



## CHAPTER FOUR: BLOCKING SUPPLY

### Securing the Nuclear Complex

A well-organized and financed terrorist group could produce a basic nuclear weapon—but only if it first could acquire enough HEU or separated plutonium to fuel a bomb.<sup>38</sup> The terrorist threat worsens the already acute risk of theft or diversion by states from the inadequately secured stockpiles of these materials around the world. *Securing weapon-usable fissile materials is, therefore, the single greatest nonproliferation priority.* As President George W. Bush has said, “The nations of the world must do all we can to secure and eliminate nuclear...materials.”<sup>39</sup>

Doing “all we can” means radically revising the management of the global nuclear complex. Piecemeal reform will not adequately protect fissile materials from theft or bridge existing gaps. While economic and political compromises will have to be made in order to meet the security imperative, a tightened regime can be compatible with full use of nuclear energy and should be undertaken in cooperation with the nuclear industry. It is important to recognize that the viability of the nuclear industry is at stake: The violent use of stolen fissile material or the collapse of the nonproliferation regime would set back the use of nuclear power generation worldwide.<sup>40</sup>

A strategy to prevent terrorists and additional states from acquiring nuclear weapons must include these four objectives:

- ▶ **SECURE WHAT EXISTS NOW.** State-of-the art security must be applied to all nuclear weapons and weapon-usable materials, whether civilian or military, everywhere. Where effective security is impossible, materials must be relocated or eliminated as quickly as possible.
- ▶ **END PRODUCTION OF WEAPON-USABLE MATERIALS.** The production of highly enriched uranium should be permanently ended and separation of weapon-usable plutonium should be suspended until current stocks are drawn down. No new countries should build or operate enrichment or reprocessing facilities. Rather, states without such facilities should have internationally guaranteed access to fuel services from existing fuel producers. All states—nuclear weapon and nonweapon alike—should place existing fuel cycle facilities under new institutional controls.
- ▶ **END USE.** Civilian research, power, and naval reactors that run on weapon-usable fuels should be converted to alternate fuels or shut down. Conversion or shutdown of civilian research reactors, including those in the United States, should be accelerated and the fuel returned to the states of origin. Permission for convertible reactors to use U.S.-origin HEU fuels should be rescinded, and material returned to the United States for disposal. The G-8 should use money from its Global Partnership against the Spread of Weapons of Mass Destruction for these purposes.
- ▶ **ELIMINATE SURPLUS MATERIALS.** Large stockpiles of weapon-usable materials in countries around the world should be securely eliminated. The U.S.-Russian plutonium disposition program should be rethought, and must include a greater focus on securing materials pending their disposition and the reinvigoration of disposition projects.

Each of these objectives is worthwhile on its own; together, they make up a comprehensive and aggressive yet realistic approach to nuclear material security. However, many of the needed steps will require significant adjustments by, and contributions from, numerous countries, and will therefore be controversial. Leadership, cooperation, and sustained political support at the head-of-state level will be a prerequisite for success.

The new standards and initiatives proposed here must apply equally to all states with nuclear materials and facilities, whether or not they are signatories to the NPT or possess nuclear weapons. Civilian facilities in a nuclear weapon state (for example, a university-run research reactor or a privately run facility) should be required to meet the same security standard and operational guidelines as a civilian site in a non-nuclear weapon state. Similarly, materials in the defense sector of a state such as Brazil or India should meet the highest standards that exist for defense-related materials in the United States or France. Terrorists searching for such materials will not distinguish among sources—they will go where access is easiest.

#### **SECURE WHAT EXISTS NOW<sup>41</sup>**

Because the most difficult part of making a nuclear bomb is acquiring the nuclear material, *all weapon-usable nuclear materials should be treated as if they were nuclear weapons, and the highest standards applied to weapons should become the global norm for all such materials regardless of use or location.*<sup>42</sup>

Currently, the IAEA publishes voluntary standards for nuclear material protection.<sup>43</sup> These standards do not adequately protect all direct-use nuclear materials against current threats, yet many states' security practices do not meet even these minimum

**Table 4.1. Global Stocks of Fissile Material<sup>a</sup>**  
(in Metric Tons)

GLOBAL STOCKS			
CATEGORY	PLUTONIUM	HEU	TOTAL
<b>Civil Stocks (rounded)</b>	<b>1,700</b>	<b>175</b>	<b>1,875</b>
Power and Research Reactor Programs	1,595 <sup>b</sup>	50	
Declared Excess <sup>c</sup>	107	125 (U.S. only)	
<b>Military Stocks</b>	<b>155</b>	<b>1,725</b>	<b>1,880</b>
Primary	155	1,250	
Naval and Other	–	175	
Russian HEU Declared Excess	–	300	
<b>Total</b>	<b>1,855</b>	<b>1,900</b>	<b>3,755</b>

Note: HEU, highly enriched uranium.

Source: David Albright and Kimberly Kramer, “Fissile Material: Stockpiles Still Growing,” *Bulletin of the Atomic Scientists*, 60, no. 6 (November/December 2004): p. 14; see also [www.isis-online.org/global\\_stocks/summary\\_tables.html#table1](http://www.isis-online.org/global_stocks/summary_tables.html#table1).

a End of 2003.

b This figure includes 230 tons of separated unirradiated plutonium.

c Russia, the United Kingdom, and the United States have declared this amount of their military plutonium in excess of their defense needs. It will be consumed for civilian uses.

**Table 4.2. The Forty-Six Countries Known to Possess Weapon-Usable Uranium**

Argentina	Germany	Latvia	South Africa
Australia	Ghana	Libya	South Korea
Austria	Greece	Mexico	Syria
Belarus	Hungary	Netherlands	Taiwan
Belgium	India	North Korea	Turkey
Bulgaria	Indonesia	Pakistan	Ukraine
Canada	Iran	Peru	United Kingdom
Chile	Israel	Poland	United States
China	Italy	Portugal	Uzbekistan
Czech Republic	Jamaica	Romania	Vietnam
Denmark	Japan	Russia	
France	Kazakhstan	Serbia	

guidelines. A new, enhanced global standard should be established requiring that the security of nuclear stocks in *all* states be brought up to the highest standards technically possible.

The United States and its allies should lead this international effort,<sup>44</sup> starting with the creation of a high-level “Contact Group to Prevent Nuclear Terrorism,” including the United States, Russia, the United Kingdom, France, China, India, Israel, Pakistan, Japan, Germany, Brazil, and any other states that possess weapon-usable material and wish to join. States that have produced and exported weapon-usable materials (including the United States, Russia, and China) would have particular responsibilities within this group, whose goal would be to develop a new, single, enhanced standard for nuclear material and weapons security. By opening participation to all states that possess stockpiles of fissile materials, a contact group would overcome the problem

of India, Pakistan, and Israel not being members of the NPT. (As an informal venue, a contact group would not confer new juridical status on any state.) Representation should be at a very high level—special envoys reporting directly to their heads of state—to convey the urgency that participating nations attach to their responsibilities. Industry and technical communities should be actively involved. The high level of the contact group would spotlight public and media attention on the nuclear security challenge and help to overcome the many bureaucratic and institutional barriers to progress.<sup>45</sup>

UN Security Council Resolution 1540's requirement that all states must "develop and maintain appropriate effective physical protection measures" could provide an already approved basis for adopting the new standard as a legal commitment for all countries once the requirements have been set by the contact group.<sup>46</sup> Previous efforts to improve nuclear security, including through the Convention on the Physical Protection of Nuclear Materials, will provide valuable lessons, but difficulties encountered in these attempts should not be allowed to deter this more ambitious effort from being pursued, this time with greater political support. It merits repeating, however, that serious and sustained political leadership will be necessary to break through the political and financial barriers to improved nuclear material security.

