LA-UR- 97-2380

Approved for public release; distribution is unlimited.

Title: Virtual Nuclear Weapons

Author(s): Joseph F. Pilat

Submitted to: US Institute for Peace

DISCLAIMER

Los Alamos
NATIONAL LABORATORY

Form 836 (10/96)

VIRTUAL NUCLEAR WEAPONS

Joseph F. Pilat

A. Introduction

The term *virtual* nuclear weapons proliferation and arsenals, as opposed to *actual* weapons and arsenals, has entered in recent years the American lexicon of nuclear strategy, arms control, and nonproliferation. While the term seems to have an intuitive appeal, largely due to its cyberspace imagery, its current use is still vague and loose. We believe, however, that if the term is clearly delineated, it might offer a promising approach to conceptualizing certain current problems of proliferation. Accordingly, we start with a brief analytical note on the concept itself.

The phrase is currently used in at least two distinct ways, each reflects a different conceptual connotation with different policy considerations. The first use is in a reference to an old problem that has resurfaced recently: the problem of growing availability of weapon-usable nuclear materials in civilian nuclear programs along with materials made "excess" to defense needs by current arms reduction and dismantlement. It is argued that the availability of these vast materials, either by declared nuclear-weapon states or by technologically advanced nonweapon states, makes it possible for those states to rapidly assemble and deploy tens, hundreds, or even thousands of nuclear weapons. Excessive stockpiles of weapon-usable material constitute, in this sense, a virtual nuclear arsenal. In this sense, virtual proliferation is the 1990s terminology for what was called in the 1970s "latent arsenals" or "latent proliferation" (e.g., Harold Feivson, George Quester) in the 1970s. It is a *physicalist* approach to proliferation; that is, it is a way to consider a state's distance from the bomb by reference to its nuclear material stocks and fuel-cycle status. The holders of this view consider virtual weapons as a grave nuclear-proliferation threat, envisioning a world that could be awash in nuclear powers with large arsenals within a short period of time. As such, virtual weapons testify the dangers of some forms of nuclear-power production, as well as to the shortcomings and deficiencies of current nuclear arms control and nonproliferation regimes.

The second use has quite a different set of connotations. It is derived conceptually from the imagery of computer-generated reality: reality without physical representations. In this use, we think of virtual proliferation and arsenals not in terms of the *physical* hardware required to make the bomb but rather in terms of the *knowledge/experience* required to design, assemble, and deploy the arsenal. Both uses highlight proliferation risks, but the second use also looks to virtual arsenals as a new means to pursue the goal of disarmament and of a nuclear-free world. Virtual arsenals allow states ways to extend the fuse between ready-to-go, assembled nuclear weapons and

yet keep some elements of nuclear deterrent in place.[1] This view, whose proponents argue that virtual arsenals "reinforce the nonproliferation regime and provide possible solutions to remaining regional nonproliferation issues, especially South Asia,"[2] oversell the potential benefits of virtual arsenals and minimizes the risks and challenges of the approach. Nevertheless, virtual weapons are a physics reality and cannot be ignored in a world where knowledge, experience, materials, and other requirements to make nuclear weapons are widespread, and where dramatic army reductions and, in some cases, disarmament are realities.

In our view, both concepts have analytic value but remain inadequate by themselves. They are useful in defining a continuum of virtual capabilities, ranging from those at the low end that derive from general technology diffusion and the existence of nuclear energy programs to those at the high end that involve conscious decisions to develop or maintain militarily significant nuclear-weapon capabilities. The validity of this continuum notion depends on a number of general and contextual questions. Are virtual arsenals inevitable or a matter of choice? Will virtual arsenals undermine or promote nonproliferation and arms control efforts? If they provide assurances to states, are those assurances credible? Cost effective? A useful long-term hedge?

In this paper, we only address these questions in a first, approximate manner. To do so, we explore the concepts and technical requirements of virtual weapon capabilities, and then we examine the cases of Japan and Israel in some depth and also look at the cases of Sweden, South Africa, Belarus, Kazakhstan, and Ukraine.

B. Nuclear Knowledge/Experience

Virtual weapons and arsenals are issues of public interest as the end of the Cold War has created a new global environment regarding nuclear weapons. The Strategic Arms Reduction Treaty (START) I has already committed the United States and Russia to deep reductions in their stockpiles; START II, if it enters into force and is implemented, is expected to further reduce stockpile by two-thirds. START III, as agreed in broad outline at the 1997 Helsinki Summit, contemplates even further reductions. Apart from China, the other four declared nuclear-weapon states no longer produce fissile material and all of the acknowledged nuclear-weapon states have now stopped testing; it is hoped that the recently concluded comprehensive test ban treaty (CTBT)

---

[1] In the view of one proponent of virtual nuclear arsenals, "[t]he aspiration of virtual arsenals is not one commonly associated with nuclear disarmament—the complete and total elimination of all capability to build nuclear weapons. Given the spread of civilian nuclear power and the advance of nuclear technology, such a goal is infeasible. Virtual arsenals aim instead to ban the existence of all assembled, ready-for-use nuclear weapons, and thus to push them to the background of world politics without abandoning all their alleged benefits or leaving the major powers vulnerable to nuclear blackmail." (Michael J. Mazarr, "Virtual Nuclear Arsenals," *Survival*, Vol. 37, No. 3 [Autumn 1995], p. 8.)

[2] Ibid, p. 22.

(CTBT)will enter into force rapidly, although the prospects are uncertain primarily because of India's opposition. Nevertheless, in anticipation of the CTBT, the United States has launched a science-based stockpile stewardship (SBSS) program aimed at retaining and preserving its nuclear-weapon deterrent capability under the new conditions. The other declared weapon states are expected to follow suit.

