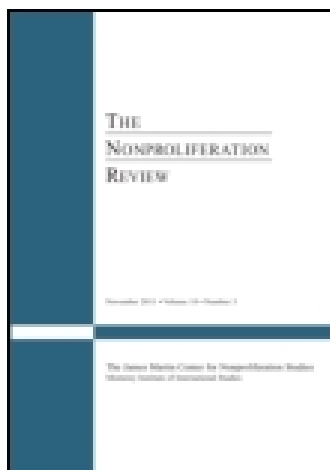


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VIEWPOINT

SERIOUS RULES FOR NUCLEAR POWER WITHOUT PROLIFERATION

Victor Gilinsky and Henry Sokolski

The authors propose five principles for addressing the major deficiencies of the current treaty-based approach to nonproliferation. These involve: effectively closing the door to withdrawals from the Treaty on the Non-Proliferation of Nuclear Weapons (NPT); defining which nuclear technologies fall within the NPT's "inalienable right" provision, so as to maintain a reasonable safety margin against possible military application; expansion of International Atomic Energy Agency inspections to include greater readiness to use its "special" inspection authority; creation of an NPT enforcement regime, to include a secretariat; and universalizing the NPT so as to apply to all states, while creating a path for current non-parties to come into compliance. There is no illusion here about the prospects for the adoption of this approach. At a minimum, the world needs to be frank about the gap between nuclear programs and current nonproliferation protection. Encouragement of greater use of nuclear power should be predicated on closing that gap.

KEYWORDS: Nuclear energy; Treaty on the Non-Proliferation of Nuclear Weapons; International Atomic Energy Agency; nonproliferation; safeguards; United States; North Korea; Iran

We try in this viewpoint to step back from the day-to-day struggles in Washington over nuclear nonproliferation policy to ask what measures are needed to be reasonably confident that expanding nuclear power globally will not increase the number of nuclear weapon states.

We recognize that, since the start of the Atoms for Peace program in the mid-1950s, the United States has supported the worldwide use of nuclear power. It also has opposed the spread of nuclear weapons and supported measures to control the nuclear weapon proliferation risks inherent in spreading nuclear technology for civilian purposes. The principal administrative elements of these nonproliferation efforts are the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the associated inspection activities of the International Atomic Energy Agency (IAEA), as well as various national and international export controls.

In practice, US policies promoting the global use of nuclear energy have raced ahead of the means available to control the associated nuclear weapon proliferation risks, leaving a broad security gap. What passes for US nuclear nonproliferation policy—the perennial pushing and pulling over the details of nuclear export controls and agreements—does not begin to address that broad gap.

Unless the signatories to the NPT agree to deal with the fundamental deficiencies of the NPT by interpreting the treaty in a way that sharply limits access to fuels that are also usable in nuclear weapons, and agree to universal enforcement of that interpretation, increased worldwide nuclear energy use will carry with it the inevitable risk of further nuclear weapon proliferation.

Nuclear Weapon Proliferation and Nuclear Power: What's the Worry?

In any effort to assess our current nonproliferation policies, we must remind ourselves of why we still resist the spread of nuclear weapons. In fact, it has become fashionable in some industry and academic circles to discount the dangers on the grounds, chiefly, that proliferation has proceeded more slowly than once feared.

The usual reference is to President John F. Kennedy's 1963 remark that "by 1970, unless we are successful, there may be 10 nuclear powers instead of 4, and by 1975, 15 or 20."¹ But this was a warning, not a prediction, and a useful one that led to nonproliferation efforts that slowed the process. In view of our experience with states falsely claiming to be conducting "peaceful" nuclear programs and later using their facilities for illicit purposes or conducting clandestine bomb activities—in India, Iran, Iraq, Israel, North Korea, Pakistan, South Africa, and Syria—it is time to heed these warnings again.

There is also a school of thought that even if additional states obtained nuclear weapons it wouldn't make much difference because the weapons would just serve as deterrents.² There is a troubling disconnect between this cheerful theorizing—which is not without an element of self-interest—and any awareness of the devastating possibility of nuclear war. Just because the weapons are supposed to be for deterrence doesn't mean they won't be used. Such use is, after all, implied in the threat that underlies deterrence. And if they are used, they are likely to profoundly change the way the world is organized, with unpredictable—but likely unhappy—consequences.³ A few years ago, former Secretary of State Henry Kissinger wrote:

If one imagines a world of tens of nations with nuclear weapons and major powers trying to balance their own deterrent equations, plus the deterrent equations of the subsystems, deterrence calculation would become impossibly complicated. To assume that, in such a world, nuclear catastrophe could be avoided would be unrealistic.⁴

Happily, we have not reached this state. No such weapons have exploded in anger since World War II, and it has been a long time since people have seen the consequences of atmospheric nuclear tests. But this also means there is not the gut level consciousness about proliferation dangers that there is about the dangers of nuclear accidents. Whereas everyone agrees that expanded use of nuclear power has to be predicated on tough safety rules, there is no corresponding agreement when it comes to rules to protect against the spread of nuclear weapons, especially when it comes to restrictions on nuclear power programs.

One often hears from nuclear industry sources that "civilian" nuclear programs are not a proliferation worry because they are an unlikely source of nuclear explosive materials

for would-be bomb makers. They argue that just as current nuclear weapon states relied on dedicated military programs, so would any future would-be weapon state.⁵

Our view is different. Leaving aside the correctness of the assumptions about past weapon programs, in this case the past is not a good guide to the future because conditions have changed fundamentally. Today, all non-weapon states are members of the NPT. If one should decide to obtain weapons, it would have to withdraw or cheat, both courses that would risk a military response until the would-be bomb maker had weapons comfortably in hand. This would put a very high premium on traversing the period of vulnerability as quickly as possible. Kissinger made this point in 2006: "A policy of using preventive force against aspiring nuclear powers, however, creates incentives for them to acquire nuclear weapons as rapidly as possible...".⁶

That means drawing on bomb material and know-how where it is most quickly obtainable, which would mean tapping a nuclear power program if there is one, unless, of course, there are strict measures in place to prevent that. If there is any doubt about this conclusion, consider the following counterfactual: suppose each of the major World War II belligerents already had civilian nuclear power programs before the war started. Would they not have tapped them rather than started independent nuclear weapon programs anew? The answer suggests why strict nonproliferation measures are important.

The NPT's Deficiencies

In this regard, no one believes there are adequate preventive anti-proliferation measures in place today; we wouldn't be endlessly discussing various international fuel supply schemes to mitigate the risks that national uranium enrichment and fuel reprocessing might be used to produce nuclear explosives otherwise. Everyone understands that the NPT, as it has been interpreted up to now, has basic deficiencies:

- The treaty allows withdrawal on three months' notice;
- It does not delineate the limits on permissible "peaceful" technology, with respect to fuels that are immediately usable to make nuclear explosives;
- It sharply restricts IAEA inspections;
- The treaty lacks an established enforcement system, so that each violation requires an improvised response; and
- The treaty's universality is undermined by India, Israel, North Korea, and Pakistan, which stand as examples of what a state can accomplish outside its strictures and norms.

The advance of technology since the treaty went into force has exacerbated these problems by lowering the technological barriers between civilian nuclear activities and nuclear weapons. The prime example is the spread of centrifuge enrichment technology, which can be used to produce low enriched uranium to fuel power reactors but also can bring states within weeks of acquiring weapon-grade uranium to make a bomb. More generally, worldwide advances in materials and manufacturing and computing skills have put weapon design and manufacture within reach of a larger group of states.

Nuclear Power Expansion Remains the Goal of Major Nuclear Suppliers and the IAEA

Despite these acknowledged basic inadequacies of current nonproliferation protections, the US government has supported worldwide use of nuclear power since President Dwight D. Eisenhower's Atoms for Peace program and continues to do so today. The rationale, however, has evolved.

In proposing the program, Eisenhower said that starting with small projects had "the great virtue that it can be undertaken without irritations and mutual suspicions incident to any attempt to set up a completely acceptable system of world-wide inspection and control."⁷ In time, however, the projects got bigger and much more significant from the point of view of international security. Meanwhile, the effectiveness of the IAEA inspection system did not keep pace. This arguably mattered less when the two Cold War camps expected to keep their client states in line mainly through their own intelligence and intervention. But now we really do need the "completely acceptable system of world-wide inspection and control" of which President Eisenhower spoke, especially if there is to be a major expansion of nuclear power plants.