Once the new standards and obligations to implement them are established, countries should be offered several ways to comply. For civilian sites, this compliance could be demonstrated through acceptance of IAEA International Physical Protection Advisory Service inspections. The security of military facilities is more complex, but additional transparency and information sharing between states possessing weapon-usable materials would be a

useful mode of confidence building. The wealthiest states should also provide assistance to other countries to ensure they can meet these new standards, including financing for security upgrades and relocation of materials from states that cannot meet state-of-the-art standards.<sup>47</sup> This assistance can be provided in large part by the G-8 Global Partnership against the Spread of Weapons of Mass Destruction, which has allocated \$20 billion over 10 years for this effort, although additional funds and a broadened scope beyond the former Soviet Union will be necessary. Assistance should include sharing best practices on personnel reliability and physical protection similar to those provided by the international community to states of the former Soviet Union.<sup>48</sup> The costs of such assistance are minuscule compared to the economic, political, and strategic costs of a terrorist attack committed with nuclear materials obtained from poorly secured stocks.

To further reduce the threat from nuclear terrorism, the United States and its allies should also reorient and more aggressively pursue the Global Threat Reduction Initiative (GTRI), which was launched in 2004 by the United States. The GTRI seeks to perform a global cleanout of nuclear materials from vulnerable research facilities and to either convert or shut down research reactors that operate on weapons-grade uranium. Current plans call for implementing GTRI goals within ten years. The major obstacles to faster implementation of the program are inadequate staffing and financing, and a disproportionate emphasis on conversion—rather than shutdown—of older, unnecessary facilities. More creative approaches, including a larger number of international partners, innovative contracting, and undertaking multiple operations simultaneously, are needed. With the necessary resources and emphasis, the ten-year goal can—and should—be met in four years.

Because civilian facilities are among the most vulnerable sources of nuclear materials worldwide, securing and eliminating these stocks of material should be given relative priority. Several dozen countries possess vulnerable weapon-usable materials (almost exclusively uranium) for use in research reactors. Absent a compelling rationale for their continued use, these materials should be removed. The United States, working with Russia and other partners, should accelerate efforts to relocate the vast majority of these materials in four years, with funding levels of at least \$50 million per year.<sup>49</sup> Money should not be allowed to constrain this vital national security undertaking—dollar for dollar, the benefit will be huge. The United States needs to recognize the special risks associated with vulnerable HEU in the states of the former Soviet Union and prioritize efforts to secure this material, including its rapid repatriation to Russia, or even its relocation to the United States, as was done in Project Sapphire in 1994.<sup>50</sup> Rapid security upgrades of Russian sites containing high-risk HEU could be completed within one year.

### **NUCLEAR TERRORISM**

Related but distinct from efforts to prevent terrorists from acquiring nuclear weapons is the urgent need to prevent other kinds of nuclear-related terror attacks, including the use of radiological dispersal devices (RDDs, also known as dirty bombs) and attacks on nuclear facilities, including power and research reactors. These efforts are beyond the scope of this study, but are covered in extensive detail in Charles Ferguson et al., *The Four Faces of Nuclear Terrorism* (Monterey, Calif.: Monterey Institute for International Studies, 2004).

## **END PRODUCTION OF WEAPON-USABLE MATERIALS**

Enough civil and military weapon-usable materials exist globally to produce well over 100,000 nuclear weapons. As Table 4.1 shows, 300 metric tons of military material has been designated as excess: It is unneeded. The entire 3,755 metric tons of HEU and plutonium are difficult and expensive to protect. Effective means of disposing of large amounts of plutonium do not yet exist. For these reasons, in 1994 the U.S. National Academy of Sciences called surplus stockpiles “a clear and present danger” to international security.<sup>51</sup> Yet established producers continue to make more of these materials, and several other countries are considering or actively seeking to acquire their own facilities to add to the excess.<sup>52</sup> The continuing production of HEU and separation of plutonium are a global anomaly: acutely dangerous, expensive, and wholly unnecessary. The two halves of the threat are intimately linked: Neither can be addressed alone. Establishing a new fuel cycle system will require creating benefits for states that forgo enrichment and reprocessing; imposing costs on those that do not; and, for current producers, accepting steps of equal consequence. Specifically, successful fuel cycle reform has three necessary elements: providing internationally guaranteed fuel services to states that do not enrich and reprocess; banning further production of HEU; and implementing a plutonium production pause.

### ***No New Facilities/Guaranteed Fuel Services***

President Bush, the director general of the IAEA, the UN secretary-general’s High-Level Panel, and others have endorsed radical fuel cycle reform. On February 11, 2004, President Bush said:

The world must create a safe, orderly system to field civilian nuclear plants without adding to the danger of weapons proliferation. The world's leading nuclear exporters should ensure that states have reliable access at reasonable cost to fuel for civilian reactors, so long as those states renounce enrichment and reprocessing. Enrichment and reprocessing are not necessary for nations seeking to harness nuclear energy for peaceful purposes.<sup>53</sup>

Unfortunately, while it recognized the risks associated with the expansion of nuclear production capabilities into new states, the statement failed to take account of the dangers posed by the continued production of weapon-usable materials in states where they already exist. Little progress in furthering the president's proposed reform has yet been made, in part due to a lack of U.S. follow-up, and in part to wide resistance to the needed changes. There are concerns among developing nations that a supplier cartel would unduly restrict their access to nuclear technology and a broader reluctance among non-nuclear weapon states to accept more stringent nonproliferation obligations when nuclear weapon states are seen as failing in their commitments to disarmament.

Article IV of the Non-Proliferation Treaty states:

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with articles I and II of this Treaty.

2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of

equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

There is a growing debate, however, whether the existence of facilities capable of producing weapon-usable materials can be considered consistent with this “peaceful uses” clause, or with the obligation of non-nuclear weapon states under Article II of the Treaty not to pursue nuclear weapons. In its 2004 report, the UN High-Level Panel recognized the problem but straddled the issue in stating that “the mounting tension between the goals of achieving a more effective nonproliferation regime and the right of all signatories of the [NPT] to develop civilian nuclear industries needs to be addressed.” The majority of member countries interpret Article IV to allow nuclear material production, but *there is nothing inherent in the right to enjoy the benefits of peaceful nuclear technology that explicitly guarantees or requires possession of enrichment or reprocessing facilities*. However, reinterpreting the NPT to restrict the ability of states to develop or possess such facilities and materials will be exceedingly difficult. States seeking this new definition, especially nuclear weapon states, will be confronted by an openly skeptical group of states unwilling to cede any ground on their access to nuclear technology as long as other existing nonproliferation obligations, including those associated with disarmament, are perceived as going unimplemented. To obtain a legal endorsement of some new standard, advocating

states will need—and should be willing—to give more in order to get more.