Notwithstanding uncertainties and instabilities that portend future dangers of proliferation, this emerging global environment is likely to have an impact on the thinking and behavior of at least some of the undeclared nuclear-weapon-capable states. South Africa has already rolled back its nuclear-weapon program in 1991 and signed the Treaty on the Nonproliferation of Nuclear Weapons (NPT). The nuclear programs of the three significant non-NPT signatory states—India, Israel, and Pakistan—have probably already implemented some form of stewardship program, whatever the scope and level of sophistication. These states are likely to maintain or even expand those programs in the future, especially if they agree to the CTBT and a cutoff in the production of fissile material for weapons. Israel, the most advanced state among the three, is formally committed to the principle of a NWFZ in the Middle East after a comprehensive peace in the region is achieved.

This new environment raises issues and problems regarding the control and safeguarding of nuclear weapons technology that are qualitatively different than those of the past and highlights the problems and prospects of virtual arsenals. A primary issue in this new context is the cluster of questions related to controlling and safeguarding knowledge and experience relevant to nuclear weapons technology. Understanding the reality of nuclear-weapon knowledge and experience is essential both for stewardship and the rolling back of nuclear weapons programs. This issue has been neglected, even ignored, by arms controllers almost since the Acheson-Lilienthal report at the dawn of the nuclear age.

The problem of *knowledge/experience* has hardly been addressed thus far in nuclear nonproliferation and arms control agreements. This is clear, for example, from a brief analysis of Articles II and III of the NPT. Article II of the NPT, which formulates the fundamental obligation of the non-nuclear weapons states as "not to manufacture...nuclear weapons or other nuclear explosive devices" could be argued to cover any knowledge that is presumably an intrinsic aspect of manufacture. However, the exact operational meaning of the obligation under Article II is not so clear because the NPT contains no operational definition of the key phrases "manufacture" or "nuclear explosive device." Even if we interpret the term "manufacture" broadly, as the negotiating record of the NPT suggests (the so-called "Foster criteria"), to mean *all* actions that entail the *intention* to make nuclear weapons, it still remains unclear what kind, if any, of nuclear-weapons-

related research is prohibited.[3] The problem is that, except for the reference to manufacture or acquisition of nuclear explosives, nowhere in the NPT is there an explicit effort to draw the line between legitimate and illegitimate nuclear research activities, nor is there an attempt to draw the line between *theoretical research* and *applied development*. Nothing in the NPT prohibits the scientists of a non-weapons state from conducting theoretical research on, for example, the hydrodynamics of the implosion mechanism, as long as they maintain that the purpose of this research is peaceful and can show a possible peacetime use. The stress of the prohibition in Article II is, however, clearly on production, not on R&D. The question of nuclear weapons knowledge/experience *per se* was hardly dealt with by the framers of the NPT. To the extent that they recognized the problem, they circumvented it by imposing a broad (but vague) prohibition on all activities directed at manufacturing or acquiring nuclear weapons.

These ambiguities and omissions are manifested more clearly in Article III of the NPT, which sets up the terms to verify compliance with one aspect of Article II. It requires non-weapon parties to conclude a full-scope safeguard agreement with the IAEA, "with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons." Notably, the IAEA full-scope safeguard mechanism—the verification mechanism of the NPT—is more limited in its objectives than the broad terms of the prohibition. While Article II (according to the Foster criteria) prohibits any activity intended to manufacture nuclear weapons, Article III provides a safeguards system whose mandate is limited to "all source or special fissionable material in all peaceful nuclear activities within the territory of such State." The IAEA/NPT model of full-scope safeguards (INFCIRC/153) deals essentially with nuclear *materials* and *facilities*: the prime focus of IAEA inspections. While INFCIRC/153 allows for conducting "special inspections" directed at other suspect activities related to the manufacture of nuclear weapons, in reality the IAEA safeguards system imposes no practical limitations on activities that fall under R&D that do not involve nuclear materials, or locations where nuclear materials are not customarily present.

---

[3] According to Bunn and Timerbaev, during the negotiations on the NPT the US gave its own criteria for defining "manufacture" to potential signatories who asked for clarification. In his testimony before Congress, William C. Foster, the US chief negotiator, characterized the criteria, developed in consultations with the Soviet Union and Sweden, in the following manner:

> [F]acts indicating that the *purpose* of particular activity was the acquisition of a nuclear explosive device would tend to show noncompliance. (Thus the construction of an *experimental* or prototype nuclear explosive would be covered by the term "manufacture" as would be the *production of components which could only have relevance to a nuclear explosive device*). Again, while the *placing of a particular activity under safeguards* would not, in and of itself, settle the question of whether the activity was in compliance with the treaty, it would be helpful in allaying any suspicion of non-compliance. (Cited in George Bunn and Roland M. Timerbaev, *Nuclear Verification Under the NPT: What Should it Cover? How Far May it Go?*, Programme for Promoting Nuclear Non-Proliferation, Study Five, 1994. p. 5.)

These ambiguities are not surprising, nor are the omissions accidental. The framers of the NPT recognized that *knowledge/experience* cannot be subjected to effective international control and safeguards like a physical commodity, and international control of nuclear-related research cannot be effectively enforced without severe infringement of the principles of scientific freedom and national sovereignty as they are understood today. The IAEA system of declarations and inspections was designed to reveal diversion of nuclear material from civilian uses to the manufacture of nuclear explosives, which was the major concern at the time the NPT was negotiated.[4]

Furthermore, other proposed nuclear arms control agreements, such as the CTBT and the fissile material cutoff, also deal only with the physical aspects of nuclear weapons. The reason for the absence of the problem is the enormous change in international security that the end of the Cold War and the Gulf War brought about: making arms reductions, rolling back of arsenals, and other measures of disarmament thinkable. During the Cold War the best one could hope for was nonproliferation and arms control.

