such cooperation despite the lack of an express provision, but in less obvious cases, the lack of precision can be harmful to the purposes of the MTCR.

Finally, serious consideration should be given to making the regime binding under international law. It may well have been the case that a nonbinding agreement was all that was negotiable at the time, but a great deal has changed since then. There are several reasons for preferring a binding international instrument in this instance. First, the hypothetical situations described above would be better handled under a treaty.

to the guidelines by those former republics of the Soviet Union which have missile component production facilities or missile assembly facilities on their territory. Although Chinese officials reportedly told the Bush Administration they will abide by the principles of the regime, that is a unilateral assurance, made only to the United States, in the context of trying to deflect Congressional attacks on China's most favored nation trade status. Surely that is a weak reed on which to lean, particularly given China's highly irresponsible behavior regarding ballistic missiles, cruise missiles, and related technologies in the recent past. See infra note 802.

296. Of course, some level of interpretation is always required in international agreements as perfect clarity is impossible. See RICHARD FALK, THE STATUS OF LAW IN INTERNATIONAL SOCIETY 343 (1970) ("The central place of interpretation in the legal order is obvious."). Still, some legal standards are clearer than others, e.g., "the concentration of nitrobenzene in the discharged water cannot exceed 57 ppb." is not entirely free from ambiguity, but it is far less susceptible to differing interpretations than, for example, regulating radio and television broadcasting "in the public interest."

297. It might be argued that a MIRV bus is a stage or re-entry vehicle under MTCR item 2 or flight control equipment under MTCR item 10, but such an interpretation would be farfetched as the bus is not a propulsion stage, nor is it itself designed to be able to re-enter the atmosphere. Similarly, someone might claim that the raw geographic information relevant to developing Tercom guidance might be considered avionics software under MTCR item 11, but it fits none of the examples. One might argue that the blast doors are launch and ground support equipment under MTCR item 12, but that is even more far-fetched as the blast doors do nothing to launch the missiles (they would launch equally well if there were no such doors). See MTCR Guidelines, supra note 118.

298. Elizabeth Verville, at the time the Deputy Assistant Secretary of State for Politico-Military Affairs, made that point at the 1991 meeting of the American Society of International Law. If a nonbinding agreement was the most that could have been negotiated, it would have been foolish to demand a treaty instrument, thereby passing up the benefits which could be obtained by nonbinding means. On the other hand, the negotiability of a particular approach is rarely an independent variable. It usually is a function of how much effort is put into it, at what governmental levels, and what one is prepared to exchange in return.
as such cooperation would clearly be contrary to the object and purpose of the treaty and as a result, would be a violation of it. Second, the current status of the MTCR, as parallel statements of national policy which are linked to no legal instrument, has led to some of the most severe disputes under the MTCR. Under a treaty, an exporting country acting in good faith would have to ask itself not what its policy is but what the treaty terms really mean. Third, in a well-functioning treaty regime, the allowed cir-

299. The Vienna Convention does not say that in so many words. See Vienna Convention, supra note 165. However, article 31 states that “[a] treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.” Id. art. 31 (emphasis added). Of course, that still requires a term which can be given two meanings: one consistent with the treaty’s object and purpose, the other not. That might be difficult with the three hypothetical examples discussed in the text, as they are rather far removed from the plain meanings of the terms of the MTCR. However, under article 18 of the Vienna Convention, a state which has signed but not ratified a treaty is not bound by all the treaty’s detailed provisions, but it is “obliged to refrain from acts which would defeat the object and purpose of the treaty.” Id. art. 18. The hypothetical examples discussed in the text are so egregious as to be acts which would clearly defeat the object and purpose of the MTCR. An interpretation of the Vienna Convention that prohibits nonparty signatories from defeating the object and purpose of a treaty but allows parties to defeat the purpose, so long as they comply with the detailed requirements of the agreement, would be absurd. It would seem to follow that a party cannot defeat the object and purpose of a treaty even if the treaty has no explicit provision dealing with a specific matter.

300. Russia, for example, entered into a deal with India to provide it with $250 million in cryogenic (supercooled liquified gas) engines for space launch purposes. The United States protested, arguing that the sale violated the MTCR. The Russians said it did not, and they continued with the deal. Ranjan Roy, Russia, India Sign Pact to Put Troubled Ties Right, INTER PRESS SERVICE, Jan. 25, 1993, available in LEXIS, News Library, Wires File; Russia Will Go Ahead with Rocket Sale to India, REUTERS, July 16, 1992, available in LEXIS, News Library, Wires File. Subsequently the United States imposed import and export sanctions on both the Indian purchaser and the Soviet supplier, and the Soviets reportedly backed down. Holmes, supra note 199. There is no question that the engines were large enough to fall under MTCR item 2. But the MTCR by its terms does not forbid all such cooperation. Rather, the state which announces it is abiding by the MTCR pledges to make a determination, which it reserves entirely to itself, of whether a particular item of assistance to a foreign space program should be allowed, taking into consideration the following factors spelled out in the MTCR Guidelines:

A. Nuclear proliferation concerns;
B. The capabilities and objectives of the missile and space programs of the recipient state;
C. The significance of the transfer in terms of the potential development of nuclear weapons delivery systems other than manned aircraft;
D. The assessment of the end-use of the transfers, including the relevant assurances of the recipient states referred to in sub-paragraphs 5.A and 5.B below;
E. The applicability of relevant multilateral agreements.

MTCR Guidelines, supra note 118, at 600-01.

As these are supposed to be wholly national decisions, different suppliers could weigh the same factors differently. Thus the United States thought (probably correctly) that this assistance would be helpful to Indian efforts to obtain ICBMs. The Russians may have concluded that on balance the engines were more closely associated with legitimate space efforts.
cumstances might be clearer. Under a treaty regime, parties might be given a duty to consult in questionable cases. In contrast, it is hard to imagine such a legal duty in an agreement which purports to create no legal obligations. Finally, a treaty would have provisions for formal adherence. With some nonbinding agreements, it can be difficult to ascertain who is and who is not an adherent to its provisions. That is far less likely to be a problem with treaties, which have well-established structures and procedures for adherence, including a depositary (the U.N. or a particularly interested government) with whom one can check.

One possible way to make the MTCR a binding arrangement without converting it into an entirely free-standing treaty would be to make it subordinate to nondissemination provisions in new global agreements multilateralizing the INF ban on IRBMs or freezing ICBM levels at current numbers. The MTCR would then have the same posture toward the new treaties as the Zangger Committee list has to the NPT, i.e., an agreed statement by parties to the treaty as to the exports that would not be consistent with the treaty's requirements. Such lists can be amended without changing the treaties themselves.

3. Forbidding the Transfer of Other Strategic Delivery Systems

Efforts to impede advanced proliferation should deal with delivery systems

301. For example, space cooperation might be limited to NPT or Tlatelolco countries which do not have IRBMs or ICBMs and which agree to forego them as a condition of space cooperation.