The first step is a new international fuel cycle arrangement that would guarantee fuel cycle services to states that do not possess domestic fuel cycle capabilities. Such a mechanism would have to provide a credible international guarantee of fresh reactor fuel and removal of spent fuel at prices that offer an economic incentive. Such an arrangement would reduce, if not eliminate, the economic or energy security justification for states to pursue their own fuel cycle facilities, and in so doing would test states' commitment to a nonweapons path. States that turn down economically attractive alternatives to costly new production facilities would engender suspicion of their intentions, inviting sanctions and other international pressures.

The Expert Group on multinational options for managing the nuclear fuel cycle, impaneled by IAEA Director General ElBaradei is evaluating different options, and the incentives that would be needed to adopt them. The Contact Group on nuclear terrorism proposed in the present chapter could advance the IAEA Expert Group's work. Several potential mechanisms for guaranteeing the supply of fresh fuel have been put forward (see "Options for Providing Guaranteed Supplies of Nuclear Fuel," page 95). Successful options will need to assure recipients that the supply arrangements will be inviolable, and the most effective will include redundant systems to provide fuel if primary sources fail.

Attempting to stem nuclear proliferation crisis by crisis—from Iraq, to North Korea, to Iran, etcetera—ultimately invites defeat. As each deal is cut, it sets a new expectation for the next proliferator. Regime change by force in country after country is neither right nor realistic. The United States would bankrupt and isolate

## **OPTIONS FOR PROVIDING GUARANTEED SUPPLIES OF NUCLEAR FUEL**

There are a number of possible arrangements for ensuring that states that abandon fuel cycle capabilities can obtain guaranteed access to fuel services. The goal in each case would be to undercut the economic argument for programs to develop enrichment capabilities.

**A COMMERCIAL CONSORTIUM OF FUEL PROVIDERS.** Government-backed collections of fuel-producing states or companies could form supply groups to commercially outcompete domestic fuel production programs. Three or more fuel-providing entities could offer reinforcing contracts to prospective buyers (if one company dropped out, another would be obligated to fulfill the contract). The fuel could be sold or leased (depending on recipient states' ability to manage spent fuel). Such an initiative would require a new level of cooperation and coordination between companies that have fiercely guarded their commercial relationships and would require intense government-corporate interactions. All of the affected companies, however, already have close (if not coordinate) relationships with their national governments, which could be used to ensure cooperation with the proposed new arrangements.

**INTERNATIONALLY MANAGED STOCKS OF FUEL.** The IAEA statute allows for states to donate nuclear materials to the control of the agency, which it can then use as directed by the IAEA Board of Governors. States could transfer the "flag" or ownership of fresh nuclear fuel that could then be transferred by the agency to

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### **OPTIONS FOR PROVIDING GUARANTEED SUPPLIES OF NUCLEAR FUEL (continued)**

states on an economically viable basis. Transfers could be made to the IAEA in lieu of or in addition to voluntary contributions to the IAEA, or seed money could be used to start a cost-neutral program of fuel transfers by the agency. In addition, the IAEA could take possession of stocks in smaller amounts to serve as a backup to commercial contracts. In the event that political, economic, or technical factors led to the end of a fuel supply arrangement, the IAEA could step in, backstopping and thereby guaranteeing continuous supply.

**BLIND AUCTIONS OF FUEL.** Fuel supply guarantees could be provided not to states but to the IAEA, which could then be empowered to conduct auctions among eligible states for the material. This would mean that states or companies would not be in a direct position to deny fuel services, since the fuel would be provided directly to and by the IAEA or some alternate body. Companies might commit (or be persuaded to commit) to provide the IAEA with a certain amount of fuel per year. Providing states would then have to fulfill these commitments, increasing the resilience of the guarantees. A political commitment could also be envisioned under which all such sales were required to go through the IAEA as a form of control and transparency.

**IAEA AS GUARANTOR.** The IAEA could itself provide fuel guarantees to states that had abstained from acquiring fuel cycle

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### **OPTIONS FOR PROVIDING GUARANTEED SUPPLIES OF NUCLEAR FUEL (continued)**

capabilities. In turn, supplying companies or states (or both) would then be required to fulfill IAEA obligations for fuel supply. Leading supplying states could sign agreements with the IAEA to fulfill commitments made by the agency on their behalf.

itself, all the while convincing additional countries that nuclear weapons would be their only protection. A more systematic approach that prevents states within the NPT from acquiring the nuclear infrastructure needed to produce nuclear weapons is the only real sustainable option. Obtaining global acceptance of this new norm will be unlikely, however, even with incentives, so long as existing facilities continue to pursue business as usual.

### **STOPPING CURRENT PRODUCTION**

The United States should work with other countries committed to nonproliferation to end the production of HEU, and to adopt a temporary “pause” in the separation of plutonium.

Under an HEU production ban, uranium enrichment needed for the supply of low-enriched reactor fuel would continue.<sup>54</sup> Institutional measures should be adopted to improve the transparency of operations, and therefore improve confidence that facilities continue to be dedicated only to this purpose. These steps should include application of integrated safeguards, remote detection equipment, and real-time monitoring equipment to detect alterations. Annual national declarations of HEU holdings and production should also be required, as described in the section “Global Nuclear Accounting” below.

Plutonium is more complicated. There is a massive global oversupply of weapon-usable plutonium for both civil and defense purposes. Enough separated plutonium exists to fuel the reactors that need it for several decades. Freezing production would permit the steady drawdown of these dangerous stockpiles.

The pause would require several countries, including the United Kingdom, France, Russia, and Japan, to cease operation at large industrial reprocessing facilities, and would entail significant financial, technical, and political hurdles. It is possible that some of these states, and other key actors such as India, would reject the goal of a moratorium out of hand. Many in the technical community would oppose it, arguing that plutonium use is an efficient energy strategy. Notwithstanding these difficulties, the accumulation of plutonium constitutes such a large global threat in today's circumstances that the security imperative should override other considerations and be vigorously pursued.

The proposed pause would last only until current stocks were sufficiently reduced to allow for resumed production on a just-in-time basis (perhaps twenty to thirty years). States that currently use plutonium-based reactor fuel (known as mixed oxide, or MOX, fuel) would continue to do so, drawing on existing stocks. If they did not have sufficient stocks, they could exchange plutonium-bearing spent fuel for equivalent amounts of plutonium-bearing fresh fuel from states such as France, Russia, or the United States. They could also make use of excess weapons plutonium in Russia and the United States (see below).

In addition to shrinking the global burden of fissile material, a plutonium production pause would facilitate the negotiation of a "Fissile Material Cutoff Treaty" (FMCT)—a verifiable ban on enrichment and reprocessing outside international safeguards.