Still, there are weighty reasons why states want to nurture nuclear knowledge and experience. Such a capability can provide insurance that allows states to take some risks in the disarmament arena that may be viewed as necessary for military, political, or economic reasons, but which are otherwise difficult. Nurturing *knowledge/experience*, as well as other capabilities required for this purpose, is conditional upon some form of stewardship program.

The program of the United States, which is certainly the most advanced in concept, may provide something of a model for other nuclear powers. The Nuclear Posture Review (NPR) of the Department of Defense identified requirements to maintain nuclear weapons capability in a no-test environment (with preparations to resume underground testing if directed to do so), to maintain and improve the safety and security of stockpile weapons, and to ensure a supply of tritium. In pursuit of these requirements, the NPR called for, inter alia, the development of a stockpile surveillance engineering base; the demonstration of the capability to refabricate and recertify warheads in the enduring nuclear stockpile; the maintenance of the capability to design, fabricate new warheads; and the maintenance of a science and technology base. In many respects, the latter point undergirds all the others and is, in essence, the maintenance of the *knowledge/experience* base.[5]

---

[4] During the NPT negotiations in the mid-1960s, a number of technologically advanced states, in particular Sweden and Switzerland (and, to a degree, Germany), conditioned their support of the NPT on keeping some ambiguities concerning theoretical nuclear weapons research. Both Sweden and Switzerland had at that time small, secret nuclear weapons research programs; clearly they wanted to keep their research options open in this area.

[5] For a discussion of technical requirements for maintenance of this base, see John D. Immele and Philip D. Goldstone, "Stewardship of the Nuclear Stockpile Under a Comprehensive Test Ban Treaty (CTBT)," presentation at AMSIE '96, American Associate for the Advancement of Science, February 12, 1996.

This effort will require the development of major capabilities and a long-term commitment to ensure its success, and outlines the science-based stockpile stewardship program reflects this.[6] Even if the required funding is forthcoming over the long term, the realization of the objectives of the program remains uncertain. Despite the costs and problems of assuring knowledge and experience will be a significant hedge against changes in the world over time, knowledge and experience have now and will have in the future a life of their own. In any event, there are intrinsic difficulties involved in attempts to control and safeguard nuclear *knowledge/experience.*

It is intuitively recognized that human knowledge and experience is a commodity radically different from all physical commodities. While controlling, safeguarding, and dismantling *physical entities* such as warheads, nuclear material, facilities, etc. is, in principle, a straightforward matter; this is not the case with the dismantling of nuclear weapon *knowledge/experience* stored in human minds and embodied in coherent organizational structures. Such a commodity is closely tied to the trial-and-error process characteristic of searching human minds and the way it is influenced by organizations and institutions. Even if all the physical carriers of that knowledge (e.g., technical reports, photos, tapes, discs, etc.) were destroyed, as long as there is a cadre of scientists and engineers and organizational/institutional structures that once developed and produced atomic weapons, it could be done again and certainly more easily and faster than the first time.

Knowledge/experience is not the kind of commodity that can be easily subjected to effective international control and safeguards. It appears that no international control of nuclear-related research could be effectively enforced without severe infringement of the principles of scientific freedom and national sovereignty as we understand them today; This was one of the lessons of the failure of the Baruch Plan in 1946, the first (and only) proposal for global rolling back of nuclear weapons and knowledge, and it has been one of the most problematic issues with the present control regime over Iraq.

C. The Case of South Africa

South Africa is the world's first and only nuclear weapons state to have unilaterally and voluntarily dismantled its national-indigenous atomic weapons program, including its knowledge/experience base, and subsequently joined the NPT as a non-nuclear weapons state. For this reason, the South African case is so intriguing. The South African case sets up a certain precedent for "rolling back" proliferation and highlights some of the extraordinary issues involved in any such process.

---

[6] See Ibid.

To understand this case, we must understand its history. On March 24, 1993, President F. W. de Klerk told the South African Parliament that in the 15-year period covering the mid-1970s and 1980s, South Africa had embarked on a nuclear weapons program directed at providing the nation "a limited nuclear deterrent."[7] But in late 1989 and early 1990, shortly after de Klerk had assumed the presidency, "final effect was given to decisions that all the nuclear devices should be dismantled and destroyed."[8] By that time the program had completed six gun-type fission nuclear devices and a seventh was in the making. De Klerk made it clear that the nuclear project had been dismantled before South Africa acceded to the NPT on July 10, 1991, and that by that time it no longer had nuclear devices. Two months later South Africa concluded a comprehensive safeguard agreement with the IAEA under which it placed all its nuclear materials and facilities under international safeguards.[9] In his public announcement, de Klerk noted that the South African government would provide a full disclosure of its past nuclear weapons program, allowing IAEA inspection visits under which access to the dismantled program's facilities, records, and personnel would be granted. Subsequently, a number of IAEA technical teams inspected those facilities through the spring and summer of 1993, examining both nuclear material and equipment, interviewed the officials in charge of the program and its dismantling, and compiled a detailed report describing the South African nuclear weapons program and the way it was dismantled.[10]

The technological and political rationale for initiating the South African nuclear project in the mid-1970s (under Prime Minister John Vorster) was rooted in a mixture of a "can-do" technological mind-set and a deep sense of political isolation, growing Cuban military involvement in Angola, and fears of Soviet designs in South Africa. The nuclear project was not a product of any specific military need, nor was there ever a military interest in using the bomb. Almost from the outset, the scope and objectives of the top secret nuclear project were guided by a strategy, officially approved by the South African head of state in 1978, that maintained that the purpose was strictly "political," that is, to force Western governments, especially the United States, to come to South Africa's aid in the unlikely case of an overwhelming attack by the Soviet-back African forces. It was essentially a "strategy of ambiguity" built upon three stages under which South

---

[7] Bill Keller, "South Africa Says It Built 6 Atom Bombs," *The New York Times*, March 25, 1993.