At the moment, a major, global nuclear expansion is not in play, mainly because of unfavorable economics and—since the March 11, 2011, Fukushima accident—because of increased safety concerns.⁸ Nevertheless, such expansion remains the goal, or at least the expectation, of key nuclear exporters—the United States included—and of the IAEA in Vienna.

President Barack Obama has consistently supported an expanded role for nuclear power both abroad and at home. In a March 2012 speech at Hankuk University in South Korea, almost exactly a year after Fukushima, the president said the world needed nuclear power.⁹ He predicted that "nuclear energy will only become more important," and that remains the operational assumption in the government.¹⁰

The IAEA also announced optimism about nuclear power expansion post-Fukushima. At the 2012 IAEA General Conference, Director General Yukiya Amano said he expected "a steady rise in the number of nuclear power plants in the world in the next 20 years." His low case for 2030 projected a nuclear power capacity increase of about 25 percent, and his high case projected a doubling of current capacity.¹¹ The projections are significant as expressions of the agency's sentiments and those of the national nuclear bureaucracies it represents. However unrealistic, these projections find their way into official and semi-official nuclear establishment reports and bolster support for nuclear power.

Security Implications of the Climate Argument for Nuclear Power

In his January 27, 2010, State of the Union address, President Obama reiterated his support for building "a new generation of safe, clean nuclear power plants in this country." In this he is following in his predecessors' footsteps.¹² But his rationale—that nuclear power is necessary to deal with climate change—is significantly different, and it has far-reaching security implications.

Since we are talking about a global rather than a local effect, the climate benefit of nuclear power installations only accrues if there are very many of them. In resting the case for nuclear power on the need for them to deal with global warming, proponents are therefore saying that we must build a very large number of nuclear plants. The experts say it would take well over 1,000 plants just to make a *dent* in the climate problem.¹³ But an increase of that size would likely involve nuclear power programs in dozens more states, including many in the rougher parts of the world—most Middle Eastern nations have already expressed interest in building nuclear plants—a worrisome prospect from a security point of view.

The putative climate imperative for nuclear power has made it easy for US nuclear officials to argue that, yes, they would like to see effective nonproliferation protection, but at the end of the day we have to settle for what we can get, because we must have lots of nuclear power to deal with climate change, no matter what. However, that is exactly the case where that nonproliferation protection is needed most.

More importantly, there are environmentally acceptable energy alternatives to nuclear power, including ones superior for coping with climate change. An obvious example is natural gas, which allows faster and cheaper reductions in carbon.¹⁴ We do not accept the notion that the world is locked into eventually relying on large numbers of nuclear power plants to cope with global warming.

Putting Security First

For this reason, we believe it would make more sense to reverse the current policy priorities under which “nuclear” trumps protection, and instead insist on adequate protection against proliferation as a condition for nuclear trade. We would aim to persuade others to accept that standard. If prospective customers are unwilling to agree to such protection, our answer is to stop encouraging nuclear expansion until such protection is available.

We do not agree with the rationalization that the United States must sell in the international nuclear market, even if the agreements covering the trade are not as tight as we would like, because if we don't others will, and “you have to play the game if you want to participate in setting the rules.” We think the United States would be more convincing by setting a principled example. Nor do we go along with that ultimate cop-out—that technology controls are not important because proliferation is really a political and not a technical problem. It is obviously both, and an essential aspect of nonproliferation is to keep it difficult, both technically and politically, for states to join the weapons game, so that we can reasonably exclude the possibility that civilian nuclear programs will contribute to weapon development.

We are very much aware of the positions of the majority of states on NPT issues, and their negative reactions to further restrictions, and even existing restrictions, on access to nuclear technology.¹⁵ It is clear they are in no mood to accept a major tightening of the rules, and we are under no illusion that the United States can by itself impose such a major tightening. But we can start to talk about the issues in a more straightforward manner

than we have been doing, and we can seek to persuade the international community of the value to all states of effective nonproliferation.

In fact, we have been moving in the opposite direction by promoting the “three pillars” interpretation of the NPT, which hobbles our nonproliferation efforts.¹⁶ This reinterpretation of the treaty puts sharing of nuclear technology on a par with nonproliferation. It’s easy to see why US diplomats find this path of least resistance appealing—technology sharing is easy and pleasant for all parties, while imposing nonproliferation restrictions is just the opposite. The trouble is, taking this approach leads to a markedly weakened NPT.

Some argue that acceptance of the “three pillars” formulation is necessary to give the United States the bona fides to conduct nonproliferation policy, and that it is in any case so firmly entrenched there is no point in questioning it. The result is a kind of zero-sum game in which the nonproliferation obligations of the majority of members are held hostage to technology sharing by the main nuclear states. The loose interpretation of the latter by the hopeful recipients has been especially problematic, and is what creates the proliferation problem in the first place.

By putting the obligation to share technology on a par with nonproliferation, the three pillars formulation singles out nuclear energy as the internationally politically anointed energy source, irrespective of its real economic value. This reflects 1960s “energy of the future” thinking but makes no sense today.

Unfortunately, President Obama’s comments on the foundations of the NPT have not been helpful. On the treaty’s 40th anniversary in 2010, the president described it as standing on “three pillars—disarmament, nonproliferation and peaceful uses”¹⁷ We need to get back to viewing the NPT—whose formal name is the Treaty on the Non-Proliferation of Nuclear Weapons—as indeed primarily about the nonproliferation of nuclear weapons.

Five Principles for Strengthening the NPT Regime

We propose here to examine what effective nonproliferation protection would entail. We express this in terms of five principles addressed to the main deficiencies of the NPT. So far as we can tell, nowhere in the nonproliferation literature is there a clear statement of a policy goal. There is an abundance, in fact, a superabundance of discussions of the value or attainability of this or that agreement provision or requirement, but nowhere do we find a statement of what it is we want in the way of protection.¹⁸ In effect, the principles we detail below are an outline of what it takes to have an international environment in which nuclear power can thrive without providing an easy target for would-be bomb makers.

Make Withdrawals from the NPT Effectively Impossible

We need to make it much more difficult—in fact, essentially impossible—to exercise the NPT’s withdrawal provision. This is vital, not least because the member states’ safeguards agreements with the IAEA remain in force so long as the states remain parties to the

treaty.¹⁹ The US position is that safeguards continue in perpetuity, but it is unclear what would actually happen if another state announced its withdrawal.

The international responses to North Korea's 1993 withdrawal threats and ultimate 2003 withdrawal announcement were deficient in that, however much everyone deplored North Korea's action, no one made the case at the time that a state, while in a state of violation, cannot legally leave the NPT. It was a question of legitimacy, which, while intangible, remains important in international affairs, even to the North Koreans.

There seems now, finally, to be general agreement on this point—that a state in violation of the NPT cannot relieve itself of its responsibilities by announcing withdrawal—and that the international reaction to a similar case would be more forceful.²⁰ Nevertheless, ambiguity still remains over whether North Korea is still obligated by its NPT membership. President Obama's statement deploring North Korea's February 12, 2013, nuclear test explosion did not so much as mention the NPT. It would have been helpful if the president had said that North Korea's NPT withdrawal was not valid and that it stands in continued violation of the treaty, for current actions as well as past ones.²¹

But even this, in our view, would not go far enough. A state should not be allowed to gather the production tools for making a bomb while a member and then free itself of its treaty responsibilities by withdrawing, even if it is in good standing at the time. What this means is that a state shouldn't be allowed to leave the treaty with technology it obtained as a member, with the forbearance of other members on the assumption that it was doing so for peaceful uses. And this should apply whether the technology was imported or developed indigenously.

The position that NPT safeguards apply in perpetuity, even if it gained universal acceptance, would not entirely deal with this issue. There is, in practice, no way to erase the advantages that a state bent on nuclear weapons gains from its nuclear power program, an advantage that lies in part in equipment and materials, but perhaps most importantly in the training of scientific and technical personnel.

It would be useful to introduce these NPT arguments into the current discussions that have arisen in Japan and South Korea over the advisability of obtaining nuclear weapons.²² The voices for weapons certainly have become much louder after the 2013 North Korean nuclear test.

Limit NPT State Signatories' Access to and Production of Nuclear Weapon-Usable Materials

The NPT cannot be a vehicle for legally coming dangerously close to a weapon capability. There has to be a technological safety margin between genuinely peaceful and potentially military applications to make it impossible to surprise the world with a bomb. As a consequence, the "inalienable right" language in the treaty has to be interpreted in terms of the treaty's overriding objective, and thus there have to be restrictions on the kinds of technology that are acceptable for nonmilitary use. Nuclear power needs to develop in a way that does not provide easy access to nuclear explosive materials. Where to draw the line is now coming to a head in the context of Iran's nuclear program.