The pause would ease the establishment of the broader global norm against the domestic acquisition of fuel cycle facilities (see “The Fissile Material Cutoff Treaty and Nuclear Material Recommendations” below). Finally, a pause should be used by states, including the United States and key technical partners, to aggressively pursue technical development of more proliferation-resistant fuel cycles that eliminate the need for plutonium separation. As a further incentive, states that agreed to participate in the pause and other proposed new fuel cycle arrangements could be invited to participate in these research and development programs.

### **THE FISSILE MATERIAL CUTOFF TREATY AND NUCLEAR MATERIAL RECOMMENDATIONS**

Establishing a ban on the production of fissile materials outside safeguards has been a long-time international goal. The general outlines of such an agreement, as previously laid out by the Conference on Disarmament, would still allow the production and accumulation of HEU and the separation of plutonium, albeit under international inspections. The proposed treaty, therefore, would be more permissive than the recommendations contained in the present report. Internationally monitoring the production of weapon-usable materials may be preferable to unaccounted production, but does not reduce the direct risk of nuclear theft or weapons use as much as an HEU ban and plutonium moratorium.

The IAEA could verify such a plutonium production pause if given sufficient resources and access. National technical means of intelligence collection could also be used to build confidence that the pause was in effect. A plutonium production pause is clearly an ambitious goal, as evidenced by the difficulties in negotiating even a ban on non-safeguarded production in the UN-based Conference on Disarmament. The security gain, however, is so great that it justifies the political effort that will be required. It should be emphasized, however, that the goal can only be achieved through a heightened political commitment led by the United States that would make the pause a top security priority.

**Table 4.3. HEU and Plutonium Production Activities**

HEU AND PLUTONIUM ACTIVITY	PROPOSED STATUS
HEU and separated plutonium for nuclear weapons	Terminate in all states
HEU production for ship propulsion	End; convert to alternative LEU fuels
HEU and separated plutonium for reactor operation	End; convert to alternative LEU fuels
HEU production and use for research reactor fuel	End; convert to alternative LEU fuels
HEU production and use for isotope production	End; convert to alternative LEU fuels

Note: HEU, highly enriched uranium. LEU, low-enriched uranium.

Until an HEU ban and plutonium production pause are in effect, steps should be taken to erect high institutional barriers to the misuse of civilian facilities for nonpeaceful purposes. Any state seeking to use peaceful facilities for weapons purposes should be forced to violate numerous legal, political, and economic commitments, raising the costs of such actions. Multinational corporate ownership or various forms of multilateral control would be useful steps in this direction. All types of management would need to adopt stringent measures to control sensitive technologies and ensure the reliability of plant personnel.<sup>55</sup>

### **END THE USE OF FISSILE MATERIAL**

Civil use of HEU and plutonium drives the production and transport of these materials, increasing the risks of diversion by terrorists and giving cover for clandestine nuclear weapon programs by states. *These risks are unnecessary, since there is no inherent technical or economic need for the use of HEU or separated plutonium in any peaceful application.* The choice to use them is just that, a choice. The use of these materials is an exercise of national sovereignty, but one that directly affects the security of other states and should therefore increasingly come under international scrutiny.

The main nonweapon uses for HEU and separated plutonium are in research reactors, nuclear power reactors, and naval propulsion. Technology has progressed to a point where all of these uses are unnecessary.

### ***Plutonium Use in Power Reactors***

The debate over the use of plutonium-based fuels for energy production goes back decades. France, Japan, Russia, and India have made large investments in developing plutonium-based fuel

cycles (known as closed fuel cycles).<sup>56</sup> Other countries, including the United States, have pursued a once-through fuel cycle (known as an open fuel cycle) in which spent fuel is stored and ultimately disposed of rather than reprocessed, thereby avoiding the proliferation risks of separated plutonium.

It is not clear which system (closed vs. open) will prove superior over the very long term with respect to cost, waste management, and security. However, it is beyond question that for the foreseeable future the use and transport of separated plutonium for the civilian fuel cycle greatly increases the risk that terrorists or additional states will acquire the means to produce nuclear weapons.

States clearly have the right to oppose actions that threaten their security. If progress is not made on international fuel cycle management, the United States should consider adopting a simple policy statement to the effect that it opposes the separation of plutonium for civil purposes. The United States should abide by its present commitments to others to allow use of U.S.-origin nuclear material for plutonium-based activities, but should refuse any new commitments.

Comments received on the draft of the present report noted that past U.S. opposition to plutonium use had not produced a global consensus against reprocessing, and that renewed opposition would be unlikely to succeed. Those who made these comments therefore advocated that the United States should endorse and even engage in plutonium use so that it could shape improved international safeguards and security standards related to such use: an “if you can’t beat ’em, join ’em” strategy. These commentators suggested that the United States invest heavily in advanced nuclear reactor research to develop alternatives to the once-through use of nuclear fuel, including reactor concepts

that might involve plutonium separation, as well as research into non-nuclear energy applications. It is not clear, however, how endorsing or engaging in plutonium use could improve America's security. To the contrary, the limited U.S. decision to dispose of excess military plutonium by irradiating it in power reactors has already been used by other countries as justification for their much broader plutonium use. Further active support by the United States would only lead to more, not less, plutonium use, with commensurate risks of theft and diversion. Advanced reactor research would be beneficial if—but only if—it were directed to technologies that did not depend on plutonium separation.

### *Research Reactors*

For more than twenty-five years, the United States has sought to end the civilian use of HEU. Research reactors are the main civil users of this material. On February 11, 2004, President Bush stated that the United States “will help nations end the use of weapon-grade uranium in research reactors. I urge more nations to contribute to these efforts.” These efforts include accepting U.S.-origin research reactor fuel into the United States for disposal and helping Russia do the same with material it exported over the past several decades. The United States is also helping Russia develop low-enriched uranium (LEU) fuels to convert Soviet-era research reactors, just as it has successfully developed fuels to convert the majority of the world's HEU-fueled research reactors of U.S. origin and design.

These efforts, however, are moving much too slowly, and the United States has failed to use all of the tools and leverage at its disposal. Fifty of the 135 research reactors worldwide that continue to use HEU fuel either are in the United States, are of

U.S. origin, or use U.S.-supplied fuel. The United States should pursue a more aggressive and comprehensive policy to end the use of HEU in research reactors worldwide, including in the United States itself. Washington should increase the amount of money spent on developing and testing of new LEU fuels to enable the last few reactors that cannot now convert to do so, and provide technical assistance and financing for reactors that are being shut down or converted to LEU fuels.

The United States should also finance the validation of medical isotope production using LEU. Once this is complete, the U.S. Food and Drug Administration should ban the importation of such isotopes produced with HEU. More broadly, the United States should explicitly prohibit the use of U.S.-origin HEU in any reactor able to be converted to LEU fuel, and once all operating reactors can convert, require the repatriation of all U.S.-origin HEU for disposal. In the meantime, the U.S. Department of Energy should establish the legal authority to bring non-U.S. material to the United States if this is deemed essential for its protection. This can be a time consuming process and should be conducted in advance of any potential operation.