[8] Ibid.

[9] For the most detailed official account of the history of the South African nuclear project, see Waldo Stumpf (the chief executive office of the state-controlled Atomic Energy Corporation), "South Africa's Nuclear Weapons Programme" (mimeograph), paper presented at a conference in New Delhi, India, November 1993. Also see David Albright, {South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists* (July/August 1994), pp. 37-47; R. Jeffrey Smith, South Africa's 16-Year Secret: The Nuclear Bomb," The *Washington Post*, May 12, 1993; J W. de Villiers, Roger Jardine, and Mitchell Reiss, "Why South Africa Gave Up the Bomb," *Foreign Affairs*, 72 No. 5 (1993), pp. 2-13.

[10] International Atomic Energy Agency, Director-General, "The Denuclearization of Africa," GC(XXXVII)/1975, Sept. 9, 1993.

Africa would have revealed its bomb only "if the country found itself with its back to the wall." According to one South African senior official, "no official tactical application was ever foreseen or intended as it was fully recognized that such an act would bring about international retaliation on a massive scale."[11]

Shortly after it took office in September 1989, the de Klerk government decided to undo its own grand secret. The end of the Cold War, the collapse of the Soviet Union, and the withdrawal of the Cuban forces from Angola in South Africa in 1989-90, had left the nuclear rationale outdated. Not only was a nuclear weapons capability no longer needed, but the program had increasingly become a political liability, especially given the anticipated changes in the domestic power structure. Accession to the NPT and full dismantling of its program would be in the best interests of the country, at home and abroad. The South African nuclear weapons program was then dismantled in a controlled, safe, and secret manner, with no international body present to witness and verify the process. In addition to dismantling the seven nuclear devices, decontaminating the project's facilities, and converting them to conventional weapons and non-weapons commercial activities, all hardware components of the devices as well as design, manufacturing, and other sensitive data were destroyed. De Klerk made clear that South Africa wanted to dismantle its program in a permanent way, without hedging on the possibility of reversing the process.

The South African case highlights the complex legal and practical issues involved in "rolling back" a nuclear weapons program and shows that there are currently no international norms guiding such a process. Neither the NPT nor the Treaty of Tlatelolco were designed to address the issue of unilateral disarmament. It highlights the complicated and intriguing question of dismantling past knowledge and experience: How is *knowledge/experience* "dismantled"? Can it be dismantled and verified, the way we do with physical objects? Can it be "safeguarded"?

The questions concerning the dismantlement of a nuclear weapons program can thus be seen to be extremely complex, especially in the context of NPT obligations as discussed above. While Article II of the NPT forbids signatories to manufacture nuclear weapons, it provides few clues as to what to do with a country that once manufactured nuclear weapons and possesses such knowledge and experience and has now decided to accede to the NPT. Though such a country must fully dismantle its nuclear weapons arsenal and declare all its nuclear material and facilities under a full-scope safeguard agreement with the IAEA, such a former weapon state under the NPT is not explicitly prohibited from keeping much of its past nuclear knowledge and experience intact. As long as a small core of scientists and engineers is kept together, the nation's ability to manufacture nuclear weapons is hardly dismantled, and at least in the short run it could easily and

[11] Albright, op cit., p. 38; also Stumpf, op cit., p. 10;.

quickly abjure its new obligations if its circumstances changed.[12] Clearly, South Africa could have kept a virtual capability had it so desired.

Because of the unique nature of *knowledge/experience*, there is a vast legal gray area as to what a nation is entitled to retain under the NPT after it has dismantled its nuclear weapons hardware. Would retaining a modest stewardship program to preserve a full and orderly historical record concerning the program's past technical accomplishments? Such a program would hardly seem to violate any explicit NPT negotiations, which are after all future-oriented, not about erasing the past. But does it violate the *spirit* of the NPT pledge? Again, this is unclear.

The South African *modus operandi* of rolling-back its nuclear weapons program is, indeed, unique and extraordinary. Acceding to the NPT did not require South Africa to make the kind of public disclosure regarding its nuclear past that it did, nor to shred any of its historical records concerning its political motivations and technical accomplishments. The way the de Klerk government dismantled its nuclear weapons project reflects its own political interests and calculations. By 1989-90 not only did the nuclear program not relate to any possible external threat to South Africa, so that there was no longer a political rationale for it, but its very existence became politically dangerous. By March 1993, only a year prior to the change of power in South Africa, the de Klerk government needed credibility for its claim that it had no hidden nuclear bombs. To close the secret pages of the South African nuclear past, de Klerk needed not only to erase that past but also to convince his countrymen and the world of his government's honesty: full disclosure, confirmed by IAEA inspection teams, was in the best political interest of the de Klerk government.

D. The Case of Israel

While there may be certain similarities between the strategies that guided South Africa and Israel in their nuclear quests, even a cursory comparison of their geo-strategic and domestic situations highlights the vast difference between them. South Africa developed the bomb to protect and preserve its Apartheid regime; the bomb was the regime's ultimate insurance policy. Once South Africa got rid of this racist regime on its own, the rationale for the bomb became totally obsolete; it needed no more to hedge against threatening future. South Africa changed its governing system from within at the time the perceived threat from the outside was already disappearing.

[12] On the other hand, with stewardship of past knowledge/experience alone, it is increasingly difficult to retain a nuclear option for the long-run. Without an active R&D infrastructure and a clear sense of mission, it is difficult to retain good scientists who over time will lose interest, go elsewhere, retire and eventually die. See Marvin Miller and Jack Ruina, "The Breakout Problem," in Joseph Rotblat, et. al. (eds.) *A Nuclear-Weapon-Free World* (Boulder: Westview Press, 1993), pp. 83-102.