302. Consider, for example, the question of China's status under the MTCR. In May 1991, the United States announced that it was banning the sale to China of certain computer and space equipment because of China's missile exports. In November 1991, Chinese officials told Secretary of State James Baker during a visit that they intended to observe the MTCR guidelines. In February 1992, China provided written assurance it would do so. China's Commitment to Non-proliferation an Issue in Clinton's MFN Deliberations, Int'l Trade Rep., May 12, 1993, at 795. President Clinton's report to Congress said China did so in March 1992. Renewal of Most-Favored Nation Status for China, supra note 139. But a Kyodo News Service report in May 1993 stated that China has yet to join the MTCR, though China said in February that it would. U.S. Protests Missile Exports Involving China, Russia, supra note 139. The United Press International then reported in July that "China has not signed but agreed to abide by the Missile Technology Control Regime ...." U.S. Official Meets China Foreign Minister on Arms, UPI, July 27, 1993, available in LEXIS, News Library, Wires File; see also Geoffrey Crothall, Arms Sales Warning: U.S. to Threaten Sanctions, South China Morning Post, July 23, 1993, at 10, available in LEXIS, News Library, China File. Dr. Gordon Oehler, Director of the CIA's Non-Proliferation Center, complicated matters further during CIA Director James Woolsey's Congressional testimony when Dr. Oehler stated "China has agreed to adhere to the guidelines and parameters of the MTCR, but they are not expected to become members of the MTCR." In response to a question Dr. Oehler added, "I don't know whether they've been asked, but I don't think that they would if they'd been asked." U.S. Security Policy vis-a-vis Rogue Regimes: Hearing Before the International Security, International Organizations and Human Rights Subcomm. of the House Foreign Affairs Comm., 103d Cong., 1st Sess. (1993) (testimony of James Woolsey, Director of Central Intelligence), reprinted in Fed. News Service, July 28, 1993, available in LEXIS, News Library, Wires File. Someone in the U.S. government probably knew what the facts were, but the President and the CIA could not both have been correct.
other than ballistic missiles. In considering options for restraints on delivery systems beyond those on ballistic missiles, it is essential to bear in mind that we are reduced to second-best solutions. Negotiation of severe restrictions on access to all possible nuclear-capable delivery systems has no prospect for international acceptance. In contrast, restrictions on strategic delivery systems, which may be of far greater interest to advanced proliferators than to nascent programs, should have far better prospects. There are weapons delivery systems in addition to ballistic missiles that are suitable for that role and have little justification for conventional defense. Their ready availability on the market would seriously undermine efforts to control all types of weapons of mass destruction. Moreover, the more successful constraints become on ballistic missiles, the more interest countries will have in acquiring other long-range delivery systems. The delivery systems in question are available only from a handful of actual and potential suppliers, and there is little or no current commerce in them, which should make the negotiation of constraints much easier.

a. Ban the Sale of All Bombers

There is no need for any state to transfer bombers to any other country.

303. It was understandable for Western countries to focus their control efforts initially on ballistic missiles. Even though they are related to the equipment and technology of space rockets, these long-range ballistic missiles (ICBMs and IRBMs) have no legitimate use except for delivering weapons of mass destruction. Countries of concern were known to be seeking them, either under the guise of peaceful space research or clandestinely. The number of countries capable of selling ballistic missile technology was small but growing. Given these facts, it was sensible to begin control efforts with ballistic missiles. It was much less understandable to exclude the Soviets and Chinese. That decision was made early in the Reagan administration. Of course, the Soviets and Chinese might not have participated if invited, but they could hardly be relied on to abide by an international rule-making from which they had been so humiliatingly excluded. In the end, both have indicated support for the MTCR but only after the passage of a great deal of time, a large number of highly destabilizing transfers, particularly by the Chinese, and lost opportunities to improve the controls.

304. Importing countries often have legitimate conventional defense requirements for multi-purpose fighters, for example, or for conventionally powered attack submarines, even though these may be capable of nuclear delivery as well. Moreover, the export of conventional weapons systems is important to the economies of several countries. The annual value of arms exports over the two decades from 1971 to 1990 when expressed in constant (1985) dollars ranged from just under $12 billion to over $27 billion, and it averaged $19.8 billion. Ian Anthony et al., The Trade in Major Conventional Weapons, in SIPRI Yearbook 1991, at 197, 231-32 (Stockholm International Peace Research Inst. (SIPRI) ed., 1991). According to a more recent report by the Congressional Research Service, sales to third world countries dropped 22% in 1993 but still amounted to $20.4 billion, of which the United States had the single largest share. Eric Schmitt, U.S. Arms Merchants Fatten Share of Sales to Third World, N.Y. Times, Aug. 2, 1994, at A6. Thus, both the developed and the developing countries are likely to resist any broad sweeping restrictions on all advanced nuclear-capable weaponry.

305. Cruise missiles are also covered by the MTCR, though the controls on parts, exotic materials, and expertise for indigenously produced cruise missiles are poorly elaborated when compared with the controls on ballistic missiles.

306. Older American terminology drew distinctions between light, medium, and heavy bombers. The light bomber category has been eliminated due to the great gains
Since the Korean War, no country has transferred heavy bombers to another nation.\textsuperscript{307} Although medium bombers have been sold in the past, there has not been a brisk trade in them, even within an alliance framework, since at least the 1970s, when the Soviets sold Tu-22 Blinders to Iraq and Libya. One might argue that because there is no commerce, there is no need for an agreement. But relying on that reasoning is far less protective of global security interests than a treaty. After all, the best time to ban something is when it is not yet an issue, as in the Antarctic Treaty’s prohibition on nuclear testing or waste disposal on that continent\textsuperscript{308} or the Outer Space Treaty’s prohibition on placement of weapons of mass destruction in orbit.\textsuperscript{309} Moreover, in times past, several nations did sell light and medium bombers to other nations, and in the absence of a legal prohibition, that commerce could resume.\textsuperscript{310} In that regard, it would be most unhelpful to world security if the United States were to sell B-1 bombers to Israel, if France were to sell Mirage IVs to Pakistan, or if Russia were to sell Backfires to India.\textsuperscript{311} Negotiating suitable definitions of bombers in terms of weight-carrying capability and range, so as to distinguish them from the more common fighter-bombers, should be relatively easy.\textsuperscript{312}

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\textsuperscript{307} The Soviets have sold a limited number (three or five) Bear F aircraft to India. See supra note 135. But these were reportedly outfitted for antisubmarine warfare, not long-distance bombing.


\textsuperscript{310} The British sold Canberra and Buccaneer bombers to several countries outside NATO, including India and South Africa. The Soviets sold TU-16 Badgers to Egypt and Indonesia and TU-22 Blinders to Iraq and Libya. Bill Sweetman, Backfire Goes to Market, Air Force Mag., Feb. 1993, at 42-43.