Finally, the United States—working with the G-8—should fund the large-scale return of HEU fuels of Russian or Soviet origin to Russia. This should also include financing of retraining and job creation for reactor operators displaced by reactor shutdowns.

### ***Submarine and Ship Propulsion***

As with the other nonweapon uses, there is no technical need to use HEU on ships. The current generation of naval propulsion reactors could be modified to use specially developed high-

density LEU fuels. Some ships and submarines will be unable to convert at an acceptable cost, however. In those cases, safeguards on the HEU and a stringent accounting system could be applied. Multilateral ownership could apply to fuel management facilities as well. Finally, in the limited cases in which a country could not convert its naval reactors but was willing to close its enrichment plant, an internationally guaranteed fuel supply should be considered, in much the same way as it might be for power reactors.

### **ELIMINATE STOCKS**

Final disposal of weapon-usable materials is the only way to guarantee that they will never be used in a nuclear device. Most of the world's HEU and plutonium is in the United States and Russia, although much smaller but significant amounts of such material exist in a number of other countries as well (see tables 4.2 and 4.4). In the fifteen years since the end of the Cold War, some limited progress on disposal has been made, but the pace of efforts to eliminate weapon-usable uranium and especially plutonium has been unacceptably slow, and their scope unacceptably narrow.

Of the two types of materials—HEU and plutonium—weapon-usable uranium is by far the more solvable, and the more pressing challenge. HEU is easier to use in nuclear weapons than plutonium, although both present an attractive target for terrorists. The United States has agreed to purchase 500 metric tons of weapons-grade uranium from Russia and use the blended down LEU as fuel in power reactors. To date, some 200 metric tons—enough for 8,000 nuclear weapons—has been diluted in Russia and transferred to the United States. But some 300 metric tons of the original purchase target remain in weapon-usable form, to say nothing of the remaining Russian stockpile—which may

**Table 4.4. Stocks of Weapon-Usable Plutonium**  
(in Metric Tons)

STATE	SEPARATED CIVIL PLUTONIUM	MILITARY PLUTONIUM	WEAPON EQUIVALENTS <sup>a</sup>
Russia	38.2 <sup>+</sup>	95 <sup>*</sup>	16,650–33,300
United States	45.05 <sup>+</sup>	49.95 <sup>#</sup>	11,875–23,750
France	47.95 <sup>+</sup>	5 <sup>*</sup>	6,619–13,238
England	70.8 <sup>*</sup>	3.2 <sup>*</sup>	9,250–18,500
Germany	25.6 <sup>*</sup>	N/A	3,200–6,400
Japan	38.6 <sup>+</sup>	N/A	4,825–9,650
China	0 <sup>+</sup>	4.8 <sup>*</sup>	600–1,200
Belgium	1.8 <sup>*</sup>	N/A	225–450
India	1.0 <sup>*</sup>	.36 <sup>*</sup>	170–340
Israel	0	.56 <sup>*</sup>	70–140
Switzerland	2 <sup>*</sup>	N/A	250–500
North Korea	0	<.04	~5–10
Pakistan	0	.04 <sup>*</sup>	5–10

Sources: International Atomic Energy Agency, and Institute for Science and International Security, U.S. Department of Energy.

a These calculations are based on official estimates that it would require 8kg of plutonium to produce a nuclear weapon (IAEA), and a similar estimate from the U.S. Department of Energy that a nuclear weapon could be produced with only 4kg of plutonium.

+ International Atomic Energy Agency

\* Institute for Science and International Security

# U.S. Department of Energy

amount to an additional 500 metric tons under uncertain security. Downblending needs to be accelerated to ensure the fastest possible elimination of this material. Russia and the United States should agree to double the pace from 30 to 60 metric tons of HEU per year.

The plutonium question is much more complex. Unlike uranium, plutonium cannot be easily mixed or mechanically blended down to prevent its use in nuclear weapons. From the dozens of solutions evaluated by the United States and Russia over the past decade, two seemingly viable options emerged—irradiation and immobilization. In 2000, the two countries negotiated an agreement committing each to eliminate 34 metric tons of plutonium using one of the two methods. Russia has relied almost exclusively on irradiation, whereas the United States—until recently—pursued a mixed approach. Despite years of hard work and considerable investment, however, the results have been almost nil. Almost no weapon-origin plutonium has been eliminated in the ten years since the United States began a serious effort to do so. Indeed, the start of actual elimination in both Russia and the United States is still several years away. Moreover, the disposal of 68 metric tons of plutonium, while worthwhile, will only provide a significant security benefit if it marks the start of a much larger process that would include the bulk of weapon-origin plutonium in each country: about 100 metric tons in the United States and 150 in Russia.

It is past time to acknowledge the need to begin again. Fresh and energetic attention needs to be given to plutonium disposal if nuclear weapons are to be kept out of terrorist hands. The United States should reevaluate its entire plutonium disposal program, with a renewed emphasis on securing plutonium under

international monitoring as an intermediate step to elimination. The time line for disposing of the first 68 metric tons of excess plutonium, even under optimistic estimates, stretches out for decades. The intervening period is too long not to require the highest standards possible for interim secure storage.

In Russia, the United States has helped to construct a highly secure facility at Mayak originally intended for storing military-origin fissile material. Russia currently plans to store only 25 metric tons of surplus plutonium there. It should be urged to use the facility's full capacity by storing 200 metric tons of HEU at the facility, pending its downblending to LEU. Washington should drop its objections to storing nonmilitary plutonium, in recognition that disposal is going to take much longer than originally expected. The United States should also consider outright purchase of Russian excess plutonium for storage and elimination in the United States.

### **GLOBAL NUCLEAR ACCOUNTING**

No single international organization or government knows how much weapon-usable nuclear material exists in the world. Some countries do not even have an accurate inventory of their own material. Without an accurate accounting system for nuclear materials, there can be no effective prevention of nuclear terrorism or serious pursuit of nuclear disarmament.

The United States should work to develop a global nuclear accounting and transparency system. While the primary focus should be on weapon-usable material, all states possessing nuclear materials would eventually have to cooperate. The long-term goal would be for all states to maintain an accurate, validated accounting of all nuclear holdings, under international standards

for accounting and transparency. All states would be required to provide a declaration to a central organization or publicly state their holdings. The existing commitment by a handful of states (including the United States and several European states) to make annual declarations of plutonium holdings through the IAEA provides a model that could later be extended with other forms of transparency.

Such a registry would have to be carefully established so that sensitive information—such as the exact location of specific amounts of materials—could remain protected for security reasons, yet declared holdings could be verified. This would be no easy task, since even the amount of nuclear material within their borders is considered highly sensitive information by some countries. The United States has released a comprehensive plutonium inventory and has provided funding for Russia to develop its own accounting of civil plutonium production. However, neither country has declared its HEU holdings. Still, the benefits of establishing a global registry for nuclear materials should prevail over institutional preferences for keeping the numbers classified.

