

# Nuclear Smuggling: Patterns and Responses

RENSSELAER LEE

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“The most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons-usable materials in Russia could be stolen and sold to terrorists or hostile nations and used against American troops abroad or citizens at home.”

— Secretary of Energy Advisory Board, January 2001

Political and economic upheavals over the past decade have weakened the ability of Soviet successor states to monitor and control their potentially dangerous nuclear assets. A strong theoretical possibility exists—and has existed for some time—that nuclear material and even complete weapons could be removed from insecure stockpiles, trafficked abroad, and sold to virulently anti-Western states and groups.

Several factors underscore the significance of this threat. One is the enormous quantity of former Soviet fissile material stored outside of weapons—some 600 to 650 tons scattered among 300 buildings at more than 50 nuclear facilities.<sup>1</sup> According to standard calculations, only six to eight kilograms of plutonium and 15 to 25 kilograms of highly-enriched uranium (HEU) are needed to make an implosion-type nuclear bomb; hence, even minor leakage episodes could provide the makings of a major proliferation catastrophe.<sup>2</sup> (The required amounts could be greater or less, depending on the design of the device and the engineering skills of the producer.) A second factor relates to reputedly lax physical security and accounting systems at many nuclear weapons enterprises. A third is the depressed economic situation of employees in parts of the nuclear complex, reflected in relatively low pay, a shrinking social safety net, and uncertain professional prospects. These factors are widely believed to constitute a prime source of proliferation danger on the supply side. A fourth concern, frequently cited by US authorities, is that outside adversaries such as Iraq, Iran, and the al Qaeda organization have made efforts to acquire nuclear weapons or sufficient materials and expertise to make

them. There seems little doubt that Russia's vast and troubled nuclear complex has been a target of such attempts, although adversaries also may have looked to other nuclear-armed states (such as Pakistan) to supply their weapons of mass destruction (WMD) requirements.

Finally, existing US nuclear security programs have only modestly reduced the nuclear proliferation threat from Russia and other newly independent states (NIS). The basic US approach has been twofold: to contain the threat at the source with technological fixes and procedural norms—"to build better fences around nuclear facilities" in the words of a former Department of Energy (DOE) official familiar with the programs<sup>3</sup>—and to improve export control regimes, including NIS border defenses against nuclear smuggling. The new systems, though, still do not extend to many facilities, and adversaries with sufficient resources and the right connections could easily exploit the gaps in them. Also, insider corruption and economic hardship can erode the deterrent value of even the advanced safeguards being introduced, possibly paving the way for serious proliferation episodes. Additionally, the extraordinary length of Russia's border with neighboring countries, which runs some 12,000 miles, underscores the immense challenge of preventing clandestine exports of nuclear goods from that country.

In surveying the condition of nuclear security in the new states, the question arises whether hostile states or groups already have acquired ingredients of nuclear weapons (or the weapons themselves) and from where and in what quantities. No clear answers are available, although there is much speculation. An international black market of sorts for radioactive substances developed in the aftermath of the Soviet collapse, but it provides few clues. Confirmed smuggling cases involving weapons-usable material are few and far between, and traffickers in these instances have had no obvious links to customers. Yet, as with drugs and other illicit commodities, what is seized may represent only a fraction of what has been shipped; needless to say, an interdiction rate substantially below 100 percent for stolen weapons-grade uranium or plutonium would raise serious security concerns for the United States and for the West generally. Furthermore, supply and demand vectors might have converged in ways that are simply beyond the present capabilities of Western authorities to monitor and detect. As argued in this article, the relatively innocuous visible traffic might conceal a shadow market that is organized on the initiative of the buyer or end-user and oriented toward meeting the latter's specific military requirements.