\textsuperscript{311} This is not an entirely hypothetical matter. Russia reportedly agreed to sell 12 Tu-22M-3s, the latest version of the Backfire supersonic bomber, to Iran. Gallery of Middle East Airpower, Air Force Mag., Oct. 1992, at 64; Sweetman, supra note 310, at 42. Tupolev officials later denied that they had sold or would sell Backfires to Iran. Ukraine Shows Off Backfires in Iran, Flight Int’l, Jan. 12, 1994, available in LEXIS, News Library, Flight File. Ukraine, in contrast, has no such inhibitions and actually displayed two Backfires in Iran. Id. Ukraine could not legally sell its Bear and Blackjack bombers as they are currently counted as heavy bombers under START I and the Lisbon Protocol. See START I, supra note 41; Lisbon Protocol, supra note 41. There appears to be no such prohibition for the Backfires.

\textsuperscript{312} Negotiating an agreement to control bombers would raise two more difficult collateral questions. One is whether it will be possible to identify and control the transfer of components and subsystems of bombers so as to make it more difficult for countries to build their own bombers or to enhance the survival and penetration capability of bombers they already possess. The second issue is whether comparable restraints should be adopted on tankers and associated equipment for air-to-air refueling.
b. Ban the Sale of Nuclear Submarines and of Missile Submarines

There is no reason for any country to sell or otherwise transfer nuclear powered submarines to another. In recent years, in addition to the nuclear weapons states, interest in nuclear powered submarines has been shown by several states, including India, Brazil, and Canada. Because of their great range and relative invulnerability and the comparative ease with which attack submarines can be outfitted with nuclear-armed cruise missiles or torpedoes, nuclear submarines present a potentially formidable delivery system. A ban on the sale of nuclear powered submarines would not interfere with existing commerce. However,

315. Brazil's Aramar Experimental Center, in addition to enriching uranium, also has the objective of developing a 50-MW submarine reactor, to run on 20% enriched fuel, a project on which it reportedly had spent $50 million by 1988. Turner, supra note 48.
316. The Canadian interest in nuclear attack submarines to protect their arctic waters seems to have crashed on the shoals of budgetary reality. Canada had once considered acquiring up to 10 nuclear submarines, in part a response to a dispute with the United States over transit through the Northwest passage. However, the program was cancelled in 1989, the casualty of a large defense spending reduction and substantial public and political opposition to the multi-billion dollar cost. David Pugliese, European Firms Market Subs for Canada, Des. News (Canada), Feb. 25, 1991, at 3.
317. At one time the United States did transfer Polaris submarine missiles to Great Britain, and in 1983 it entered into an agreement to supply Trident submarine-launched ballistic missiles. Anthony et al., supra note 304, at 247. Reportedly, the deal involves 72 Trident-2-D-5 missiles. The deal only involves transfer of the missiles; the British will build the four Vanguard submarines and supply the nuclear warheads. Id. According to another report, the United Kingdom has one Vanguard operational, two under construction, and one on order. Mather, supra note 66. The British have not announced how many warheads the missiles will carry, though it seems likely it will involve a total force of several hundred independently targeted warheads. In an era of reduced tensions in Europe, the British are not likely to be needing new ballistic missile submarines beyond those already planned. In any case, they can build their own nuclear submarines, as can all of the nuclear weapons states. William Webster, when he was the Director of Central Intelligence, testified that the five nuclear weapons states are also the states which currently build nuclear submarines. Nuclear Proliferation: Hearing of the Senate Governmental Affairs Committee, 101st Cong., 1st Sess. (1989) (testimony of William Webster, Director of the Central Intelligence Agency) quoted in Fed. News Service, May 18, 1989, available in LEXIS, News Library, Wires File. Similarly, the French are in the process of building new nuclear subs and associated missiles. France is building a new class of nuclear powered ballistic missile submarines to carry the new multi-warhead M5 missile, which can carry up to 12 warheads and has a reported range
there has been enough interest in such weapons that it would be prudent to preclude commerce in nuclear powered submarines and in related nuclear power plants and technology.\textsuperscript{318} The more difficult question concerns controls on related technology. The United States already has strict controls on nuclear propulsion technology.\textsuperscript{319}

No country should transfer submarines (whether nuclear or non-nuclear powered) which are specifically designed or altered to serve as carriers of ballistic or cruise missiles. There has been no such commerce to date, but in recent years it has been clear that restraint and good sense do not always govern suppliers’ actions when there is much money to be made and no legal prohibition on the sale. A prohibition binding at international law thus offers the best assurance that good sense will continue to prevail.\textsuperscript{320}

c. Limit the Transfer of Aircraft Carriers

Aircraft carriers provide the capacity to project power at great distances, and their fighters could give such carriers a significant long-range nuclear

An illustration of the kinds of problems this can involve arose in the negotiation of safeguards for the Brazilian nuclear program, because the Ipero facility is intended to supply HEU for submarine fuel and the IAEA Statute only allows safeguards to be applied to peaceful activities (military submarines being a nonexplosive but also nonpeaceful use of atomic energy). Mark Hibbs, Brazil’s Military May Block Safeguards with Argentina, NUCLEONICS WEEK, Nov. 28, 1991, at 8. On the other hand, a good case can be made that it would be better to limit assured supplies for naval reactors to 20% enriched uranium.

\textsuperscript{319} Much of the technology for naval propulsion is classified. Nuclear naval propulsion plants are on the Munitions Control List, Category VI(e). 22 C.F.R. § 1211 (1994). The United States also has controls on the sale of other items relevant to nuclear naval propulsion under the Commodity Control List. 15 C.F.R. § 799.1, Supp. No. 1 (1994).

\textsuperscript{320} For both nuclear submarines and missile-carrying conventional subs, a possible alternative to a categorical ban would be to restrict sales to NPT parties and those states that have undertaken comparable obligations. If this alternative is chosen, it is essential that the supplying state obtain a legally binding assurance from the recipient state that the supplied items will never be used to carry or deliver any weapon of mass destruction. This would only be a second-best solution and would need to be supplemented with considerable supplier restraint to deal with states of doubtful intentions, such as Iran, Iraq, Libya, and North Korea. A categorical ban, in contrast, would be far easier to police.
delivery capability. Even those that use conventional propulsion are exceptionally expensive, so that it is barely plausible for current threshold states to contemplate their indigenous construction. On the other hand, countries such as Argentina and India have purchased used ones. An agreement is needed which would: (1) bar the transfer of nuclear-powered aircraft carriers and (2) limit future sales of conventionally-powered aircraft carriers, their major critical components, and carrier-capable aircraft to states which are parties to and in compliance with the NPT or the Treaty of Tlatelolco.\footnote{321}

\section*{C. New Arms Control Initiatives To Freeze Threshold Nations' Nuclear Weapons Capabilities in Place}

As previously noted, export control measures, including related controls on information dissemination, are integral to an effective strategy for dealing with advanced proliferation, but they are not themselves a sufficient strategy. Perfection in execution is more than one can reasonably expect. Moreover, in the long run, even airtight export controls will only slow a determined country with adequate resources. Thus, by themselves they cannot prevent the ultimate acquisition of advanced nuclear weapons and delivery systems.\footnote{322} An effective strategy against advanced proliferation must also provide the threshold states with positive measures they can either accept or be put at a political disadvantage if they do not become a party to those measures. Naturally, the threshold states could already become parties to the NPT\footnote{323} or to a regional arrangement which would require them to undertake comparable duties, as has been done with the