A number of states will need considerable training and assistance to ensure that their accounting practices are compatible with those of more advanced nuclear states. This assistance can easily be provided bilaterally or through the IAEA—if the agency is given the necessary resources.

## **SUMMARY OF POLICY RECOMMENDATIONS**

- ▶ Create a high-level “Contact Group to Prevent Nuclear Terrorism” to lead efforts to improve the security of all weapon-usable nuclear materials. (p. 87)

- ▶ Establish an effective global standard of protection for all weapon-usable fissile materials and create international obligations to protect these materials. (p. 88)
- ▶ Expand and enhance the G-8 Global Partnership program to improve nuclear security assessments, upgrades, and material relocation. (p. 89)
- ▶ Accelerate and increase funding for the Global Threat Reduction Initiative to secure and relocate vulnerable nuclear materials worldwide within four years. (p. 89)
- ▶ Seek an internationally endorsed ban on production of HEU and a decades-long moratorium on the separation of additional weapon-usable plutonium. Aggressively pursue proliferation-resistant fuel cycle concepts that avoid plutonium separation. (p. 91)
- ▶ Provide guaranteed, economically attractive fuel services to states that do not enrich uranium or reprocess plutonium, and consider ways to place existing facilities under new institutional controls. (p. 94)
- ▶ Reevaluate and re-prioritize the U.S.-Russian plutonium disposal program, with a renewed emphasis on securing plutonium under international monitoring. (p. 107)
- ▶ Develop a global nuclear accounting and transparency system. (p. 108)

## **Threat Reduction**

The Nunn-Lugar Cooperative Threat Reduction Program, to dismantle and secure nuclear, chemical, and biological weapons in Russia and the former Soviet Union, has been a remarkably cost-effective investment in U.S. security. Hundreds of ballistic missiles

have been dismantled, thousands of nuclear warheads have been retired, enough nuclear material for thousands of nuclear weapons has been eliminated, and enough for thousands more has been secured. In addition, thousands of nuclear, chemical, and biological weapons experts have received the means to begin transforming their careers from military to civilian work.<sup>57</sup>

Although the discussion here will focus on Russia, efforts are under way to expand the scope of this type of cooperation to proliferation problems in other regions. Three strategic issues confront the programs. First, how can progress be accelerated with Russia and the other former Soviet republics? Second, how can more partners, including Russia, be effectively engaged? Third, how can the experience that has already been gained be extended to other countries and regions where proliferation of nuclear and biological weapons is a concern?

These issues are intertwined, and they have major implications for U.S. policy. For example, accelerating progress with Russia requires engaging more international partners in the work. However, to this point the United States has been the top funder of the threat reduction programs, and therefore has not had to share management of the activities with other countries. Adding more countries, including Russia, to the decision-making mix might initially slow rather than accelerate progress.

Likewise, much work remains to be done in Russia, and extending such cooperation to other countries and regions threatens to drain resources away from this top priority. Therefore, although an urgent need for new threat reduction programs could emerge in countries such as Iran and North Korea, demands for new projects and funding in these countries must be carefully balanced with requirements of the continuing work in Russia.

A partial answer to these problems has been to establish an initiative within the G-8, the Global Partnership against the Spread of Weapons and Materials of Mass Destruction. The G-8 leaders launched this effort at Kananaskis, Canada, in June 2002, to cooperate on nonproliferation, disarmament, counterterrorism, and nuclear safety issues.<sup>58</sup> The United States pledged \$10 billion to the initiative over ten years, and the other G-8 partners pledged to match this amount.

Initially focused on Russia, the Global Partnership is considering expanding its work to new countries, including Ukraine, Uzbekistan, and Georgia. Additional partners such as Norway and Sweden have already joined and become actively involved in funding high-priority projects such as submarine dismantlement in Russia. More partners such as Finland, the Netherlands, Poland, Switzerland, Australia, Belgium, the Czech Republic, Denmark, Ireland, South Korea, and New Zealand joined in 2003 and 2004.<sup>59</sup> This process should continue to expand the number of countries open to threat reduction cooperation and the number of partners willing to contribute to this work.

The hardest challenge, of course, is to convince states that are “proliferation problems” to engage. Their leaders tend to believe that their nuclear programs are necessary to their national security, sometimes in a regional context, sometimes against a perceived adversary such as the United States, which possesses superior military forces. To succeed in this context, threat reduction cooperation must be part of an effort to draw the country out of its isolation and into the international system, thus changing its perception of its national interests and how best to preserve its national security.

To extend the reach of threat reduction initiatives, a new strategy will be needed. The experience gained in the former

Soviet Union should be used to tackle proliferation problems in new regions, but important differences must also be taken into account. Russia, for example, a nuclear weapon state under the Non-Proliferation Treaty, had a high degree of technical expertise that immediately enabled its scientists to engage on an equal footing with their U.S. counterparts. From the earliest days of threat reduction work, Russian experts contributed their knowledge as well as hardware they had created to implement projects in material protection, control and accounting, and other areas. A country such as Libya, by contrast, would find it more difficult to do so—thus creating, potentially, a more one-sided assistance relationship than that which developed with Russia.

Most important, to succeed in other settings, threat reduction will have to succeed in Russia. At the current pace, many of the stockpiles in Russia would remain insecure at the end of this decade, after almost twenty years of work.<sup>60</sup> Insecure stockpiles of nuclear weapons and related materials, technologies, and expertise in Russia pose urgent security risks, especially in a world in which al Qaeda maintains that acquiring such weapons is a “religious duty.” In March 2004, Director of Central Intelligence George Tenet told Congress again that “Russian WMD materials and technology remain vulnerable to theft or diversion.”<sup>61</sup>

Unfortunately, progress in joint U.S.-Russian threat reduction programs—led primarily by the U.S. Departments of Defense, Energy, and State—has been slow in recent years. Whether one judges by the percentage of Russian nuclear warheads and weapon-usable materials secured, the amount of fissile material destroyed, the number of facilities converted to commercial production, or the number of new permanent jobs created for weapon scientists, *it is evident that less than half of the overall threat reduction mission in Russia has been completed.*<sup>62</sup>

The biggest impediments to progress are political, not technical or financial. In fact, key programs for securing nuclear warheads and weapon-usable nuclear materials have accumulated hundreds of millions of dollars in unexpended balances. If, however, there were sufficient high-level U.S. and Russian commitments, including at the presidential level, to break through obstacles, then more money would be needed to implement an accelerated effort.

While approximately \$1 billion per year is being made available for Russia and former Soviet republic threat reduction programs, a number of lower-profile threat reduction efforts should be accelerated in the near term by making additional funding available. These include programs for redirecting weapons scientists, purchasing additional quantities of downblended Russian HEU, repatriating additional quantities of Soviet-origin HEU fuels to Russia for secure storage,<sup>63</sup> converting research reactors that use HEU, consolidating Russian nuclear material in fewer facilities, developing controls on exports, and investing in long-term sustainability strategies for security equipment that has already been installed.