In the early days of nuclear power—the 1950s and 1960s,—technology control was not on the international agenda. Enthusiasm for plutonium as the fuel of the future in fast breeder reactors overrode any official concern about its weapon potential. Under Atoms for Peace, the United States shared its reprocessing technology with all states, as it was seen as an essential part of nuclear power programs.²³ This complacency about easy access to plutonium was jolted by India's 1974 nuclear explosion, which led the principal exporters to establish the Nuclear Suppliers Group to exercise some control over the spread of what were euphemistically called "sensitive" nuclear technologies. The resort to euphemisms is itself telling. Neither the United States nor the other exporters ever publicly addressed the tensions in the NPT between prohibitions on bombs and liberal promises of technology—between the NPT Article IV's "inalienable right of all the Parties" to "nuclear energy for peaceful purposes" and the qualification that this activity must be "in conformity with Articles I and II," which prohibit acquisition of nuclear weapons. The conflict remains unresolved. That, after all, is what the struggle over Iran's enrichment program is about.

The well-known root problem is that separated plutonium and highly enriched uranium (HEU) can be converted to weapons use too quickly for international inspection to provide protection against that possibility.²⁴ The IAEA refers to its inspections and related protection systems as "safeguards." This introduced some confusion because the IAEA uses "safeguards" as a term of art for all the inspections it conducts, whether or not the inspections in question actually achieve their purpose of providing the timely warning needed to safeguard against military diversions.

It is therefore important to clarify that the IAEA's basic NPT safeguards document declares the purpose of IAEA safeguards is to deter diversion by the threat of early detection.²⁵ If sufficiently early detection cannot be counted on—as it realistically cannot for plutonium and HEU—there is no deterrence related to inspection, and therefore no effective safeguarding in terms of the IAEA's standard. In our view, the commercial use of materials that cannot be safeguarded in this sense should not be permitted.

The same concerns, once removed, apply to the enrichment and reprocessing facilities capable of producing nuclear explosives. As the Strategic Plan for the George W. Bush administration's Global Nuclear Energy Partnership program put it, "...*there is no technology 'silver bullet' that can be built into an enrichment plant or reprocessing plant that can prevent a country from diverting these commercial fuel cycle facilities to non-peaceful use.*"²⁶ (Emphasis in original.) This explains why we don't want to have such facilities spread to non-weapon states in the first place.

Reprocessing Spent Fuel, Recycling Plutonium

In principle, plutonium recycling should be easier to deal with because it is widely recognized that there is no economic case for plutonium reprocessing or recycling spent fuel.²⁷ The fast breeder programs that were the original incentives for separating plutonium have almost all receded into the indefinite future.²⁸ Nor do the recent claims that reprocessing and recycling facilitate waste disposal withstand scrutiny. That has not, however, dissuaded the national laboratories and nuclear fuel firms from clinging to plutonium technology as a link to the original dream of an all-nuclear future, regardless of

its current impracticality. To make it pay, the industrial supporters are counting on heavy subsidies—following the principle that to make money you don't need an economical product, you just need someone to pay for it.

The last refuge for plutonium recycling supporters is the claim that it serves arms control purposes by consuming plutonium, thus reducing long-term risks.²⁹ It does so, however, by separating plutonium and exposing it, in a number of fuel cycle stages, to considerably increased near-term risks. In view of the dangers and lack of economic benefits of reprocessing plutonium and recycling spent fuel, it makes sense to ban them altogether.

Such a ban would be no more than what President Gerald R. Ford proposed in 1976.³⁰ For many years, these fuel activities were restrained by the unfavorable economics, though the nuclear community never wholly accepted the nonproliferation critique of plutonium recycling. But in 2007, the recycling adherents convinced the Bush administration to launch the Global Nuclear Energy Partnership, a futuristic reprocessing and recycle crash program. The advertised purpose was to "solve" simultaneously the nuclear waste and proliferation problems by having the United States and other major nuclear supplier states provide a full range of fuel services. In reality, it was a poorly thought out scheme, based on technology that didn't exist, to rekindle the nuclear dream of a fast reactor future.³¹ The Obama administration cut back the Bush program but kept much of it going, and when the president spoke in South Korea in 2012, he called for "an international commitment to unlocking the fuel cycle of the future."³² It is not surprising that nuclear bureaucracies in other states, and especially South Korea, have been emboldened in expressing their interest in plutonium technology.

A key pending policy issue concerns the so-called gold standard for civilian nuclear cooperation between the United States and other countries. This is the standard established in the 2009 agreement between the United States and the United Arab Emirates that permits reactor sales but rules out nuclear fuel activities. Unfortunately, the Obama administration has been ambiguous about whether it will apply this standard to all such agreements.³³ Without a firm US commitment to it, there is no chance for the standard to gain international acceptance.

We should be clear that to restrict fuel cycle activities to a small number of states would mean not only that states that have not yet gotten into these activities would forego doing so, but also that some states already involved in such activities would have to give them up. While giving up reprocessing facilities would not involve economic penalties—as reprocessing is uneconomic, and broadly understood to be so—that does not mean that agreement to do so will be easily won.

Uranium Enrichment

Gaining agreement for restricting enrichment is an even more difficult proposition, as enrichment is a necessary part of the nuclear fuel cycle. Centrifuge enrichment, rather than enrichment *per se*, is the main concern because it lends itself to small-scale operation and thus is relatively accessible for many states.

A number of states already operate enrichment facilities or have development programs.³⁴ An aura has developed around enrichment that goes beyond any economic

rationale, one that ultimately relates to the connection with nuclear weapons. That is not necessarily what the operators have in mind, but we can be sure they are aware of the weapons potential, and—at minimum—of the political leverage this provides.

One way or another, to gain broad agreement on limiting access to this technology, there would have to be a reasonably common rule for all (the “inalienable right” phrase in Article IV of the NPT is immediately followed by the words “without discrimination”). To grasp the magnitude of the change that would be required from the current ad hoc approach, imagine the effort to restrict Iran’s enrichment program would have to be matched by an effort to restrict Brazil’s roughly comparable program, in order to be consistent. But that is part of what it would take to restrict enrichment activities to a small number of states in order for nuclear power to operate with a reasonable safety margin from the point of view of proliferation. The technology has spread beyond the point where grandfathering the existing enrichment programs is a workable solution. That would be a recipe for a creeping retreat to an increasingly unstable state of affairs—a world in which many states are a short step from nuclear weapons, one they could likely take before their neighbors or the international community could react.

Coming up with a satisfactory answer on how to limit access to this technology is a vexing problem. One possible approach would be to assess a safeguards fee to compensate for the very considerable IAEA effort involved in monitoring centrifuge facilities. If, as seems likely, the monitoring effort involved would not be much less for smaller plants, a large fee would discourage small operations and thus restrict the number.

Expand Inspections

The IAEA’s inspections, when first instituted, were infrequent and specifically limited to listed facilities, and the inspectors approached their tasks with blinders on. The IAEA inspection system is a very different one today, especially after the upgrades that followed the 1991 Gulf War, which revealed the ineffectiveness of the original system. Nevertheless, there are intrinsic limitations on what can be achieved through inspections alone.³⁵ The most recent addition, the Additional Protocol (AP), further expands the agency’s inspection rights.³⁶ It marks an important advance. But the AP remains voluntary and a number of states have yet to accept it. Also, to encourage acceptance of this protocol, the IAEA agreed to reduce the frequency of routine inspections for states that accepted the AP, so that, for example, the inspection goal for reactor spent fuel inspections would be once a year instead of once a quarter.

To be effective, the IAEA’s inspection system has not only to provide timely assessments at known facilities within a state, but also to be able to rule out the existence of clandestine facilities.³⁷ The reason for concern about clandestine facilities is that reprocessing and centrifuge enrichment lend themselves to small-scale operation. And whereas such facilities may be insignificant in commercial terms, they can be very significant in military terms. This means, for example, that the commonly held view that light water reactors (LWRs) by themselves are a safe proposition (in terms of proliferation) is correct only if we can rule out clandestine reprocessing, not only contemporaneously, but in the future.³⁸

Ironically, this was pointed out in 1977 by an Oak Ridge National Laboratory group opposed to nonproliferation restrictions. In specific, they wanted to show that a state that wanted to produce plutonium for bombs could easily get around a ban on commercial reprocessing. To drive the point home, the Oak Ridge team made public a design for a small reprocessing plant that a state with a minimal industrial base could build quickly and secretly to obtain enough plutonium for dozens of bombs. The memorandum describing the design included equipment lists, process sheets, and drawings.³⁹

The Oak Ridge experts said that most equipment would be available from local industries such as wineries or dairies or could be fabricated in a small shop. The described “quick and dirty” plant isn’t something anyone can put together in a garage. But it is entirely credible that experienced reprocessing experts could assemble it.