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\item[\footnote{321}321.] The provision limiting transfers to NPT (or equivalent) parties should be supplemented with an informal understanding on restraint as to those NPT parties whose non-nuclear intentions are in serious doubt, i.e., Iran, Iraq, Libya, and North Korea.
\item[\footnote{322}322.] By greatly delaying the date when a nation could acquire a militarily significant force and by greatly increasing the cost, highly effective export controls can make achievement of an advanced proliferation program far more difficult. Knowledge of that fact could make the undertaking considerably less attractive to the threshold country.
\item[\footnote{323}323.] The author would strongly oppose trying to induce India, Pakistan, and Israel into measures short of the NPT if there were any possibility that they would otherwise become NPT parties in the near future. But there is no such prospect. As the most recent ACDA Director put it, "It is important to recognize that the conditions for their adherence to the NPT as non-nuclear weapons states do not exist. It is no good demanding now what is not possible now." Ronald F. Lehman II, \textit{Arms Control: Passing the Torch as Time Runs Out}, Wash. Q., Summer 1993, at 43.
\item Consider also the following statement of Raja Mohan from the Indian Institute of Defense Studies. While leaving open the possibility of some kind of regional non-proliferation arrangement (presumably covering Pakistan, India, and China), he stated that there was a “complete political consensus in our country” against the NPT. “I can assure you that no government in our country can last for five minutes if it only thinks of signing the NPT.” Mark Hibbs & Ann MacLachlan, \textit{India Can't Count on France for Tarapur Fuel Past 1993}, \textit{Nucleonics Wk.}, Apr. 16, 1992, at 9. Pakistan will take no such step unless India does as well. In deciding on intermediate measures to preclude the growth in the size and sophistication of the arsenals of the threshold states, we should do nothing that would permanently foreclose NPT adherence. But this is a circumstance where we cannot afford to let the ideal become the enemy of the good.
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Treaty of Tlatelolco. But the essence of the problem is the unwillingness of states to abandon their option to acquire nuclear weapons and give up the weapons they may already possess. A better strategy would provide them with an intermediate point, whereby they would not be required to give up their existing capabilities at this time, but they would effectively give up the option to (1) increase the number of their devices and (2) increase the yield of their weapons.

Two measures first proposed in the early days of arms control negotiations, a multilateral agreement precluding the production of nuclear materials for weapons purposes and a multilateral ban on all nuclear testing, have been revived recently because they would have considerable merit in their own right as arms control measures to further stabilize

324. There has been occasional talk of creating nuclear weapons free zones in, inter alia, the Middle East and South Asia. No doubt the entry into force of such NWFZs would resolve the most important nonproliferation problems, including the advanced proliferation problem, in those regions. The difficulty has been, and remains, getting the countries of greatest concern to agree to become party to any constraint which conclusively requires them to give up their existing nuclear weapons capabilities.

325. George Perkovich argues for a slightly different approach to deal with problems in South Asia, viz., in which the two countries would not give up their capabilities to acquire nuclear weapons in short order but would agree not to actually deploy them, resulting in what he calls "non-weaponized deterrence." George Perkovich, A Nuclear Third Way in South Asia, FOREIGN POL'y, Summer 1993, at 86. This approach is highly appealing, but its validity depends on Perkovich's assertion that neither Pakistan nor India has chosen to build nuclear weapons. "Despite all their expense and effort, though, India and Pakistan have not yet deployed nuclear arsenals or even declared themselves to be nuclear weapon states." Id. at 87. While the author has had no access to classified information for over 12 years and thus cannot personally determine whether Perkovich is correct, it is widely believed among nongovernmental experts that he is wrong. That suggests that his desire to freeze those capabilities in place may still be a workable approach but that it will have to be done against a factual background where one or both countries has at least some nuclear weapons already deployed to its forces, and under present circumstances, neither country is likely to disassemble them.

326. In a letter to Soviet Premier Bulganin dated March 1, 1956, President Eisenhower proposed "to work out, with other nations, suitable and safeguarded arrangements so that future production of fissionable materials anywhere in the world would no longer be used to increase the stockpiles of explosive weapons." 1 DOCUMENTS ON DISARMAMENT 1945-1959, at 593, 594 (U.S. Department of State ed., 1960). This became known as the "Cutoff" proposal, and it was later combined with a further suggestion that nuclear material from weapons purposes be converted and transferred to peaceful uses. This combined proposal was thereafter called "Cutoff and Transfer." See ACDA, supra note 231, at 2.

327. The Soviet Union first proposed a total ban on nuclear testing in 1955, separate from other disarmament measures then under discussion. The United States, United Kingdom, and France objected, arguing that such a ban should be linked to progress on other matters, particularly Cutoff. Several years of intermittent negotiations, a moratorium on nuclear testing, the resumption of testing, and more negotiations finally led President Kennedy to conclude that a comprehensive ban could not be achieved because of disagreements over the number of allowed on-site inspections. A more limited ban barring nuclear weapons in all environments except underground was quickly negotiated. This became the Limited Test Ban Treaty. Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, Aug. 5, 1963, 14 U.S.T. 1313, 480 U.N.T.S. 43; see ACDA, supra note 281, at 34-41. There remained, however, considerable interest in a comprehensive test ban (CTB), and the non-aligned states pushed for inclusion of a CTB (and sometimes also Cutoff) in the agreement or a
relations among the nuclear powers. However, their value is greatly increased when viewed through the lens of advanced proliferation.

1. A Treaty Banning Production of Nuclear Materials for Weapons

One step which would substantially assist in reducing the advanced proliferation problem would be for the international community to negotiate a treaty under which all parties agree to refrain from producing nuclear materials for nuclear explosive purposes. This agreement would apply to everyone: the existing nuclear powers, the threshold states, and others. To provide verification of that guarantee, all state parties, including the nuclear weapons states, would be required to place all their nuclear facilities, including those used in the past to produce nuclear materials for weapons purposes, under the safeguards system of the IAEA.328

Legally binding linkage of those measures to a nonproliferation agreement throughout the negotiation of the NPT. See id. at 11, 24, 53, 86-87, 106-08.