Other high-priority proposals for improving the pace of U.S.-Russian cooperation include, first, establishing a senior coordinator, or focused coordination team, within the White House that has the mandate to oversee, prioritize, and expedite threat reduction programs. This person or group must be more powerful than the current interagency working groups and must have unfettered access to the president and his senior advisers.

The United States and Russia could also create a system of performance-focused meetings between high-level U.S. and Russian political officials to evaluate threat reduction progress, receive reports from program managers on advances and problems in each program, and negotiate solutions to such problems.

Moreover, both the Russian and American presidents should agree to (1) designate securing and eliminating nuclear, chemical, and biological weapon stockpiles as a top priority for both countries' national security and (2) set a target date of 2008 for completing comprehensive security upgrades of all nuclear weapons and weapon-usable material in Russia.<sup>64</sup> The two presidents would further agree to undertake specific measures to break through procedural logjams, and the Russian side would commit to maintaining security systems after U.S. assistance has been phased out.

The specific stumbling blocks that require presidential attention are disputes over U.S. access to sensitive Russian facilities, liability in nonproliferation agreements, and visa policies and procedures for Russian and U.S. threat reduction personnel.

The U.S. executive branch should also work with Congress to get permanent authority to waive the annual certifications required for cooperative threat reduction programs and the specific conditions on constructing a chemical weapons destruction plant in Russia.<sup>65</sup>

## **SUMMARY OF POLICY RECOMMENDATIONS**

- ▶ Develop a strategy to extend threat reduction cooperation to new countries and regions, building on experience in Russia and the former Soviet republics. (pp. 112–113)
- ▶ Expand the number of target countries and partners participating in the G-8 Global Partnership program. (p. 112)
- ▶ Engage President Bush and his Russian counterpart, Vladimir Putin, to establish cooperation as a top policy priority and resolve stumbling blocks to implementation. (p. 114)

- ▶ Launch a fast-paced initiative, in partnership with Russia, to fully protect Russian nuclear weapon–usable material by 2008. (p. 115)
- ▶ Establish a senior coordinator, or focused coordination team, within the White House with a mandate to oversee, prioritize, and expedite threat reduction programs. (p. 114)

## **Stopping Transfers: Export Controls and Interdiction**

Effectively controlling sensitive exports will continue to be a critical part of any successful nonproliferation regime. As international trade and technology expand, export controls on sensitive nuclear-related materials must be strengthened and fully implemented. The Bush administration has made international enforcement of export controls a high priority, and has identified several useful methods to encourage all states to tighten their national export control laws and policies.<sup>66</sup> These include a proposal to make the export of sensitive nuclear technology contingent on acceptance of the IAEA's Additional Protocol. In addition, the Bush administration led efforts that resulted in the adoption of Security Council Resolution 1540, which requires all states to enact laws to criminalize proliferation and to establish effective export controls.

Working to improve the effectiveness of existing export control systems, however, requires more than creating new obligations. Steps must be taken to improve the reach and effectiveness of the existing regime and to improve coordination among the various overlapping export control systems.

### **EXPAND THE SCOPE OF EXPORT CONTROL REGIMES**

The scope of the A. Q. Khan network demonstrates the need to draw new states into international efforts to control sensitive nuclear

technologies.<sup>67</sup> Many of the countries involved in providing or transshipping technology to Iran, Libya, and North Korea are not part of any of the existing export control arrangements. All states possessing nuclear-relevant technology should be brought under the umbrella of these regimes. States that can play even a small role in providing or transshipping key assets need to ensure they do not assist would-be nuclear proliferators. Several states with advanced nuclear capabilities, including Pakistan, India, North Korea, and Iran, are not members of the Nuclear Suppliers Group or the Zangger Committee;<sup>68</sup> nor are they all likely to be invited to join.<sup>69</sup> The traditional policy of export control regimes has been to regulate the transfer of technology to these states rather than seek to stem the export of technology from them. But states can be brought into compliance with these systems, even if they do not formally join.

Security Council Resolution 1540 on nonproliferation requires all states to “establish, develop, review and maintain appropriate effective national and trans-shipment controls” and “border controls” to prevent the proliferation of nuclear, chemical, and biological weapons and their means of delivery.<sup>70</sup> States must enact “appropriate laws and regulations to control export, transit, trans-shipment and re-export” of materials that would contribute to proliferation.<sup>71</sup> This resolution not only encompasses states with nuclear technology, it also places the burden of export control on non-nuclear states such as Dubai and Malaysia that may serve as shipping ports and manufacturing sites for proliferation-related activities.

How will this new export control requirement be implemented? One approach would be to promote a model law on export controls that would aid states in adopting the export systems

required by the Security Council. The United States and Europe have pursued such an approach with varying success in the states of the former Soviet Union. Similarly, the IAEA provides such models for nations implementing nuclear safeguard agreements. A model law could be drafted to strengthen reporting requirements under existing export control regimes such as the Nuclear Suppliers Group that could be adopted even by nonmembers. To increase the chances of its universal adoption, the law could also be attached on a national basis to existing customs law and policy, under the guidance, for example, of the Unified Tariff Code of the World Customs Organization.

Yet adopting laws is not the same as effectively controlling exports. Pakistan was unable or unwilling to enforce its nuclear security laws against A. Q. Khan and his associates.<sup>72</sup> And even if this one network is disbanded, sustained international cooperation and observation, including the sharing of information on suspected violations, will be required if the full potential of Resolution 1540 is to be reached. Regular reviews of implementation of the resolution will be required.

### **IMPROVE EXISTING REGIMES AND MEMBER PERFORMANCE**

Proliferation-related export controls are currently governed by four different arrangements: the Nuclear Suppliers Group, the Missile Technology Control Regime, the Australia Group, and the Wassenaar Arrangement. Of these, the Nuclear Suppliers Group and the Wassenaar Arrangement have the most application to nuclear and dual-use issues. While all of these regimes have been useful in regulating trade in sensitive technologies, they have several shortcomings.

First, these groups operate by consensus, which impedes the adoption of new measures and biases the groups toward the lowest common denominator. Expanded membership, including nonsuppliers or members with divergent security interests, exacerbates this problem. Also, member states lack transparency in their export control systems and decision making and are inefficient at information sharing. This problem is compounded by the fact that member states have not harmonized their individual policy responses to proliferation threats and are not keeping pace with growing proliferation problems. Members are failing to deal effectively with increased dual-use trade and technology transfers. Finally, the systems are hampered by their voluntary nature and lack of enforcement and penalization measures. If export control systems are to be effectively implemented in an expanded threat environment, states need to be open and to be held accountable for their export decisions. Moreover, the actions of a few resistant states should no longer be allowed to impede the capabilities of the entire system.

Several options exist for dealing with these challenges, including moving the export control systems to a majority or weighted voting system to replace consensus rule. There is likely to be considerable internal resistance within these voluntary systems, which needs to be recognized and overcome.<sup>73</sup> This is clearly a case in which high-level leadership will be required to achieve results.