Although this wasn’t the objective of the Oak Ridge exercise, it cast doubt on the assumed benign character of nuclear power plants in the absence of commercial reprocessing. If a country with LWRs but no commercial reprocessing could quickly build a small “quick and dirty” plant to obtain enough plutonium for weapons, then stand-alone power reactors could be much more dangerous propositions than previously believed.

To address the problem of clandestine plants, two former IAEA deputy directors general have urged that the agency make greater use of “special inspection” rights it already has under the comprehensive NPT safeguards agreements. For historical and bureaucratic reasons, the threshold within the agency for invoking such inspections rights is exceedingly high. The IAEA’s right to conduct a special inspection has only been invoked once in adversarial circumstances (with North Korea in 1993).⁴⁰

Finally, a problem that is not immediate but is bound to arise in the future concerns the NPT safeguards exclusion for materials used in “non-prohibited military applications,” which principally means naval reactor fuel. This is a potential gaping loophole that at a minimum needs to be narrowed, and perhaps eliminated altogether, just as “peaceful applications of nuclear explosions” were in effect read out of the NPT.

Ensure Enforcement

In the early years of the NPT, there was an implicit assumption that each of the two Cold War blocs would police its sphere. The United States did that, for example, when, in the mid-1970s, it forced Taiwan and South Korea to dismantle their clandestine nuclear weapon efforts. But now the NPT needs an established enforcement mechanism to deal with treaty violation in a predictable way. At present, each violation calls for improvisation by a rotating cast of powerful states. And while the logic of “safeguards” over plutonium and highly enriched uranium is that the international system will react to evidence of violations rapidly, the natural response time of the international system is more often measured in years.

It is vital that future would-be bomb makers be disabused of any notion that they could evade tough international sanctions. What is needed—as Pierre Goldschmidt, a former IAEA deputy director general for safeguards, has recommended—is a country-neutral, reasonably predictable, more or less automatic sanction regime that puts all states on notice in advance of NPT violation, including violations of any IAEA safeguards agreements.⁴¹ Improving the ability to detect possible violations will not deter

violators if they know that little will be done quickly enough to stop their bomb making. A permanent secretariat attached to the treaty would help to make such a process work.

The record of US-led ad hoc enforcement is decidedly mixed. The trouble is that political considerations inevitably intrude: sometimes to deflect US interest from pursuing enforcement of nuclear agreements, sometimes even to look the other way.

In his 2009 speech in Prague, President Obama said: "We need real and immediate consequences for countries caught breaking the rules or trying to leave the treaty without cause. ... We must go forward with no illusions. Some countries will break the rules. That's why we need a structure in place that ensures when any nation does, they will face consequences."⁴²

More recently, the president's NPT ambassador stated: "There is no greater threat to the integrity and vitality of the treaty than the unresolved cases of noncompliance. Because of the corrosive effect of noncompliance on international confidence in the NPT, we must redouble our efforts to encourage full compliance with treaty obligations."⁴³

The present situation in which a violator does not face immediate sanction significantly undercuts the disincentives to violations. What would actually happen in any particular instance depends on who the violator's friends and enemies are, and on what else is distracting the world from the violation.

Iran has been sanctioned (in a long, drawn out process) not because it has been charged with specific NPT treaty violations, but rather because it is seen as a potential violator of IAEA safeguards requirements that threatens the interests of other powerful states, mainly Israel and the United States.

By contrast, North Korea's flagrant 1992 violation in refusing required IAEA inspections evoked an entirely different response, mainly because the United States feared a North Korean withdrawal from the NPT would undermine the then-upcoming 1995 NPT Review Conference. Investigation of its violation was postponed, and in return for not operating its small indigenous plutonium production reactors, North Korea was offered two large LWRs worth about \$5 billion. The deal eventually broke down, but the precedent remains: in the right circumstances, blackmail can work.

It also undermines worldwide respect for the NPT when enforcement is farmed out to a nonmember, as was the case when the United States acquiesced in Israel's 2007 bombing of Syria's clandestine reactor, instead of bringing Syria's violation before the IAEA.⁴⁴ The point applies as well to reported cooperation with Israel in taking action to sabotage Iran's nuclear program.⁴⁵

One cannot talk about NPT enforcement today without addressing the US reaction to the North Korea's third nuclear test on February 12, 2013. As observed earlier, President Obama's statement, calling for "swift and credible" action in response to violation of Security Council resolutions, did not mention the NPT.⁴⁶ This omission fosters the impression that the administration regards the NPT as of marginal significance.

Bring Nonmembers into the NPT Process

The most difficult NPT-related issue concerns what to do about the three NPT holdouts—India, Israel, and Pakistan—and the member-in-violation, North Korea. Under the NPT,

there are only two classes of states: the five nuclear weapon states and non-weapon states, which includes the three holdouts.⁴⁷ Although discriminatory, the original intent of only recognizing five nuclear states was to make sure that number did not grow larger. To now create a new class of members that would also have nuclear weapons would therefore undermine the treaty's original intent.

However implausible or even impossible it may now seem, it is probable that the only way that all states can be brought under the NPT system is if all reduce their nuclear weapons to zero. The United States and Russia have made substantial reductions but the continuation of that process is predicated on all nuclear states participating in further weapons reductions. Without such reductions, it doesn't seem likely that the nonnuclear NPT members would agree to necessary restrictive measures on the use of nuclear energy. Ultimately, the reductions will have to include India, Israel, and Pakistan, and of course North Korea.

We recommend universalizing the treaty—that is, regard it as applicable to all states, including the three holdouts, which would then be in noncompliance.⁴⁸ Of course, as a legal matter, one cannot force a state to join a treaty. But as a practical matter, if the 190 NPT signatories so decided, they could treat the three holdouts, and of course North Korea, as states in noncompliance, with the appropriate disadvantages that would follow from that.

To take a positive view, if these states agreed to join in the weapon reductions process under adequate monitoring, and so could be considered on their way toward compliance, any adverse treatment as a consequence of their noncompliance could be moderated.

We are under no illusions about the current practicability of this proposal. But we are also convinced that it is an essential element of an effective system to bar proliferation. It simply makes no sense to accept President Obama's goal of zero nuclear weapons but at the same time dismiss any notion of applying that goal to India, Israel, and Pakistan. As President Obama said in Prague: "This goal will not be reached quickly—perhaps not in my lifetime. It will take patience and persistence." Yet he set a goal. In the same way, we are trying to set a goal for nonproliferation.

What Now?

To sum up, it is our view that for a nonproliferation system that is reasonably able to cope with the kind of nuclear expansion implicit in US nuclear energy policy there need to be firm measures: (1) to prevent NPT withdrawals; (2) to restrict access to nuclear explosive materials; (3) to ensure adequate IAEA inspections; (4) to guarantee enforcement; and (5) to deal with NPT holdouts. We obviously are nowhere close to this standard, and in fact NPT members presently resist change in the direction of meeting it.

The official US response to this unsatisfactory state of affairs has been to focus on incremental measures, ones on which some progress could be made through relatively low-level negotiations.⁴⁹ Even nonproliferation academics and nongovernmental analysts reach no further, and in fact dismiss anything beyond this incremental approach as unrealistic or positively harmful. Not surprisingly, the nuclear power community regards

any suggestion to go beyond the working-at-the-margins approach as dangerous, if not tantamount to "anti-nuclear," even when it comes to reining in enrichment and reprocessing.⁵⁰

Along this line of thinking, to gain the necessary bona fides for tightening nonproliferation protection, the United States needs to encourage worldwide nuclear expansion and to involve itself heavily in selling nuclear technology. There is in this, of course, more than a touch of self-interest, as there has always been in such advice, going back to *Atoms for Peace*. Historically, nuclear sales have invariably come before protection against their misuse.

To keep active on nonproliferation and yet avoid roiling the diplomatic waters, diplomats and academics spend a great deal of time discussing inoffensive—and ineffectual—schemes, such as fuel banks and multinational fuel centers.⁵¹ Fuel banks, seemingly simple and catchy, so beloved by diplomats, are a non-solution to a non-problem.