Negotiating the details of such a nonproduction agreement would admittedly be time consuming, and there are a number of issues which would need to be resolved. A full discussion of them is beyond the purposes of this article. Among the most important issues are:

(1) IAEA safeguards would need to be imposed at all nuclear facilities in all five nuclear weapons states. As each of the five already has at least some of its peaceful nuclear facilities under IAEA safeguards, that requirement would be less precedent setting than it might seem. The United States has entered into a treaty with the IAEA providing for IAEA safeguards on all source or special fissionable material in the United States except that for national security purposes. Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America, Nov. 18, 1977, 32 U.S.T. 3059. The United Kingdom earlier entered into a comparable arrangement with the IAEA and EURATOM. Agreement Between the United Kingdom of Great Britain and Northern Ireland, the European Atomic Energy Community and the International Atomic Energy Agency for the Application of Safeguards in the United Kingdom of Great Britain and Northern Ireland in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, Sept. 6, 1976, 1111 U.N.T.S. 168. The agreement entered into by the Soviet Union was not for all peaceful facilities but rather for selected power and research reactors. Agreement Between the Union of Soviet Socialist Republics and the International Atomic Energy Agency for the Application of Safeguards in the Union of Soviet Socialist Republics, Feb. 21, 1985, 24 I.L.M. 1411 (1985). China has also entered into an agreement to apply IAEA safeguards to peaceful facilities. China Signs Nuclear Safeguards Agreement with IAEA, XINHUA, Sept. 90, 1988, available in LEXIS, News Library, Intl File. The Chinese agreement means that IAEA safeguards are now being applied to peaceful nuclear facilities in all five of the nuclear weapons states. Id. Such a nonproduction agreement would require approximately a doubling of the IAEA's safeguards effort and thus would pose a major administrative and budgetary challenge for the Agency. This estimate is based on conversations the author held in November 1991 with former IAEA officials and in October 1992 with U.S. officials in the State Department and ACDA. The nuclear weapons states may not want to rely entirely on IAEA safeguards to assure that materials are not diverted from peaceful to weapons purposes. Consequently, pairs of states should have the option of negotiating supplemental bilateral verification agreements. The Argentine-Brazilian agreement provides precedent for such specialized arrangements in the IAEA context. See supra note 48.

(2) As shown graphically by the Iraqi case, IAEA safeguards as then practiced were not able to detect wholly undeclared nuclear facilities, though as discussed, there is legal authority to inspect suspect facilities once detected. See supra notes 284, 285 and
A nonproduction agreement would have value in its own right as a legally binding hedge against one of the two major nuclear powers suddenly deciding to reverse its unilateral pledges and beginning to

accompanying text. As is currently the case with non-nuclear weapons states which are NPT parties, the task of discovering clandestine facilities in the nuclear weapons states and in the non-NPT party states which might join a nonproduction treaty would fall primarily on national intelligence systems. Although doing so should be somewhat easier in this comparatively open era than at the height of the Cold War, intelligence may not be enough, by itself, to make a nonproduction agreement sufficiently well verified with respect to clandestine facilities. It should be supplemented with a challenge inspection system.

Challenge inspections in the United States could substantially raise concerns, like those raised by Henkin and Koplow, over possible infringements of constitutionally protected rights. See supra note 62. The problem is somewhat less severe with nuclear installations than other kinds of weaponry, because the credible installations should fall into one of two categories: (1) government laboratories, bases, test sites, and other installations or (2) civilian nuclear installations. The former should not raise significant constitutional issues. The latter already falls under the so called “regulated industry” exception to the Fourth Amendment. Even so, some precision will be needed in drafting the agreement to reconcile these interests. One possibility would be to designate categories of installations which will be automatically open to IAEA inspectors (as civilian installations already are under the U.S.-IAEA safeguards agreement) but require the challenging state to make a threshold showing to the IAEA before any facilities other than those in the designated categories could be inspected.

(3) While production of additional nuclear materials for nuclear weapons would be forbidden to all parties, some renewed production of HEU might eventually be needed for naval propulsion and research reactors. However, the amounts of HEU already on hand in both the United States and Russia, and the HEU which will be freed-up as strategic and tactical nuclear weapons are retired, are so vast that they should meet naval propulsion and research reactor needs for decades. Until a decade ago, virtually all research reactors, even the smallest ones, were fueled with highly enriched uranium. Technology has been developed which allows many of them to use 20% enriched uranium fuel instead. Nevertheless, there may always be a few high-powered research reactors that will require HEU as fuel. Safeguards arrangements through the IAEA would also be needed to prevent the use of HEU for naval propulsion from becoming a loophole through which materials could flow into additional nuclear weapons. Similarly, some production of non-nuclear weapons materials such as tritium would almost certainly still be necessary for weapons purposes. See supra notes 248-51 and accompanying text. Tritium has a half-life of 12.26 years. Tritium, CONCISE ENCYCLOPEDIA OF NUCLEAR ENERGY 821 (D.E. Barnes et al. eds., 1962). Nuclear weapons containing tritium thus need to have their tritium periodically replenished, otherwise the ideal quantity is no longer present and the yield declines.

329. Both the United States and Russia have announced full or partial cessation of production of special nuclear material for weapons as unilateral policies. Given present realities, neither the United States nor Russia will be able to produce more material for nuclear weapons for years, perhaps decades, without Herculean efforts. The United States has not needed to produce additional highly enriched uranium for nuclear weapons since 1964. Michael Knapik, DOE Assessing Various Options for Inventory of High-Enriched Uranium from Retired Weapons, NUCLEAR FUEL, Apr. 1, 1991, at 1. The U.S. weapons inventory of HEU has been estimated at 500 metric tons. Id. President Clinton has ordered a cut of 200 tons of nuclear material from the U.S. stockpile and its conversion to peaceful purposes. Nuclear Containment, BOSTON GLOBE, Mar. 5, 1995, at 86.

United States plutonium production has been halted since 1988 because of concerns with the safety of the reactors and the massive environmental mess which has been created. In a major national defense emergency, these facilities could go back on line fairly quickly, though at considerable environmental risk. Short of that, it is highly doubtful that plutonium production could be resumed anytime this decade.
increase the production of nuclear materials for nuclear weapons. Yet such a non-production agreement would not interfere with the current defense programs of the major powers, and the concept is now receiving serious international consideration as an arms control initiative.

A multilateral nonproduction agreement could have a powerful impact on advanced proliferation. It would provide the threshold.

The Russians have also announced the cessation of the production of HEU for weapons purposes. Gorbachev Halts Uranium Output, L.A. TIMES, Apr. 7, 1989, at A1. In fact, the United States has agreed to purchase $12 billion worth of Russian HEU over a 20 year period. Transcript of Press Conference by President Clinton and President Yeltsin, U.S. NEWSWIRE, Jan. 15, 1994, available in LEXIS, News Library, Current File. As for plutonium production, at the time of the Gorbachev announcement on HEU, he also announced that Russia had closed one plutonium production reactor in 1987 and that two more would be closed in 1989. Gorbachev on Soviet Armed Forces' Numerical Strength, BBC SUMMARY OF WORLD BROADCASTS, Apr. 8, 1989, available in LEXIS, News Library, Intl File. The Russians have some of the same safety and environmental problems that the United States has. They also have extreme budgetary limits, effectively discouraging the resumption of large-scale plutonium production.

Although several agreements have been negotiated between the United States and Russia that constrain delivery vehicles and the number of warheads or cruise missiles they may have, there are no arms control agreements between them or any other nuclear weapons states which would limit the number of nuclear weapons per se which they may possess.