Accession to the NPT and demonstrative dismantling of its nuclear program became now a new insurance policy against radicals from the inside. South Africa's domestic interest appear to be against preserving virtual nuclear capabilities.

Israel is a very different case. Being born from the ashes of the Holocaust, nuclear weapons remain for Israel what they always were, essentially an ultimate insurance policy for unthinkable contingencies, under the heading of "last resort." Given Israel's Holocaust trauma and the existential threats it faced from its neighbors, its decision in the mid-to-late 1950s to acquire the "nuclear option" was a fundamental and long-term commitment. Unlike Iraq and Iran, Israel did not seek its nuclear capability for the sake of hegemonic aspirations or national prestige; rather, Ben Gurion's decision in the mid-to-late 1950s that Israel should develop an independent "nuclear deterrent option" was taken as a sacred matter of national survival, the ultimate way to offset the fundamental geo-political asymmetry between Israel and an Arab world that repeatedly threatened to destroy it. The nuclear option was meant to be Israel's ultimate insurance policy; Over the three decades since Israel completed the development of this option (around 1966), it has invested steadily a small but not insignificant portion of its budget to develop and maintain this national insurance policy. All nine Israeli prime ministers, from Labor and Likud alike, have committed to preserve that option. Though Ben Gurion had started the project on his own, without presenting the issue for a cabinet approval, over the years the commitment became wholly a-political and bipartisan. Israel's nuclear project was always perceived by Israelis as a sacred matter of national survival; Israel must be in a position to inflict a holocaust to prevent another holocaust.

However, Israel's position on nuclear weapons reflects to this day an essential tension between two contradictory principles regarding nuclear weapons. While Israel was determined to acquire nuclear weapons capability very early on, it also committed itself not to nuclearize the Middle East conflict. It knew that if, and once, the Arabs would acquire nuclear weapons, this could reverse the entire nuclear equation against Israel: what was a national insurance policy could turn out a source of unprecedented risk. Side by side with a policy of nuclear resolve, Israel also maintained a policy of extraordinary caution not to nuclearize the region. Unlike the five declared weapons states, Israel has not introduced publicly its nuclear weapons, and it is publicly committed not to do so. For reasons that mix international, regional, and domestic politics, the Israeli bomb has remained invisible, undeclared and opaque. In the words of *The Economist*, it is both "the world's worst kept secret" and "the bomb that never is."[13] Furthermore, since 1980 Israel has committed itself to the principle of establishing NWFZ in the Middle East as part of comprehensive regional peace.

[13] *Economist*, October 21, 1991; *Economist*, October 26, 1991.

There is an essential tension between these two fundamental principles. Simply put, the Israeli nuclear dilemma can be presented as follows. On the one hand, Israel has never presented its "nuclear option" as constituting the grounds for secure peace with the Arab world. On the contrary, Israel's long-held position on NWFZ amounts in effect to agreeing with the Arab current position that once the Middle East is peaceful no party should have a right to maintain weapons of mass destruction, including nuclear weapons. On the other hand, however, it is evident that Israel has no intention of getting rid of its nuclear-deterrent capability, even *after* signing of formal peace. Polls taken in recent years indicate that this view is overwhelmingly supported by the Israeli public.[14] Nearly all Israelis consider the nuclear option indispensable for Israeli security, especially after comprehensive peace is signed. Israeli leaders and strategists, left and right alike, agree that Israel's "nuclear option" has been a significant factor in persuading the Arab world to accept Israel and to make peace with it. The opaque but tangible way the Israeli bomb has manifested itself, both as a symbol and as a perception in the Arab's mind, must remain indefinitely to ground the fragile peace. Peace would not change the fundamental geo-politics of the Israeli predicament. Even after a peace, Israel will remain and see itself as a small Jewish island within a vast Arab world; the lessons of the Holocaust would not go away and Israel's nuclear-deterrent capability would be maintained even after peace to hedge against the possibility of resuming the conflict in the future.

In the pre-peace-process period this tension was hardly visible. To the extent that it was recognized, it was politically immaterial. As long as the Arab-Israeli conflict exists, the talk about vision of peace and their linkage to the nuclear issue was no more than academic. It was only in the context of the peace process, in particular after the establishment of the regional forum on Arms Control and Regional Security (ACRS), that it became evident that the unresolved Israeli nuclear dilemma had become already a source of major disputes and impasse.

The Arab states, especially Egypt, insist that the ACRS forum must start negotiations on the establishment of a zone free of all weapons of mass destruction as early as possible, even if the actual entry into effect of such zone would be linked to the establishment of regional peace. They claim that making progress on the nuclear discussions must be achieved in parallel to the progress on the peace front. Egypt made clear that it would be impossible to establish regional peace without ridding of all weapons of mass destruction, including Israel's nuclear weapons. They insist on the principle of universality and reciprocity in the nuclear field as a precondition to comprehensive peace and end of the conflict. Israelis, however, refuse to allow nuclear discussion at ACRS at the present time. Its ostensible argument is procedural and political; Israel maintains that until all the relevant states in the region, including Syria, Iran, and Iraq, enter into the ACRS process, it is

[14] See Alan Arian, *Security Threatened: Surveying Israeli Opinion on Peace and War* (New York: Cambridge University Press, 1995).

impossible to discuss a zone free of weapons of mass destruction, including nuclear weapons and related issues. In response to the Israeli refusal to discuss nuclear matters, the Egyptians brought the entire ACRS process into a full halt.