There is a competitive international fuel market, and no state, other than one obviously bent on weapons, has to worry about getting fuel. In fact, no state, including one obviously seeking weapons, has had to shut reactors because it was denied nuclear fuel.

As to banking fuel, it is utterly impractical to store fuel assemblies for individual reactors, as these vary significantly in their technical specifications. One could bank low enriched uranium, but even that poses problems as the reactors' fuel enrichment levels vary. In any case, a state could much more easily bank its own low enriched uranium.

Multinational facilities would make some sense if they were coupled with a requirement for participants to forego indigenous fuel cycle facilities. But the usual arguments for the multinational projects have been that they would reduce the participants' incentives to pursue their own, which isn't the same thing.⁵²

Another escape from dealing with proliferation is to embrace nuclear terrorism (as opposed to weapon acquisition by states) as the immediate, primary problem, which is convenient because there is not a lot of push back when it comes to opposing nuclear terrorism.⁵³

The truth is that the incremental, least common denominator approach is never going to get us to where we need to be, and serious people responsible for security know it. To cope with proliferation hazards in the face of weak international controls over nuclear programs, the world seems to be slipping into greater reliance on national intelligence operations—backed up in the last instance by bombing and even assassinations. It is difficult to imagine that this is a workable solution for the long term.

Nor is it workable to continue in the mode where nonproliferation is seen as a US obsession and the role of the diplomats in the great majority of states is to extract what they can from the United States for each incremental concession. They have to see it as their problem, too. To start the process of changing to a sounder long term approach, the United States, the major nuclear states, and the IAEA need to begin by speaking clearly about the risks of proliferation attached to a major expansion of nuclear power use and what it takes to check them. Nearly seventy years ago, George Orwell taught us that euphemisms and bureaucratic boilerplate can corrupt thought by making it easier to disguise and defend what otherwise cannot be defended in public.⁵⁴

We have to stop pretending that reprocessing and enrichment facilities can be “safeguarded” by international inspections and that they are only a problem if they are located in states currently considered to be “rogue.” We also have to end the charade that protection will come from multinational facilities, or fuel banks, or futuristic reprocessing schemes. We have to agree to abide by common standards. Finally, we have to stop downplaying the NPT by describing it as standing on “three pillars,” of which nonproliferation is only one. The results might surprise us. There is a lot of persuasive power in sensible thought expressed clearly.

We conclude on this optimistic note even while recognizing that states are increasingly finding pretexts for narrowing the nonproliferation safety margins, and major states, like the United States, are finding rationalizations for yielding to allies. For this viewpoint, our working assumption is that this process has not gone so far that it cannot be reversed. To be sure, it would require the president to make reversing this course and engaging other leaders to do the same a top priority, as then-president Eisenhower did in launching Atoms for Peace.

We do not, however, discount the possibility that our critics are right that there no longer is any prospect for gaining the level of proliferation protection we outlined here, so there is no realistic prospect of closing the policy gap between nuclear advocacy and nonproliferation protection. In that case, the answer is not, as they say, to fall in with the nuclear crowd in the hope of merely making minor adjustments in its rules—but to think about closing the policy gap from the other end.

NOTES

1. The American Presidency Project, “John F. Kennedy—The President’s News Conference, March 21, 1963,” <www.presidency.ucsb.edu/ws/?pid=9124>.
2. For an example from the nuclear industry, see Steve Kidd, “Nuclear Proliferation Risk—Is It Vastly Overrated?” Nuclear Engineering International, July 23, 2010, <www.neimagazine.com/story.asp?storyCode=2056931>. Kidd, who works for the World Nuclear Association, argues that “It is likely that more countries will foolishly choose to acquire nuclear weapons. If they are really determined to do so, there is little really that the world can do to prevent them—the main effort has to be in dissuading them from this course of action. How many countries will have nuclear weapons by 2030 is hard to say, but there could well be a total of 15 by then.” Kidd then cites the work of Ohio State University Professor John Muller. Mueller argues that this increase, in itself, will neither prevent nor cause wars, but will impose “substantial costs on the countries concerned.”
3. For more on these points, see the thinking of François Heisbourg, chairman of the International Institute for Strategic Studies, “How Bad Would the Further Spread of Nuclear Weapons Be?” in Henry Sokolski, ed., *Nuclear Nonproliferation: Moving Beyond Pretense* (Arlington, VA: The Nonproliferation Policy Education Center, 2012), pp. 11–23, <www.npolicy.org/userfiles/image/oving%20Beyond%20Pretense%20Chapter%201.pdf>.
4. See Henry Kissinger, Foreword, in Trilateral Commission, *Nuclear Proliferation: Risk and Responsibility*, 2006, p. v, <www.scribd.com/doc/30082942/60-Nuclear-Proliferation-Risk-and-Responsibility-2006>.
5. See Kidd, “Nuclear Proliferation Risk,” and chapter seven, “Assessing the Proliferation Risks of Civilian Nuclear Programs,” in International Institute for Strategic Studies *Nuclear Programmes in the Middle East: In the shadow of Iran* (London, UK: International Institute of Strategic Studies, 2008), pp. 141–50, <www.iiss.org/en/publications/strategic%20dossiers/issues/nuclear-programmes-in-the-middle-east-in-the-shadow-of-iran-5993/me-09-chapter-07-proliferation-8294>.
6. Kissinger, Foreword, *Nuclear Proliferation: Risk and Responsibility*, p. vi.

7. See "Text of the Address Delivered by the President of the United States before the General Assembly of the United Nations in New York City," December 8, 1953, <www.eisenhower.archives.gov/research/online_documents/atoms_for_peace/Binder13.pdf>.
8. Economics and safety are tied together. The "regulatory costs" that critics of the regulatory systems complain about are mainly the costs of providing adequate safety. There is no getting around the fact that nuclear power is intrinsically dangerous and that it takes great care in design, construction, and operation to keep it within safe bounds, all of which is expensive. The safety of light water reactors (LWRs) is difficult to assess, as the technology is especially complex. The oxide fuel melts in hours if cooling stops. In the end, it may not prove to be the best power reactor choice. A struggle is now underway in Japan, with the newly empowered safety regulators imposing conditions that the industry claims will make it too expensive to restart Japan's reactors. As to alternatives to current designs, the US Department of Energy and industry are touting small modular reactors (SMRs), basically ordinary reactors in smaller sizes. If they are small enough, their nuclear systems could be assembled in a factory—hence modular. Being smaller, SMRs would cost less to build than their larger cousins but are unlikely to produce electricity that would cost less per kilowatt. One has to wonder, if smaller reactors are such a good idea, why they weren't proposed earlier. Gaining economies of scale through factory construction would only work if very large numbers were sold, for which there is little prospect. There are efforts to breathe life into other formerly rejected designs such as the Integrated Fast Reactor, but they are unlikely to get off the ground. What is needed for safety is a reactor whose fuel won't melt in an accident. To assure significant proliferation resistance and economic competitiveness, meeting other additional, yet-to-be-achieved cost and technical attributes would also be desirable.
9. Barack Obama, "Remarks by President Obama at Hankuk University," March 26, 2012, <www.whitehouse.gov/the-press-office/2012/03/26/remarks-president-obama-hankuk-university>. Meanwhile, President Obama's former energy secretary, Steven Chu, consistently championed this argument in support of loan guarantees for nuclear power plant construction. Chu wrote on his personal Facebook page: "If we want to make a serious dent in carbon dioxide emissions—not to mention having cleaner air and cleaner water—then nuclear power has to be on the table." See Steven Chu, "Why We Need More Nuclear Power," Facebook, February 22, 2010, <www.facebook.com/notes/steven-chu/why-we-need-more-nuclear-power/336162546856>.
10. In his 2009 Prague speech, President Obama said: "We must harness the power of nuclear energy on behalf of our efforts to combat climate change, and to advance peace opportunity for all people." Meanwhile, his remarks at Hankuk University emphasized "a renewed commitment to harnessing the power of the atom not for war, but for peaceful purposes." President Obama also praised the Koreans for showing "the progress and prosperity that can be achieved when nations embrace peaceful nuclear energy," thus glorifying the role of nuclear power in promoting economic development. Barack Obama, "Remarks by President Barack Obama," Prague, April 5, 2009, <www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered>.
11. IAEA Director General Yukiya Amano, "Introductory Statement to Board of Governors," September 10, 2012, Vienna, <www.iaea.org/newscenter/statements/2012/amsp2012n012.html>. At this gathering, Director General Amano noted that "it remains clear from the Agency's latest projections that nuclear power will remain an important option for many countries, despite the Fukushima Daiichi accident. Our new low projection is for nuclear power capacity to grow by nearly 25 percent from current levels to 456 gigawatts by 2030. Our *high* projection is 740 gigawatts, which is twice current levels." (Emphasis in original.)
12. Barack Obama, "Remarks by the President in the State of the Union Address," January 27, 2010, <www.whitehouse.gov/the-press-office/remarks-president-state-union-address>.
13. John Deutch and Ernest J. Moniz, co-chairs, et al, *The Future of Nuclear Power: An Interdisciplinary MIT Study* (Cambridge, Massachusetts: MIT 2003), <<http://web.mit.edu/nuclearpower/pdf/nuclearpower-full.pdf>>. The study analyzes a future of 1,000 gigawatts of nuclear power in 2050 on grounds that "such a deployment would avoid ... about 25% of the increment in carbon emissions otherwise expected in a business-as-usual scenario." (p. xi) For additional analysis, see Sharon Squassoni, "The Realities of Nuclear Expansion," prepared statement for the House of Representatives Select