Given the large cuts in strategic arms already agreed to in principle, neither the United States nor Russia will need additional nuclear materials for weapons purposes. Indeed, the weapons they will scrap under the INF, START I, and START II agreements and their respective unilateral decisions to curtail the deployment of tactical nuclear weapons will provide more than enough special nuclear material for all new weapons systems and the reconstruction of existing ones, with massive quantities left over. See INF Treaty, supra note 289; START I, supra note 41; START II, supra note 59. According to one report, the United States will have to scrap 70 tonnes (metric tons) of plutonium under the START agreements alone, and the former Soviet Republics will have to scrap 120 tonnes. DAVID ALBRIGHT ET AL., DISPOSITION OF SEPARATED PLUTONIUM (1992). That is a very large fraction of the 89 metric tons of plutonium the U.S. recently revealed it had produced for weapons purposes since World War II. See Krauer, supra note 241.


It could also be beneficial to the general nonproliferation regime by reducing the inequality inherent in the NPT. While some NPT parties would still have a right to possess nuclear weapons and others would not, no nation will have a right to produce nuclear materials for weapons, and every country party to the treaty would be obliged to have all its nuclear facilities under IAEA safeguards.
states with an alternative to the NPT that would effectively freeze their nuclear weapons capabilities in place, at least in terms of the number of weapons in their arsenal. Some threshold states which are currently unwilling to get rid of their existing nuclear weapons or the capability to have them on short notice may nevertheless find the status quo satisfactory if their neighbors or security rivals will be similarly frozen in place or if the agreement resolves otherwise difficult political problems for them. A legally binding multilateral nonproduction agreement also provides the only realistic vehicle whereby freezing the status quo can be verified, without a participating country having to make an accounting for past production of special nuclear material.

A nonproduction agreement may be particularly helpful in South Asia. In 1989, then Pakistani Prime Minister Benazir Bhutto announced that Pakistan would not produce "weapons-grade uranium," though U.S. officials believe that Pakistan resumed HEU production in 1990 because of rising tensions with India. Whatever Pakistan's current enrichment efforts are, Pakistani adherence to a multilateral nonproduction convention would convert that announcement into a treaty obligation that could be readily verified. That may be sufficiently attractive to India to be worth taking the same step, especially if China were to join the agreement. In that regard, the Indian government has recently expressed support for a global ban on fissile material production.

In the context of recent progress toward regional peace, a nonproduction agreement could also provide a way to deal with Israeli nuclear capability. President Bush, in his May 29, 1991 initiative on arms control in the Middle East, called on all states in the region to place their nuclear facilities under IAEA safeguards. That statement would only apply to Israel's Dimona reactor, as all other known nuclear facilities in the Middle East.

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334. Some increase in weapons numbers could still take place if the threshold countries moved to more efficient weapons designs which used less special nuclear material. But that might require nuclear testing, see infra section C.2, and in any case, there are limits as to how large a percentage increase in an arsenal is possible solely by that means.

335. Such a past accounting would be essential for a new NPT party. For an interesting discussion of the special problems caused by states which step back from the threshold having partially crossed it, see Spector, Repentant Nuclear Proliferants, supra note 169.

336. As former ACDA Director Lehman put it, "A freeze on the production of fissile material on the subcontinent would not close all nuclear doors but it would open a number of important alternatives. Whatever stock of unsafeguarded material that may exist would be frozen in size." Lehman, supra note 323.


East are already under an IAEA safeguards obligation. Most Arab League states, even in the context of an otherwise acceptable peace, would strongly object to a situation in which they continue to refrain from having any nuclear weapons while the Israeli arsenal continues to grow. At least some of those states might find it more acceptable in the short run to let Israel leave its nuclear capabilities "in the basement," provided that the Israeli arsenal is not permitted to grow. Egypt and other Arab moderate states have indicated they would view imposition of IAEA safeguards at Dimona as a useful confidence-building step. A global multilateral treaty that required that result might be easier for Israel to join than a measure aimed solely at itself.

2. A Comprehensive Test Ban Treaty

Negotiations are currently underway for a comprehensive test ban (CTB), i.e., a treaty which prohibits all testing of nuclear explosives in any environment. While such a treaty is considered desirable as a restraint on the development of increasingly sophisticated nuclear weapons by the existing nuclear weapons states, it is also favored by many as a constraint on proliferation. One of the arguments advanced is that it would strengthen the existing nonproliferation regime and give greater legitimacy to it by

Notes:
341. Even the moderate Arab states are finding the Israeli nuclear weapons capability increasingly difficult to ignore. At the ceremony to sign the convention banning the possession of chemical weapons, the Arab states announced they would not adhere to it until something is done about the Israeli nuclear capabilities. Alan Riding, Signing of Chemical-Arms Pact Begins, N.Y. Times, Jan. 14, 1993, at A16. They have balked at a permanent extension of the NPT and have signalled that they intend to press instead for a short renewal period for the NPT in the absence of progress on the Israeli nuclear issue. See, e.g., Peres To Meet with Mubarak About NPT, JERUSALEM POST, Feb. 22, 1995, at 2.

342. Cobban, supra note 340.

343. For their part, many Israelis recognize that lasting peace will require some concession on their nuclear capabilities, though Israelis who favor dismantling their existing nuclear weapons are rare. However, the advancing age of the Dimona reactor may make a virtue of necessity, as Washington rumor has it the reactor is increasingly difficult to keep operating.

344. These negotiations are currently underway in Geneva under the auspices of the Conference on Disarmament, with the objective of having a treaty completed by April 1995. Holum Testimony, supra note 332. While the prospects for meeting that deadline seem remote, significant progress has been made, with considerable support shown by the Indian, Pakistani, and Israeli delegate or observer missions. Interview with a Member of the U.S. Delegation to the Conference on Disarmament, in Miami, Fla. (Jan. 1995).

345. Article VI of the NPT compels the nuclear weapons states to pursue good faith negotiations on nuclear disarmament. "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." NPT, supra note 2, art. VI. Logically that ought to have focused political pressure on the need for steep reductions in warheads and delivery systems, an issue on which the record of the superpowers was dismal until very recently. Instead, the political pressure was translated primarily into a demand for a CTB. A quick scan of the United Nations Disarmament Yearbook over the past two decades reveals a virtually unbroken string of comments and criticisms directed against the nuclear powers for their failure to con-
reducing the inequality inherent in the NPT.346 The other argument, and the one more relevant to the specific problem of advanced proliferation, is that states of actual or potential proliferation concern would become par-
clude a comprehensive test ban. United Nations, Office for Disarmament Affairs, Disarmament Yearbook. While criticism from the NATO allies tended to be mild, stronger criticism came from both developed and developing countries. These included not only ones with which the United States had generally poor political relations, but also others, like Australia and Japan, which are close allies. The dispute over a CTB was the primary reason no final declaration was adopted at the 1990 NPT Review Conference. See Spector & Smith, supra note 217, at 43-44. See also William Epstein, Conference a Qualified Success, Bull. Atom. Sci., Dec. 1990, at 45.