It is essential to understand that the impasse in ACRS is about more than matters of procedures, timetables, or political posturing. It is about the future and legitimacy of Israel's nuclear deterrent: Would Israel really be ready to rid of its nuclear option for peace? What does it actually mean for Israel to accept a verifiable NWFZ? Could Israel still maintain elements of nuclear deterrent even under NWFZ? It is hidden tension in Israel's own position on nuclear weapons that makes these questions so intractable.[15]

It is here that the idea of virtual arsenals could provide a way to resolve the tension within the Israeli position in a constructive way. In principle, it allows the reconciliation of the tension between the Israeli imperative to retain some elements of its nuclear option and the commitment to establish NWFZ in the Middle East as an integral part of regional peace. Israel could in this fashion preserve its nuclear knowledge and experience, under some form of stewardship program, in a way that would be compatible with the intuitive idea of NWFZ.

E. The Cases of Belarus, Kazakhstan, and Ukraine

The cases of Belarus, Kazakhstan, and Ukraine are in many respects unique, but they represent a development that may reappear in the future—the collapse of a nuclear-weapon state—and are important from that perspective. In the aftermath of the collapse of the Soviet Union, these newly independent states, along with Russia, were the inheritors of the Soviet nuclear arsenal, its nuclear weapon complex, nuclear scientific and technological expertise, etc. The prospect that four nuclear-weapon states might emerge from the ashes of the Soviet Union sparked concerns throughout the world. The risks of these states going nuclear in the aftermath of the Soviet collapse was raised by pundits and policy makers. Assessing the risks of such proliferation involved looking at the prospects of Belarus, Kazakhstan, and Ukraine obtaining custody of Soviet weapons on their territory after the breakup, or developing indigenous programs on the basis of

[15] Last December, Shimon Peres made headlines worldwide when he responded to a question on the nuclear issue by saying, "give me peace and we will give up nuclear. This is the whole story." Many wondered whether this casual remark signaled a real change in Israel's nuclear policy. It did not, as an official clarification soon made clear. It was not more than Peres' ill-fated and colloquial reformulation of Israel's official commitment to negotiate the establishment of a NWFZ after the establishment of lasting peace, but it highlights how unclear is that commitment. Benjamin Netanyahu, then the opposition leader, criticized Peres for his irresponsible talk and made clear in his campaign that he would not give up the nuclear option, not even in return for peace. In his speech before the US Congress after his election, he elaborated on this issue without changing Israel's formal position: a real peace was defined by Netanyahu as peace among democracies. Until then Israel could not rid of its strategic assets.

inherited nuclear reactors and other facilities, as well as expertise, from Soviet weapon and energy programs.[16]

The fate of these countries, especially Ukraine, was not foreordained. Not only was there grave uncertainty about the Ukraine, but one scholar argued that a Ukrainian nuclear deterrent made sense in order to preserve peace between Ukraine and Russia through a reliable Ukrainian deterrent to Russian aggression.[17] Despite these fears and uncertainties, an international diplomatic effort to ensure this proliferation danger never occurred ensued. It was lead by the United States and based on a belief that the West could and should act on the basis of diplomacy that recognized only one Soviet nuclear successor state, Russia; facilitated the consolidation of weapons in Russia as rapidly as possible; ensured the security of Soviet weapons; and brought all other post-Soviet states into the international nonproliferation regime.[18]

This diplomatic effort had early, tangible successes. Ukraine, as well as Belarus and Kazakhstan, all became parties to START I, and all of these states joined the NPT as nonnuclear-weapon states. All three states have removed all nuclear weapons on their territory pursuant to their commitments and transferred the weapons to Russia.

While most of the facilities and expertise for weapons design and production were located in Russia, there is considerable capability elsewhere in the former Soviet Union, and especially in these three states. Even after the nuclear weapons have been removed to Russia, these three states retain human and material capabilities useful for a weapon program, as well as stocks of weapon-usable material and the capability to produce more. It is difficult to determine nuclear expertise in the three states, but we are certain that key nuclear scientists and technicians were not only ethnic Russians. With respect to capabilities, the situation is somewhat clouded but clearer. In Belarus, the Institute of Power Engineering Problems has a critical assembly with an inventory of nearly 40 kg of uranium enriched to 90 per cent. Kazakhstan's capabilities include: the Soviet nuclear test site at Semipalatinsk (closed since 1991); the Baikal Test Facility, with the Impulse Graphite Reactor using weapons-grade fuel and other reactors, an inventory of over 200 kg of HEU, and "hot cells" that can be used for laboratory-scale reprocessing; a fast breeder, which is an excellent production reactor; another research reactor using HEU; and a missile test range and space launch facilities. Ukraine has retained the Khar'kiv Scientific Center, responsible for technology development and production of missiles and missile components; the Khar'kiv Physical-Technical Institute, with a

[16] See, e.g., Steven E. Miller, "Nuclear Proliferation Risks and the Former Soviet Union," The Woodrow Wilson Center, International Studies, Working Paper No. 6 (Washington, DC: Woodrow Wilson International Center for Scholars, April 1993), p. 1.

[17] John J. Mearsheimer, "The Case for a Ukrainian Nuclear Deterrent," *Foreign Affairs*, vol. 72, no. 3 (Summer 1993), pp. 50-60.

[18] See Miller, op. cit., p. 1.

stockpile of some 75 kg of HEU (90 per cent); stored ICBMs, cruise missiles, and strategic bombers; and heavy water production plants (250 metric tons per year).[19]

None of these material capabilities are by themselves sufficient for a nuclear-weapon program, but they do offer significant capabilities to all of these post-Soviet states. It is difficult to state how far the existing capabilities of each of these states would advance them in the event of a decision to develop nuclear weapons, especially if it were to be taken years or decades from now. But, in a fluid, unstable security environment, and faced with an unsettled and potentially hostile Russia, Ukraine and perhaps Kazakhstan might wish to maintain and enhance their capabilities to ensure they have options in the future. The most likely reasons for *not* doing so are the enormous resources it would require in states that have serious economic challenges ahead of them, as well as the possible backlash of the West should such activities become apparent and appear threatening. Of course, the more basic question is this: having given up the nuclear weapons they inherited, will these states have the interest and the resources to begin developing and deploying nuclear weapons in the future? As suggested, this prospect is not at all likely, although the possibility of Ukraine or Kazakhstan making such a decision if their security deteriorated over the next years and decades cannot be ruled out. From this perspective, their decisions on how to handle the nuclear capabilities they inherited from the Soviet Union may either maintain or ultimately foreclose their options.