- Committee for Energy Independence and Global Warming, 109th Cong, 1st. sess., March 12, 2008, <http://carnegieendowment.org/files/squassoni_testimony_20080312.pdf>.
14. Duke Energy's announced closing of its Crystal River, Florida, nuclear power plant in view of cheaper gas power is a straw in the wind, not only for future US plants but also for existing ones. Modern "fracking" extraction methods for natural gas also pose environmental problems that have to be balanced against the advantages of using this fuel, but the point is that we have a choice and are not locked into depending on nuclear power. On these points, see Reuters, "Exelon Cuts Nuclear Expansion Projects Amid Low Natgas Prices", February 7, 2013, <<http://mobile.reuters.com/article/idUSL1N0B76ZW20130207?irpc=932>>; Associated Press, "Duke Energy to Close Troubled Crystal River Nuclear Power Plant," February 5, 2013, <www.wtsp.com/news/topstories/article/296225/250/Crystal-River-nuke-plant-to-close>; and Rebecca Smith, "Can Gas Undo Nuclear Power?" *Wall Street Journal*, January 29, 2013, <<http://online.wsj.com/article/SB1000142412788732364490457827211885235812.html>>.
 15. For an excellent review of the main points of contention within the NPT regime and the issues that have made reform so difficult, see Steven E. Miller, *Nuclear Collisions: Discord, Reform & the Nuclear Nonproliferation Regime*, American Academy of Arts & Sciences (Cambridge, MA: American Academy of Arts and Sciences, 2012), <www.amacad.org/pdfs/nonproliferation.pdf>.
 16. At the 2012 Preparatory Committee for the 2015 NPT Review Conference, US Ambassador Susan F. Burk, the Special Representative of the President for Nuclear Nonproliferation, stated: "It is imperative, therefore, that all NPT Parties recommit themselves to ensuring the health and vitality of this essential international agreement by advancing each of the Treaty's three pillars together. *The Treaty and the regime cannot thrive unless each pillar thrives*. All Parties must accept responsibility for taking appropriate steps to contribute to the achievement of each of the Treaty's fundamental objectives, whether collectively or individually." (Emphasis added.) Statement by Ambassador Susan F. Burk, Special Representative of the President for Nuclear Nonproliferation, First Session of the Preparatory Committee, As Prepared, April 30, 2012, <<http://vienna.usmission.gov/43014.html>>. The problem here is one of emphasis. The NPT, of course, includes these other elements, which were added as conditions for the acceptance of the first, but the treaty is fundamentally about nonproliferation. The IAEA goes even further in promoting the notion that nonproliferation is not the key goal of the NPT. Vilmos Cserveny, assistant director general for external relations and policy coordination, stated in 2009, "The NPT consists of three *equally important* pillars—nuclear non-proliferation; peaceful nuclear cooperation; and nuclear disarmament—and the premise that progress in any one pillar strengthens the integrity of the whole." (Emphasis added.) He went on to say the IAEA's work is based on these three pillars. See IAEA, "Road to Disarmament: IAEA safeguards: A fundamental pillar of the NPT regime," excerpt from Vilmos Cserveny's statement at the General Debate of the NPT Preparatory Committee, May 4, 2009, <www.iaea.org/Publications/Magazines/Bulletin/Bull511/51103570609.html>.
 17. Barack Obama, "Statement by President Obama on the 40th Anniversary of the Nuclear Nonproliferation Treaty," March 5, 2010, <www.whitehouse.gov/the-press-office/statement-president-obama-40th-anniversary-nuclear-nonproliferation-treaty>.
 18. An arguable exception is President Gerald Ford's 1976 nuclear policy statement in which he proposed reliance on a "once-through" fuel cycle, thus eliminating reliance on plutonium until there was adequate international control to cope with proliferation risks. At that time, misuse of plutonium was seen as the main proliferation worry. HEU was not yet a principal concern. Unfortunately the international nuclear community, with considerable assistance from our own nuclear bureaucracy, rejected this once-through standard because it seemed to bar the way to the Holy Grail of nuclear power—the plutonium-fueled fast breeder. In practice, commercial reprocessing required enormous subsidies. Although the United States has the right to control the reprocessing of nuclear fuel covered by agreements for cooperation (except with Euratom), it has since given blanket approval to Japan and, more recently, India. On the occasion of signing the 2006 US-India nuclear agreement, President George W. Bush said, "I don't see how you can advocate nuclear power, in order to take the pressure off of our own economy, for example, without advocating technological development of reprocessing, because reprocessing will not only—reprocessing is going to help with the environmental concerns with nuclear power. It will make there—to put it bluntly, there will be less material to dispose." George W. Bush and Manmohan Singh, "Remarks by President Bush and Prime Minister Manmohan Singh of India," New Delhi, India, March 2, 2006, <<http://2001-2009.state.gov/p/sca/rls/rm/2006/62426.htm>>.

The issue of reprocessing approvals is now coming to a head in the renegotiation of the nuclear cooperation agreement with South Korea. The Koreans, of course, want to be treated on par with the Japanese and it will be difficult to refuse them. This is the natural consequence of a compartmentalized approach to proliferation policy as a sequence of special cases, and not looking ahead at the obvious consequences. We can only climb back up this slippery slope by applying rules in a consistent and fair manner.

19. IAEA, "The Structure And Content Of Agreements Between The Agency And States Required In Connection With The Treaty On The Non-Proliferation Of Nuclear Weapons," INFCIRC/153 (Corrected), June 1972, para. 26, <www.iaea.org/Publications/Documents/Infircs/Others/infirc153.pdf>: "The Agreement should provide for it to remain in force as long as the State is party to the Treaty on the Non-Proliferation of Nuclear Weapons."
20. Department of State, Office of the Spokesperson, "Third P-5 conference: Implementing the NPT, a joint statement issued by China, France, Russia, the United Kingdom, and the United States," June 27-29, 2012, Washington, DC, <www.state.gov/r/pa/prs/ps/2012/06/194292.htm>. This statement included the following: "As a further follow-up to the 2010 NPT Review Conference, the P5 shared their views on how to discourage abuse of the NPT withdrawal provision (Article X), and how to respond to notifications made consistent with the provisions of that article. The discussion included modalities under which NPT States Party could respond collectively and individually to a notification of withdrawal, including through arrangements regarding the disposition of equipment and materials acquired or derived under safeguards during NPT membership. The P5 agreed that states remain responsible under international law for violations of the Treaty committed prior to withdrawal." It would have been more supportive of the NPT if the statement said such withdrawal while in violation was invalid.
21. Barack Obama, "Statement by the President on North Korean Announcement of Nuclear Test," February 12, 2013, <www.whitehouse.gov/the-press-office/2013/02/12/statement-president-north-korean-announcement-nuclear-test>.
22. Steve Herman, "Rising Voices in S. Korea, Japan Advocate Nuclear Weapons," Voice of America, February 15, 2013, <www.voanews.com/content/rising-voices-in-south-korea-japan-advocate-nuclear-weapons/1604309.html>, and Howard LaFranchi, "N. Korea Nuclear Test: Will It Spoil Obama's Disarmament Plans?" *Christian Science Monitor*, February 15, 2013, <www.csmonitor.com/USA/Politics/2013/0215/N-Korea-nuclear-test-Will-it-spoil-Obama-s-disarmament-plans>.
23. In the 1950s and 1960s, there were still a good many power reactors using natural uranium fuel. Enrichment was an essential part of the fuel cycle for programs based on US-type light water reactors (LWRs), both pressurized water reactors (PWRs) and boiling water reactors (BWRs), which were gaining in popularity. The United States withheld enrichment data to protect the effective enrichment monopoly it had in the West because of the huge capacity it had built up to supply HEU for weapons. At the same time, the Atomic Energy Commission (AEC) permitted the export of research reactors fueled with HEU and large quantities of HEU to fuel them. Until the late 1960s, the AEC did not even bother to verify the amounts shipped abroad by private firms. By 1996, the United States had exported more than 25 tons of HEU. On this point, see Nuclear Threat Initiative, "Civilian HEU: United States," November 15, 2012, <www.nti.org/analysis/articles/civilian-heu-united-states/>.
24. Aside from military explosive and naval propulsion applications, highly enriched uranium fuel is used principally in research reactors. These can be fueled with lower enrichment fuels albeit with some diminution in performance at higher power reactors. On the whole, the operators of these reactors, including those at universities, have dragged their feet about converting to lower enrichment fuel. Two prominent examples are the research reactors at Massachusetts Institute of Technology and Munich Technical University, which, despite US and German government policy to convert such reactors, have managed to secure delay after delay. About fifty research reactors around the world have converted to lower enrichment fuel as a result of three decades of international efforts (launched by the US Nuclear Regulatory Commission) to reduce HEU use, but this has resulted in only about a one-quarter reduction in annual HEU use by research reactors, which previously was about a ton per year. See Ole Reistad and Styrkaar Hustveit "HEU Fuel Cycle Inventories and Progress On Global Minimization," *Nonproliferation Review* 15 (July 2008), pp. 265-87, <www.tandfonline.com/doi/full/10.1080/10736700802117312>. Reducing civilian HEU use to zero must be an important component of any nonproliferation policy.