Part of the explanation for this heavy focus on halting nuclear testing was historical: progress toward a CTB was explicitly called for in both the preamble and the operative provisions of the Limited Test Ban Treaty (LTBT). Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water, Aug. 5, 1963, preamble, 14 U.S.T. 1313 [hereinafter Limited Test Ban Treaty]. The preamble provides that the original parties "[seek] to achieve the discontinuance of all test explosions of nuclear weapons for all time." Article I goes on to state that "the provisions of this sub-paragraph are without prejudice to the conclusion of a treaty resulting in the permanent banning of all nuclear test explosions . . . the conclusion of which, as the Parties have stated in the preamble to this Treaty, they seek to achieve." Id. art. I(1) (b). The desirability of a CTB is recited in the preamble to the NPT itself. Moreover, some countries believed that halting the growth in the number of nuclear weapons was insufficient if qualitative improvement was left unrestrained, and they saw in a CTB a way to restrain improvements in the arsenals of the superpowers. In any event, such pressure was and remains a political reality.

346. An unavoidable but serious flaw in the NPT is its inherent discrimination. The treaty divides the world into two classes of countries, those allowed to go on having nuclear weapons and those that are not allowed to possess them. Although too much can be made of the argument, the author believes a CTB would make a substantial contribution to the existing nonproliferation regime by reducing the assertions that the NPT perpetuates and even fosters the inequality of states. Professor Frank, for example, in distinguishing between legitimacy and justice (while recognizing they blend into each other), notes:

The legitimate rule pulls toward compliance because those addressed perceive themselves as perpetually interacting parties engaged in a secular community with rules and rule-based institutions within which the rule-induced benefits of safety, order and predictability promote the aggregate well-being of the community. The just rule gets its capacity to pull toward compliance from the agreement of the parties of a moral order on principles governing the fair allocation of finite resources among individuals. Obviously, rules of the secular state, or of the secular community of states, exert their most powerful pull toward voluntary compliance when they are generally perceived to be both legitimate and just, and a legitimate rule may pull less powerfully toward compliance when it is seen to be unjust.


In Professor Frank's terms the NPT is a legitimate rule necessary for the preservation of international safety and order, but at least for some states, it is an unjust rule because it promotes the inequality of states. Nonproliferation will become a more powerful idea to the extent that it can harness both legitimacy and fairness by minimizing the discriminatory aspects of the treaty. Conclusion of a CTB may also decrease the risk that some non-nuclear weapons states might use the absence of a CTB as an excuse to pull out of the NPT. This argument for a CTB is related only to the general nuclear weapons proliferation problem because its validity does not depend on whether any particular country becomes party to a CTB and thus has no special relevance to advanced proliferation. For these purposes, the current Russian, U.S., and French moratoria on testing are somewhat helpful, and a treaty among the five nuclear weapons states would be almost as beneficial as a multilateral agreement.
ties to a CTB but would not become parties to the NPT or Treaty of Tlatelolco. Doing so, it is argued, would impose a substantial impediment to their development of nuclear weapons. When assessing this argument, it is vital to distinguish between nascent proliferation and advanced proliferation.

The claim that a CTB would constitute a serious impediment to a state acquiring a few simple nuclear weapons has been oversold by some CTB proponents. Although each of the current nuclear weapons states tested a simple device at the start of its nuclear weapons program, from the inception of the nuclear age, testing was not necessary for the acquisition of some nuclear weapons. Even with plutonium as the explosive material, a country might be able to circumvent the need for nuclear testing through a combination of extensive testing of the non-nuclear components, computer modeling, and the knowledge (from either the public record, espionage, or the assistance of foreign experts) of what has worked for others. Some combination of these measures apparently worked for Israel and probably for Pakistan. In short, the inability to test would be an impediment for a nascent nuclear program but not one which would ultimately prevent the development of simple nuclear weapons.

347. The first U.S. HEU device was dropped on Hiroshima without the design ever being tested. United States weapons designers were confident that the device would work and that they could calculate its yield accurately enough to allow its military use. Countries developing HEU devices would probably have no more need to test than the United States did, and that is apparently what happened in the case of South Africa. Plutonium devices are trickier for several reasons, such as the need to use an implosion to bring about a critical mass and yield uncertainties caused by the possibility of "pre-ignition." In contrast to HEU, plutonium gives off substantial numbers of spontaneous neutrons. This can cause the chain reaction to begin too soon, reducing the yield, sometimes considerably. The extent to which this is a problem is largely a function of isotopic composition of the plutonium and the sophistication of the weapons designers. The United States was sufficiently concerned about these problems that, despite a severe shortage of the material, the first plutonium device was tested at Alamogordo, New Mexico, before the second was dropped on Nagasaki.

348. In the early years of the nuclear era, countries acquiring nuclear weapons were aided by association with other nuclear powers (the United Kingdom and later France with the United States, China with the Soviet Union), and by espionage aimed at the United States (admitted in the case of the Soviet Union, widely rumored in the case of China).

349. For decades there have been rumors in Washington that Israel received nuclear weapons design information from sympathetic individuals within the U.S. weapons design establishment. Whatever the evidence supporting those assertions, it would be more than mildly surprising if a state like Israel would be willing to use its intelligence service to obtain and clandestinely smuggle out nuclear weapons-related parts and materials from the United States, as it has, but would abstain from trying to use its intelligence establishment to obtain nuclear weapons design information. After all, the illegal export of information is far less likely to be detected than the illegal export of tangible items.

350. There have been numerous press accounts that the Pakistanis received actual fission weapons designs from China. Professor Milhollin, for example, stated that in 1983, China provided Pakistan with the full, tested design details for a 25 kiloton bomb. John M. Broder & Stanley Meisler, The Terrifying Pursuit of Nuclear Arms, L.A. Times, Jan. 19, 1992, at A1. If this is true and the plans were of sufficient detail (i.e., blueprints and shop drawings), no design work or testing would be needed.
whether announced or kept in the basement. 351

A CTB will have a vastly more significant impact on advanced proliferation than its impact on the development of initial devices. 352 In the absence of widespread assistance from experts in the nuclear weapons design programs of the nuclear weapons states, major improvements in fission weapons would require either nuclear testing or a substantial and sustained effort by a large, well-financed, and well-equipped scientific and technical establishment. Developing boosted weapons is more difficult. Doing so without testing or extensive external help would require a high level of sophistication. If that describes any current threshold state, it is limited to Israel.

An even higher leap in sophistication is needed to design thermonuclear weapons. Arguments that very high yield, low weight, asymmetrically shaped, exceptionally safe thermonuclear weapons can be designed and deployed without any testing by countries which do not now possess them border on the frivolous. It is impossible to believe that Indian or Pakistani designers are so much more talented than their more numerous, far more experienced, and vastly better equipped and financed U.S. counterparts, that they could develop highly sophisticated designs without testing at all, even though this was something the United States could not accomplish. 353 Indeed, those who make the argument that a CTB would not

351. A country acquiring its first nuclear devices would still prefer to have the legal option to test because testing aids further refinement of the devices and because prudent military leaders do not like the idea of relying on weapons (conventional or nuclear) which have not been well tested. Indeed, India may have had a "dud" before its successful test of a plutonium device in 1974. Thus the ability to test legally is useful but not essential to a first device. Of course, a country may want to prove that it has "arrived" as a nuclear power. If that is what a country wishes, a mushroom cloud is a highly visible exclamation point. Lately, however, threshold countries seem to prefer ambiguity.