F. The Case of Japan

Japan, especially since the end of the Cold War, has been considered as one of the states that might consider the virtual weapon option. Japan's long standing plutonium program, its new post-Cold War geopolitical position, and a number of statements by political figures espousing nuclear weapons have all combined to create this sense. As one Japanese journalist put it:

> The Japanese plutonium program continues to dwell on the minds of nuclear nonproliferation watchers. Japan remains the only non-nuclear weapon state that is operating uranium enrichment and reprocessing plants, all of which are technically capable of production fissile materials for nuclear weapons. The magnitude of these projects exceeds those of other nations that have either abandoned or postponed similar programs.
>
> The issue of Japan's capability to acquire a nuclear arsenal is entangled with Tokyo's enigmatic diplomacy. On the one hand, it complies with its obligations to the International Atomic Energy Agency (IAEA), making financial contributions, being open to inspections, and crusading for a nuclear-free world as the world's sole victim of nuclear attacks. On the other hand, the number of remarks made by political figures alluding to Japan's ambitions for developing nuclear weapons has increased in recent years.

---

[19] *Nuclear Successor States of the Soviet Union: Nuclear Weapon and Sensitive Export Status Report*, The Monterey Institute of International Studies and the Carnegie Endowment for International Peace, No. 4 (May 1996), pp. 101, 102, 104.

> For the development of a nuclear weapon program, both the political will and the technology represented by the plutonium program are necessary. Of the two, Tokyo's political will holds the key to preventing nuclear proliferation in Japan, but the nuclear umbrella provided by the United States will have the strongest influence on Tokyo's decisionmaking.[20]

Ultimately, as this perspective illustrates, for a country like Japan, political will and political military calculations are the keys to determining whether it will decide on a nuclear weapons program, whether actual or real. Access to plutonium or other weapon-usable materials is seen by many to be a sign of Japanese weapon intentions, but it is often forgotten that these programs were initiated for economic security reasons at a time when plutonium-derived energy appeared more promising and few raised questions about Japan's interest in nuclear weapons. But perhaps more importantly, in assessing the prospects for Japanese virtual weapons, access to civil materials that all are indeed weapon-usable may not be the driving or pacing item. Nor is there undoubtedly advanced technical-industrial infrastructure (including nuclear-weapon-usable material production capabilities)—a sign of an inevitable pursuit of nuclear weapons. The ability to produce nuclear weapons rapidly on the basis of materials, technology, and knowledge that is already widely disseminated, even if there is no "experience" in weapons design and production, is certainly within Japan's grasp.

Turning to political-military rationales for a virtual arsenal, Japan is among the countries that may, in principle, see nuclear weapons as having greater potential value in the post-Cold War environment, where there have been questions about regional security and stability; challenges posed by the North Korean nuclear program, Chinese nuclear modernization in the context of more assertive foreign and defense policies, and Russian instability; and questions about the credibility of the U.S. security relationship and its nuclear umbrella, especially in the light of growing trade differences. In this context, the new post-Cold War U.S.-Japanese agreements on security, in which trade differences were de-emphasized, are important signs that the United States and Japan see the value of their security relationship even after the Cold War. But concerns in the region, based on Japan's militaristic history and in some cases its neighbors, are real. Certainly reasons for concern in the region as well as globally remain for the long term. However, the assumption that Japan would respond to future threats with nuclear weapons may not be well grounded. The Japanese would certainly favor political or diplomatic solutions, perhaps even appeasement, to deal with threats. Japan's preferred option in dealing with North Korea has been to support U.S. efforts to offer economic and political incentives to bring a halt to the North Korean nuclear weapon program. Given Japan's geostrategic vulnerability to nuclear threats or attack, the nuclear

[20] Motoya Kitamura, "Japan's Plutonium Program: A Proliferation Threat?" *The Nonproliferation Review* (Winter 1996), p. 1.

weapon option may be viewed with some skepticism by future governments, and publics remain staunchly antinuclear after their experience at the end of World War II.

Despite these considerations, Japan may indeed respond to future threats with nuclear weapons if they deem other options infeasible or unattractive. But if this situation emerges, is the mere existence of weapon-usable plutonium likely to be used and to be the pacing element of their program. In fact, Japan may not wish to pay the penalties associated with civilian plutonium. Moreover, while Japan does not have a knowledge/experience base grounded in the actual development and manufacture of nuclear weapons, Japan's advanced technological infrastructure is highly capable and can overcome this limitation. Accordingly, weapon design should not be the pacing den of a Japanese decision to go nuclear in the future. However, this may be, Japan is unlikely to embark on a path to nuclear weapons without also developing effective, dedicated delivery capabilities and command and control systems, and to have prepared for fully integrating these capabilities into the military (doctrine, training, etc.). Given Japanese vulnerabilities, a nuclear capability might not emerge before effective active and passive defenses were deployed. Of course, some grave danger could , in principle, lead Japan to forego these steps. But it is difficult to imagine such a threat, which would lead Japan to pursue nuclear weapons as rapidly as possible without full consideration of its long-term security requirements. Such a "half-way house" response could put Japan in even greater danger vis-à-vis Russia, China, or even Korea.