25. IAEA, "The Structure And Content Of Agreements Between The Agency And States Required In Connection With The Treaty On The Non-Proliferation Of Nuclear Weapons," INFCIRC/153, para. 28: "... the objective of safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection."
26. Department of Energy, *Global Nuclear Energy Partnership Strategic Plan*, January 2007, p. 3-10, <www.fas.org/programs/ssp/_docs/GNEPStratPlanJan07.pdf>. It is often forgotten, even by the Department of Energy (DOE), that the sophisticated reprocessing schemes proposed under the Global Nuclear Energy Partnership—schemes that, in principle, always kept plutonium mixed with other materials—were intended as anti-terrorism rather than nonproliferation measures. The program's strategic plan, however, acknowledged that there was no way to make reprocessing proliferation-proof.
27. Even the reprocessing vendors don't make a resource case for plutonium. Mixed oxide (MOX) fuel for LWRs costs several times what uranium fuel costs. In fact, recycling in LWRs never made any economic sense. It has been forgotten that the whole notion of thermal recycle was invented in the 1970s because the US Atomic Energy Commission's fast breeder reactor project was falling behind and the agency needed a rationale for keeping its reprocessing efforts going "until the breeder caught up." It was never expected to be economical. By the time the breeder project collapsed, MOX acquired its own support group and took on a life of its own, leaping from one rationale to another.
28. When nuclear power programs got underway, it was generally believed that as uranium was scarce and that LWRs would be a transitional technology that produced enough plutonium to fuel the ultimate in nuclear power plants, the fast breeders (so-called because they used fast neutrons and produced more plutonium in a surrounding uranium "blanket" than they consumed in the core). In practice, prototype fast breeders turned out to have problems and be too expensive to pursue. The George W. Bush administration tried to revive the concept in the form of fast "burners," plutonium-fueled reactors without the surrounding blanket, but this proved impractical as well.
29. In 2000, the DOE signed an agreement with Russia committing each state to dispose of 34 metric tons of "surplus" weapons plutonium by recycling it into reactor fuel. More than a decade later, the program has become a boondoggle. DOE's contractor, Shaw Areva MOX Services, is constructing a Mixed Oxide Fuel Fabrication Facility at DOE's Savannah River Site in South Carolina, in principle to use weapon-grade plutonium to produce power reactor fuel that, once heavily irradiated in a commercial power reactor, would contain plutonium that was less useful for weapons. But it now appears that DOE's real purpose is to use the rubric of arms control to get plutonium recycling underway. The plant is one of the largest construction projects in the southeastern United States. Its costs have reportedly soared to \$7 billion. Furthermore, the facility has no customers lined up for the MOX fuel it is supposed to produce. This has attracted the attention of federal budget cutters but doesn't seem to have diminished the project's appeal for the DOE. See Sammy Fretwell, "Critics fear \$7 billion SRS boondoggle," *State*, January 27, 2013, <www.thestate.com/2013/01/27/2606562/critics-fear-7-billion-srs-boondoggle.html>. See also Pam Radtke Russell, "Budget Cutters Eye Nuclear Reprocessing Plant," *Roll Call*, February 5, 2013, <www.taxpayer.net/media-center/article/budget-cutters-eye-nuclear-reprocessing-plant>: "It isn't expected to be completed by its 2016 target date, and the Energy Department has found little interest from commercial power plant operators in buying the fuel, which would require costly reactor modifications. ... [Former Rep. David L.] Hobson, [Republican of Ohio] described the project as a jobs program for South Carolina. In addition to the 2,600 employees now working on it, the completed facility will require permanent workers to operate it for up to two decades."
30. "I have concluded that the reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risks of proliferation." President Gerald Ford, "Statement on Nuclear Policy," October 28, 1976, <www.presidency.ucs.edu/ws/index.php?pid=6561>. There is also a precedent for banning an entire technology in the context of the NPT—so-called "peaceful nuclear explosives" were read out of the NPT even though there is an entire NPT article (Article V) devoted to them. On this point, see Robert Zarate, "The NPT, IAEA Safeguards and Peaceful Nuclear Energy: An 'Inalienable Right' but Precisely to What?" in Henry Sokolski, ed., *Falling Behind: International Scrutiny of the Peaceful Atom* (Carlisle, PA: Strategic Studies Institute,