In addition, the regimes need to improve membership criteria and make commitments more binding, with an emphasis on timely compliance.<sup>74</sup> The introduction of penalties and incentives for adoption and maintenance of high standards should be considered, but cooperative measures such as assistance and collaboration should be emphasized to maximize cooperation.<sup>75</sup>

Also, current practice only calls for states to share decisions to deny requests for exports between member states. Sharing information on export approvals would help states track what others are buying and might help identify strategic but dispersed purchases by suspect firms and states. To this end, a centralized database for information sharing should be established among participant states.<sup>76</sup>

To improve the conduct of expanded export controls, many participating states may need assistance and advice. Leading states, including the United States, should head periodic reviews of export controls in other countries. Such reviews should be pursued cooperatively, and the G-8 or individual countries should provide assistance as needed after reviews are completed.<sup>77</sup> (See “Strengthening International Law” in chapter 3.)

In addition, the Nuclear Suppliers Group should adopt two policy changes its members are currently considering: making the IAEA Additional Protocol a condition of supply for nuclear exports and adding “catch-all” provisions to the Nuclear Suppliers Group dual-use guidelines. Under this latter condition, members would have to control the export of any item, regardless of whether it appeared on the control lists, if there were a risk that the export could contribute to proliferation. This would eliminate the need to maintain an exhaustive list of controlled items.<sup>78</sup>

The forum for reviewing these ideas needs to be at a sufficiently high level to enable action, but expert enough to effectively evaluate proposed measures. One option is to ensure that the implementation of Resolution 1540 includes follow-up reporting on the requirements for export controls. A strengthened Security Council monitoring committee for Resolution 1540 might be useful in this role.

This report has also been greatly influenced with regard to export control reforms by the work done by experts at the University of Georgia Center for International Trade and Security. They have developed a set of recommendations to reform and improve current technology controls.

The University of Georgia experts recommend adopting a new and strengthened Export Administration Act (EAA). The EAA expired years ago, and Congress has failed to renew it because of concerns over how to balance the interests of industry with national security imperatives. The lack of an export control law limits the ability to penalize companies that violate U.S. export controls. In addition, University of Georgia experts call for the expansion of export control assistance to emerging supplier states and key transit states. This should be done in conjunction with broader assistance to states in meeting obligations of Security Council Resolution 1540 by establishing minimum international export control standards.

Furthermore, negotiations are needed among member countries to establish a unified and strengthened nuclear, chemical, and biological weapons and ballistic missile export control regime with more binding and precise commitments, including enhanced information sharing, and more robust export enforcement authorities. The current multilateral control regimes are ill equipped to deal with growing global trade in dangerous technologies and to respond to proliferators that are becoming more sophisticated in their acquisition patterns.

The experts at the University of Georgia also note the need to promote greater corporate compliance with nonproliferation norms and export controls by establishing an international code of compliance for exporters of sensitive materials and technologies.

Companies that trade nuclear and dual-use technologies represent the first line of defense in efforts to stem proliferation. Responsible companies have internal compliance programs to ensure that they are screening end users and observing export control regulations. But because many firms remain ignorant of national export control requirements, violations and transfers result that raise proliferation concerns.

Finally, the need to assist the IAEA in implementing the export and import reporting requirements of the Additional Protocol is also noted by the experts at the University of Georgia as an important step in improving export control implementation.

### **ENHANCE INTERNATIONAL INTERDICTION EFFORTS**

Efforts to block the transfer of weapons and technology have recently been enhanced through the creation of a broader forum for information sharing and interdiction under the U.S.-led PSI (see “Proliferation Security Initiative,” page 123 for more detail). The PSI has resulted in significant progress in a brief period of time, with member states recently seizing valuable shipments of weapons equipment to several countries. However, it has significant limits. While the initiative is a valuable extension of export control implementation, it is not and cannot be a silver bullet to prevent proliferation to terrorists or states.

The PSI regime is voluntary. It encompasses only states that choose to abide by its provisions, meaning that states seeking banned equipment can circumvent restrictions by avoiding shipments from or through the territory of participating states. Moreover, the regime is limited only to the national territory, airspace, and territorial waters of participants. It does not apply directly to international waters. Countries under whose flag a ship is traveling

## PROLIFERATION SECURITY INITIATIVE

Based on the informal and voluntary cooperation of more than a dozen countries, the Proliferation Security Initiative seeks to enhance the ability of national governments to prevent the transfer or transit of weapons-related materials and equipment through their national territories, territorial waters, and airspace, and to cooperate with other states in doing the same.

Initiative-related activities fall into three main areas:

- (1) enhancement of national legislation in participating states to ensure that shipments of controlled items can be searched or seized (or both) under national authority
- (2) intelligence sharing and law enforcement cooperation to identify illicit transfers
- (3) interdiction training, exercises, and actual intercepts in nationally controlled areas (land, sea, and air)

Members include United Kingdom, France, Germany, Italy, Spain, the Netherlands, Poland, Portugal, Australia, Japan, the United States, Canada, Norway, and Singapore. More than sixty states have pledged their support for the Proliferation Security Initiative.

can give permission for that ship to be stopped and searched, and the United States has worked out prior consent arrangements with the two countries most popular with shippers seeking flags of convenience, Liberia and Panama. Still missing, however, is a system that can deal with a legally flagged vessel or aircraft carrying weapons-related material or technology through international territory from nonparticipating countries.

The question of extending PSI activities to suspect shipments in international waters or airspace raises complicated legal issues. The Law of the Sea Treaty (to which the United States is not a full party) permits what is known as innocent passage for ships through national waterways, a provision that would appear to apply to such commerce. This gap in the PSI is a glaring potential problem that apparently can only be remedied through an expansion of international law, by means of either a convention or a Security Council mandate. The international community, however, can be empowered to interdict certain types of shipments in international territory when specific activities—such as slavery—are deemed unacceptable.

How can the international community define what is and is not acceptable, with respect to technology or even weaponry? How can the international community differentiate between banned and permitted transfers? The most direct route would be for the PSI to build out from its current membership through the negotiation of a legal convention. The goal of building an international norm banning clandestine transfers of materials relevant to nuclear proliferation is worth the investment in time and political capital that would be needed.

## **SUMMARY OF POLICY RECOMMENDATIONS**

- ▶ Expand membership in and compliance with export control regimes to all states with relevant capabilities. (p. 117)
- ▶ Expand export control assistance to emerging supplier states and key transit states. (p. 121)

- ▶ Reform existing export control regime operations by requiring notices of all sensitive exports, moving away from consensus rule making, establishing cooperative reviews of export control implementation, and considering penalties within export control systems for noncompliance. (pp. 119–120)
- ▶ Make the IAEA Additional Protocol a condition of supply for all Nuclear Suppliers Group transfers. (p. 120)
- ▶ Pass a new and strengthened U.S. Export Administration Act. (p. 121)
- ▶ Establish an international code of compliance for exporters of sensitive materials and technologies. (p. 121)
- ▶ Expand the scope of the PSI to cover shipments through international waters and airspace. (p. 124)
- ▶ Ground the PSI in international law by means of a UN Security Council Resolution. (p. 124)