Accordingly, for states such as Japan, indicators of a move to virtual (or actual) nuclear weapons may include

- deliberate decisions to establish short lead time capabilities to develop and produce nuclear weapons,
- possession or development of associated military capabilities to make weapons a strategic threat, also military exercises, etc.
- development or deployment of active and passive defenses (for strategically vulnerable countries).

These indicators may be very different for states that once possessed nuclear weapons and may have proven designs, mothballed production capabilities, and stored components and materials. It is not clear that for a country like Japan in most conceivable circumstances or scenarios, starting afresh on the basis of advanced technologies may not have *some* advantages over less-developed countries' efforts to preserve old designs and systems.

G. Conclusion

Virtual nuclear weapons capabilities are, to some degree, a physics reality that is a function of the spread of nuclear energy technologies and programs. In this sense, capabilities are widespread and will increase with nuclear power programs, especially those that involve direct-use nuclear

materials (plutonium and HEU). Yet, it is clear that a broader set of capabilities must also be considered and may be more germane to assessing future nuclear-weapon threats, including states' weaponization, delivery, and support capabilities. There is a spectrum of possibilities that derive primarily from these states' knowledge and experience, the most serious involving the capabilities of states that have had active nuclear-weapon programs and have for one reason or another mothballed, abandoned, or reduced them. There are, as suggested, degrees of virtuality. A continuum of virtual capabilities exists, ranging from nuclear-energy programs and general technology diffusion on one end to aggressive stockpile stewardship programs on the other. This continuum concept is somewhat inadequate for virtuality because placement along the continuum *may not* ultimately be determined by whether a state has once pursued or possessed nuclear weapons. Other factors, including time required to (re)develop weapons, budgets alloted to this mission, the range of virtual" activities, and the like, *may* be more important (as determined on a case-by-case basis). As noted in the discussion of Japan, in some cases starting afresh may, in principle, have advantages over long-term stewardship programs. These notions will require refinement in further research and analysis.

In any event, these conceptual issues do not address the question of whether it is in the interest of states to take actions to pursue virtual weapons? In the real world at present, virtual arsenals are unlikely to be the preferred option of most states, and a virtual-weapon regime is not likely in the foreseeable future. The reliance on nonexistent nuclear weaponry for states that required nuclear weapons as an essential element of their security would seem to pose too great a risk for those states, despite the fact that virtual weapons are by their nature purported to address those risks. The move into such *terra incognita* can be expected to be resisted by prudent statesmen and conservative bureaucracies. Moreover, the convoluted, essentially unverifiable aspects of any regime designed to deal with these risks in a cooperative fashion will militate against the creation of such regimes for the foreseeable future.

The potential value of virtual weapons, and it is merely a posited one, is for states that have decided or are deciding to reduce or eliminate their nuclear arsenals and wish to reduce, if not eliminate, any residual risks of doing so. From this perspective, both states that once had active nuclear-weapon programs and states with advanced nuclear-power programs will have capabilities, in principle, irrespective of their decisions on weapons. However this may be, virtual weapons—based primarily on knowledge and experience that cannot be easily dismantled, but also on materials, components, delivery systems, and support systems that may be disassembled and stored—will probably play an important role in the future security decisions of some states. The role of virtual weapons cannot be assumed without governmental actions designed to ensure capabilities over time through some type of "stewardship" program because technologies change,

certain materials and components age or become unavailable, experts retire or die, etc. Yet, such considerations still do not address the question of these states' decisions.

Of the cases considered, only South Africa had a clear reason to forego virtual capabilities. Japan and the Newly Independent States had no reason to pursue virtual capabilities as a matter of urgency and could be presumed to foresee diplomatic and other problems with doing so. However, they may view low-level maintenance activities with respect to capabilities as beneficial. Israel, if it enters into significant nuclear arms reductions or even eliminates nuclear weapons in the context of a Middle East peace, could view nurturing and strengthening virtual capabilities as critical to taking this step while ensuring its security.

On the basis of these preliminary conclusions, we view the concept of virtual weaponry as more complex and difficult to assess than some observers. With this understanding, the role of virtual weapons is one with important, though not-yet-explored, features, potentially some positive (e.g., decline of the risks created by accidental or unauthorized use) and some negative (e.g., the risks of rapid armament or rearmament rise). Because the present nonproliferation regime deals with nuclear weapons and nuclear material, virtual capabilities are outside the nonproliferation regime.

In some circumstances, however, virtual capabilities may promote nonproliferation objectives by providing "insurance" to states that possess actual weapons and are contemplating disavowing them. By enhancing their security by hedging against unexpected (or expected) future threats, the insurance offered by virtual arsenals may allow a state to contemplate greater risks in pursuing arms reductions or their elimination, for example, in the context of a regional nuclear-weapons-free zone (NWFZ). This element of insurance involves reassurances like those offered by security guarantees and assurances, but puts the means of redeeming the insurance policy in the hands of the state itself instead of others. Premiums are required—as suggested, some sort of stockpile stewardship program—and they may be high. Over time, these premiums may not be sufficient unless they are constantly reviewed and readjusted, and even then intrinsic uncertainties about the policy may raise questions about its future value. There may be temptations to stop paying the premiums, especially if future dangers, against which the policy was underwritten, looks less likely.

While the insurance metaphor appears useful in this context, and warrants further exploration, we do not envision meaningful new nonproliferation or arms control agreements with a focus on virtual weapons for the foreseeable future, nor do we believe they are a universally appealing panacea to the security issues surrounding arms control and nonproliferation initiatives. Nonetheless, we believe virtual weapons could, in principle, be useful in addressing a number of long-standing proliferation problems. Although they will not be the ultimate driver of a resolution

of nuclear issues in the Middle East or South Asia, they could offer an essential assurance to states willing to forego their nuclear capacities in the context of broader regional political-military agreements or arrangements.