352. Some people otherwise knowledgeable in nonproliferation matters have not understood this point. Consider the following statement by the now Deputy Secretary of Defense: "To be sure a prohibition on testing may slow the pace of proliferating nations to acquire thermonuclear weapons, but possession of crude fission weapons is the essential threat that the world seeks to avoid." John M. Deutch, The New Nuclear Threat, FOREIGN AFF., Fall 1992, at 120, 130. In contrast, the author would like to avoid the possession of crude fission weapons by additional states, but he worries far more about those states acquiring significantly more destructive weapons.

353. The Department of Energy recently announced that the U.S. conducted 1051 nuclear tests from the end of World War II through 1990. Krauer, supra note 241. This was accomplished at a cost of several billion current dollars. In 1988, the Natural Resources Defense Council, a strong opponent of nuclear testing but with a good reputation for its factual studies, announced the results of an analysis of the cost of testing. Department of Defense and Department of Energy budgets showed a cost of $241 million in 1980 rising to $726 million in fiscal year 1987. David Evans, Secret U.S. Nuclear Testing Discovered, Chi. Trib., Jan. 19, 1988, at 3. Although the number of tests per year has gone down since then, the program was still costly. The last administration's final budget request for nuclear testing was for half a billion dollars. START Treaty, Hearing Before the Senate Foreign Relations Comm., 102d Cong. 2d Sess. (1992) (questioning of Secretary Baker by Senator Simon), reprinted in Fed. News Service, June 23, 1992, available in LEXIS, News Library, Fednew File. The author has difficulty believing this was all a purposeful waste, which is the unavoidable consequence of the argument that the
restrain efforts at advanced weaponization by nuclear threshold countries are virtually always advocates for the U.S. nuclear weapons design establishment, which has a very strong self-interest in being allowed to continue to test. The same persons forcefully make the opposite argument with respect to any restraints on U.S. testing, namely the claim that testing limits will harm U.S. security because the design of new types of weapons cannot be accomplished without testing.

Of course, this benefit of a CTB depends on states of current or future proliferation concern joining the new treaty. In that regard, there are reasons to be optimistic that India and Israel would adhere to such a treaty. Many other states which have been mentioned as proliferation concerns in the past such as Brazil, Argentina, Egypt, and Indonesia would do so as well, tending to bolster the pledges they made as parties to the NPT or Treaty of Tlatelolco. Because this benefit of a CTB depends on states of advanced proliferation concern having a binding legal obligation not to test, it follows that this benefit of a CTB can only be achieved by a multilateral treaty. An extension of the current American-Russian-French moratorium, or even a treaty governing all five nuclear powers, Pakistanis can develop the most sophisticated thermonuclear weapons without testing, but we cannot.


356. Moon Ihlwan, Indonesia to Seek Global Ban on Nuclear Tests, Reuters, July 26, 1995, available in LEXIS, News Library, Curwms file. Indonesia had been host to a 1991 effort to amend the Limited Test Ban Treaty to bar all nuclear testing, and has enlisted Egypt, Mexico, India, and several other nations as co-sponsors of an effort to do so again. See supra note 345. See infra note 357 for a discussion of the advantages of amending the LTBT to obtain a CTB.

357. Of course, favorable statements made at the Conference on Disarmament are not a guarantee that a state will adhere to a CTB once it is opened for signature, and both the Indian and Israeli statements suggested adherence of other states would be important to their decision. But India, Brazil, and Egypt in particular would look foolish if, following their prominent multi-decade campaign for a CTB and having committed themselves to negotiating a CTB as parties to the LTBT, they did not adhere once a nondiscriminatory CTB was open for their participation. See supra note 345. Of course, states are willing to suffer consequences far worse than mere diplomatic embarrassment when their supreme national interests are at stake. However, the consequences of having to reverse strongly held positions is not solely a matter of appearances—there can be severe costs to a nation's reputation and perception as a trustworthy member of the international community. If India were ultimately to decline to adhere to a nondiscriminatory CTB, it would be a heavy blow to its prestige and to its claim to moral and political leadership among Third World nations.

358. The French are currently observing a moratorium on further nuclear testing. Pacific Nuclear Tests Suspended, FACTS ON FILE WORLD NEWS DIGEST, Apr. 16, 1992, at 275
whatever their benefits to the general nonproliferation regime, would be worthless on this particular point.\textsuperscript{359}

Conclusion

There are far fewer nuclear weapons states now than virtually anyone would have imagined three decades ago. While there are many reasons for this widespread failure in forecasting the future, the most important is the failure to understand the powerful centripetal forces which a carefully nurtured complex regime could exert, gradually pulling the countries into a common endeavor with shared norms, decision-making and verification structures, and common legal standards. It is true that there are three threshold states which have nuclear weapons or could have them on very short notice. But that too is only half the number that was widely expected until very recently, because in the past five years South Africa, Argentina, and Brazil reversed course and joined the nonproliferation regime. Nevertheless, a watershed has now been reached, where the exclusive focus on keeping countries from acquiring any weapons is no longer a sufficient policy response. We have vital interests—ranging from realist-oriented security interests to cooperative law-regarding interests in forging a more peaceful world—which will be severely harmed if current or future threshold states can rapidly acquire large nuclear forces with high yield weapons and long-range delivery systems.


359. Indeed, because the primary benefit of a CTB may be to restrain advanced proliferation, the amendment of the LTBT to preclude testing in all media is preferable to a new treaty. The LTBT is a highly unusual treaty in that it may be amended if a majority of the parties, plus the United States, the United Kingdom, and the U.S.S.R. (now Russia for these purposes) deposit their instruments of ratification of the amendment to the treaty. The amendment then becomes binding on all parties, not just those which ratify the change. \textit{Limited Test Ban Treaty}, supra note 345, art. II. India and Israel are parties to the LTBT, as are several of the states which have been mentioned in this article as possible future advanced proliferation candidates. Of course, those states would have a right to pull out of the LTBT, but doing so would be a drastic step and could only be done legally if the state asserted that "extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country." \textit{Id.} art. IV. A number of the threshold countries might find the political cost of making such a declaration to be excessively high.

The United States and other nuclear powers prefer to draft a new treaty, as there are considerable details which need to be worked out. On the other hand, a simple modification of the LTBT to preclude all testing, with the benefit of wrapping India, Israel, and others into a legal obligation not to test without awaiting their ratification, could be coupled with a separate treaty among the nuclear powers regulating some of the detailed matters necessary to verify the ban and deal with other technical issues.
We have the tools under international law to do something about that advanced proliferation problem, by making it more costly and time consuming to build up nuclear forces and also by offering the current threshold states an intermediate status, through new arms control initiatives, that will freeze their capabilities in place pending larger geopolitical changes which might induce them to abandon those weapons altogether. While success should be our primary concern, it is important that we take steps that minimize complaints of discrimination, which serve progressively to de-legitimize nuclear weapons (while recognizing that some will be with us for a long time), and which strengthen the role of legally binding instruments as part of a larger strategy of creating a more peaceful international order.