- 2008), pp. 252-55, available at <www.npolicy.org/userfiles/image/Peaceful%20Nuclear%20Energy,%20an%20inalienable%20Right%20to%20What_pdf.pdf>.
31. For a discussion on the program's technical flaws, see Committee on Review of DOE's Nuclear Energy Research and Development Program, "A Minority Opinion: Dissenting Statement of Gilinsky and Macfarlane," in *Review of DOE's Nuclear Energy Research and Development Program* (Washington, DC: National Academies Press, 2008), pp. 73-76, <www.nap.edu/openbook.php?record_id=11998&page=73>.
 32. See Barack Obama, "Remarks by President Obama at Hankuk University." DOE undoubtedly inserted the seemingly innocuous words into the speech. To the nuclear bureaucracies around the world, they spell plutonium recycle.
 33. See Elaine M. Grossman, "U.S. May Land Key Asian Nuclear Trade Deals in 2013," *Global Security Newswire*, January 11, 2013, <www.nti.org/gsn/article/us-could-secure-key-asian-nuclear-trade-deals-2013/>; Elaine M. Grossman, "Obama Team Reveals Nuclear Trade, Nonproliferation Decision on Capitol Hill," *Global Security Newswire*, January 11, 2012, <www.nti.org/gsn/article/obama-team-reveals-nuclear-trade-nonproliferation-decision-capitol-hill/>, and Elaine M. Grossman, "U.S. Envoy Takes Issue with Nonproliferation Lingo for Nuclear Trade Pacts," *Global Security Newswire*, August 10, 2012, <www.nti.org/gsn/article/us-envoy-takes-issue-nonproliferation-lingo-nuclear-trade-pacts/>.
 34. Argentina, Brazil, China, France, Germany, India, Iran, Japan, the Netherlands, North Korea, Pakistan, the United Kingdom, and the United States are in the first category and South Africa and Australia (and probably Israel) are in the second. See Arjun Makhijani, Lois Chalmers, and Brice Smith, "Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power," prepared by the Institute for Energy and Environmental Research for the Nuclear Policy Research Institute, October 15, 2004, <<http://ieer.org/resource/nuclear-power/uranium-enrichment/>>.
 35. It is useful to keep in mind the verdict of the 1946 Acheson-Lilienthal Report: "A system of inspection superimposed on an otherwise uncontrolled exploitation of atomic energy by national governments will not be an adequate safeguard. . . . If nations or their citizens carry on intrinsically dangerous [nuclear] activities it seems to us that the chances for safeguarding the future are hopeless." In other words, the allowed activities must be restricted to those that can be safeguarded, in the dictionary sense, by inspection. See *Report on International Control of Atomic Energy* (Washington DC: US Government Printing Office, March 16, 1946), pp. 21-22, <www.learnworld.com/ZNW/LWText/Acheson-Lilienthal.html>.
 36. See IAEA, "Model Protocol Additional to The Agreement(s) Between State(s) And The International Atomic Energy Agency For The Application Of Safeguards," INFCIRC/540 (Corrected), September 1997, <www.iaea.org/Publications/Documents/Infcircs/1997/infcirc540c.pdf>.
 37. Clandestine facilities are an obvious concern in North Korea and Iran. Iran failed to notify the IAEA of a planned enrichment facility, as it had promised to do in 2003. It later retreated from this promise. Whether this amounts to a violation of Iran's obligations or a deficiency in the IAEA system depends on legal issues that remain unclear. The IAEA has not released relevant documents and correspondence. See IAEA, "Implementation of the NPT Safeguards Agreement and Relevant Provisions of United Nations Security Council Resolutions in the Islamic Republic of Iran," Resolution adopted by the Board of Governors on September 13, 2012, <www.iaea.org/Publications/Documents/Board/2012/gov2012-50.pdf>.
 38. For a detailed analysis of this proposition, see Victor Gilinsky, Marvin Miller, and Harmon Hubbard, "A Fresh Examination of the Proliferation Dangers of Light Water Reactors," Nonproliferation Policy Education Center, October 22, 2004, <[www.npolicy.org/article.php?aid=172&rt=&key=fresh examination of the proliferation dangers &sec=article&author=>](http://www.npolicy.org/article.php?aid=172&rt=&key=fresh%20examination%20of%20the%20proliferation%20dangers&sec=article&author=>)>. It's worth keeping in mind that many states' view of the fuel cycle is still tied to the use of LWRs with oxide fuel. It isn't at all clear—for both safety and proliferation reasons and perhaps economic reasons, as well—that this is best way to extract nuclear energy. Other new types of reactors with different fuels, especially fuels that don't melt as easily, may moot many of the issues that concern us today, possibly including reprocessing.
 39. See D.L. Ferguson to F.L. Culler, "Simple Quick Reprocessing Plant," Inter-Laboratory correspondence, Oak Ridge National Laboratory, August 30, 1977, <www.npolicy.org/article_file/Simple_Quick_Processing_Plant_Culler.pdf>.
 40. North Korea refused to allow the special inspection. In 1992, Romania invited a special inspection. See John Carlson and Russell Leslie, "Special Inspections Revisited," paper at Institute for Nuclear Materials Management 2005 symposium, Phoenix, Arizona, July 2005, <www.dfat.gov.au/asno/publications/>

- [inmm2005_special_inspections.pdf](#)>. Carlson and Leslie write, "While it is obvious that special inspections cannot become *regular* occurrences, and cannot substitute for complementary access, it can be questioned whether the very high threshold assumed in the 1992 Board deliberations is consistent with contemporary expectations for the safeguards system and for the level of cooperation that states extend to the Agency." (Emphasis in original.)
41. Pierre Goldschmidt, "Looking Beyond Iran and North Korea for Safeguarding the Foundations of Nuclear Nonproliferation," Carnegie Endowment for International Peace, November 3, 2011, <<http://carnegieendowment.org/2011/11/03/looking-beyond-iran-and-north-korea-for-safeguarding-foundations-of-nuclear-nonproliferation/8ktn>>.
 42. Barack Obama, "Remarks by President Barack Obama."
 43. Statement by Ambassador Susan F. Burk, First Session of the Preparatory Committee.
 44. See Elliott Abrams, "Bombing the Syrian Reactor: the Untold Story," *Commentary*, February 2013, <www.commentarymagazine.com/article/bombing-the-syrian-reactor-the-untold-story/>. In Abrams's account, President Bush was initially inclined to bring the case before the IAEA but was persuaded to let the Israelis bomb the reactor.
 45. David E. Sanger, "Obama Order Sped up Wave of Cyberattacks Against Iran," *New York Times*, June 1, 2012, <www.nytimes.com/2012/06/01/world/middleeast/obama-ordered-wave-of-cyberattacks-against-iran.html>, and Ellen Nakashima and Joby Warrick, "Stuxnet was work of U.S. and Israeli experts, officials say," *Washington Post*, June 1, 2012, <www.washingtonpost.com/world/national-security/stuxnet-was-work-of-us-and-israeli-experts-officials-say/2012/06/01/gJQAlnEy6U_story.html>.
 46. Barack Obama, "Statement by the President on North Korean Announcement of Nuclear Test."
 47. There is no possibility under the NPT to expand the number of weapon states "For the purposes of this Treaty, a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January, 1967." Treaty on the Non-Proliferation of Nuclear Weapons, March 5, 1970, Article IX, para. 3.
 48. The Egyptian Foreign Ministry, in response to North Korea's most recent nuclear test, emphasized the necessity of the "internationalization" of the NPT. See "Egypt Stresses Necessity of NPT Internationalization," Egypt State Information Service, February 15, 2013, <<http://allafrica.com/stories/201302170072.html>>. Egypt obviously has Israel in mind here, but that doesn't detract from the idea.
 49. This outlook is captured in 2008 report of the State Department's International Security Advisory Board: "We concluded that the current international climate is quite unpropitious for gaining support from non-nuclear weapon states to accept stricter measures against proliferation. ... [Yet] we believe that incremental measures, rather than revolutionary or comprehensive changes, will be far more likely to succeed in the near term." The report is from an earlier administration but it captures the sense of current approaches as well. See State Department International Security Advisory Board, "Report on Proliferation Implications of the Global Expansion of Civil Nuclear Power," April 7, 2008, <<http://2001-2009.state.gov/documents/organization/105587.pdf>>.
 50. See, for example, the recent report by Fred McGoldrick, *Nuclear Trade Controls: Minding the Gaps* (Washington, DC: Center for Strategic and International Studies), January 22, 2013, <<http://csis.org/publication/nuclear-trade-controls>>: "Finally, the U.S. has to avoid overreach in instituting new nuclear export controls. Recent well-intentioned efforts by some in Congress and the Executive Branch to pressure other states to forswear enrichment and reprocessing capabilities could seriously damage the prospects for U.S. nuclear exports and deprive the United States of the nonproliferation influence that comes with nuclear cooperation. Some have suggested other steps that would cause similar, if not more severe, damage to U.S. influence in international nuclear affairs. Suppliers are not going to require such extreme export conditions, and most consumer states are likely to reject U.S. demands they believe deny them their rights or legitimate peaceful commercial opportunities." McGoldrick basically proposes tidying up the nonproliferation controls, but doing nothing to upset any other states, especially developing ones. He accepts that we have to offer positive incentives if we ask them to forego "sensitive" technologies. There is no larger sense here, or in the many similar reports, that the United States could, or should try to, persuade other states of the common security advantage in agreeing to a higher level of protection against bomb making.

51. In his March 2012 South Korea speech, President Obama said, "...we're creating new fuel banks, to help countries realize the energy they seek without increasing the nuclear dangers that we fear." See Barack Obama, "Remarks by President Obama at Hankuk University."
52. See Alan S. Hanson, "Nuclear Fuel Banks: Are They a Reality?," presentation made at the James Martin Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, California, December 12, 2011, <www.youtube.com/watch?v=EYmT6ftCPhg>.
53. This includes a strained effort to include "dirty bombs" in the category of serious threats. Consider IAEA Director General Amano's October 2012 speech at Chatham House in which he said: "One of the key risks we face is that terrorists could detonate a so-called dirty bomb, using conventional explosives and a quantity of nuclear or other radioactive material, to contaminate a major city." On proliferation, Amano discussed Iran and North Korea, but said nothing about tightening nonproliferation protections overall. See Yukiya Amano, "Future Prospects for Nuclear Energy," Chatham House, October 17, 2012, <www.chathamhouse.org/sites/default/files/public/Meetings/Meeting%20Transcripts/171012Amano.pdf>.
54. George Orwell, "Politics and the English Language," *Horizon*, April 1946, reproduced at <<http://georgeorwellnovels.com/essays/politics-and-the-english-language/>>.