Such concerns highlight the need for new approaches to the problem of nuclear security in the former Soviet states. On the one hand, the current contain-

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Rensselaer Lee is a contract researcher for the Congressional Research Service on homeland security, international terrorism, and organized crime. His most recent books are *Smuggling Armageddon: The Nuclear Black Market in the Former Soviet Union and Europe* (St. Martin's, 1999) and *The Andean Cocaine Industry* (St. Martin's, 1998).

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ment focus of US policy should be enlarged to better confront demand-side challenges such as monitoring adversaries' weapons programs and disrupting their WMD procurement networks—nuclear deals-in-the-making, as it were—inside Soviet successor states. For the longer term, Washington needs to fashion a demand-reduction strategy—that is, explore new options for curbing the international appetite for nuclear weapons. A variety of options—economic, diplomatic, and military—might come into play here; and implementing them will require a nuanced and differentiated vision of aspiring nuclear actors and (in the case of nation-states) a greater appreciation of strategic motivations and regional security dynamics.

### ***Supply and Demand***

Both supply- and demand-side factors operate to exacerbate proliferation pressures in Russia and the other newly independent states. The disintegration of the USSR and its “guards, guns, gates, and gulags” machinery of totalitarian control made privatized nuclear deals both thinkable and possible. An ongoing economic crisis there during most of the 1990s, combined with shrinking government orders for nuclear goods, had severe repercussions within the nuclear weapons complex. Insufficient attention was paid to protective regimes for nuclear materials; according to various Western and Russian accounts, perimeter walls and fences disintegrated, guard forces were downsized, security alarms stopped functioning, and materials accounting systems fell into disarray.<sup>4</sup>

More important, the economic downturn virtually destroyed the Soviet-era lifestyle of employees of nuclear facilities, heightening the risk of illegal nuclear deals. While the overall Russian economy has improved in recent years, conditions in the nuclear sector still are problematic. As a July 2001 Department of Energy *Strategic Plan* notes, “Many nuclear workers who in the past were part of the Soviet elite now live under difficult conditions because wages are often delayed and the quality of available food, housing, and medical care has declined.”<sup>5</sup> Reports of numerous strikes and work stoppages organized in response to these conditions underscore the widespread economic malaise that pervades the nuclear complex. Such grim circumstances increase the odds that insider personnel could be tempted to steal and sell nuclear materials to which they have access, especially if presented with a genuine offer for such wares.

Various contextual factors add to the atmosphere of uncertainty. A principal concern relates to the general unraveling of authority in Russia during the Yeltsin years. Political turmoil, widespread official corruption, the ascendancy of organized crime, and weakened central control over the provinces created new types of threats—for example, that corrupt regional bosses might conspire with criminally inclined managers to sell fissile materials abroad, or that “*mafija*” formations with inside connections might broker illegal nuclear deals. Admittedly, a strong law-and-order focus and recentralizing tendencies have been apparent in the first years of Vladimir Putin’s administration, and security at Russia’s nuclear

installations reportedly has been tightened.<sup>6</sup> Whether, or to what extent, such tendencies will reduce the risk of proliferation from Russian stockpiles, though, remains to be seen.

Further contributing to supply-side pressures is Russia's international behavior in the nuclear realm. Of particular concern is its long-standing nuclear relationship with Iran, which involves billions of dollars in current and future contracts for nuclear reactors and related technology and equipment. At certain points in the relationship, considerations of commercial gain have outweighed concern for proliferation risks. In 1995, for instance, Russia signed a protocol to sell a centrifuge plant for uranium enrichment to Iran. (It backed off under US pressure.) In 2000, a controversy erupted over a plan by a Russian Ministry of Atomic Energy component to sell Iran equipment intended for Atomic Vapor Laser Isotope Separation, also used for uranium conversion; that deal has been held up after US objections.<sup>7</sup> No evidence exists that the Russian government is deliberately selling fissile materials or bomb design technology to Iran, but US officials worry that the broader technical cooperation between the countries will open a Pandora's box of nuclear proliferation problems. For example, in October 2000 an Assistant Secretary of State for Nonproliferation told the Senate Foreign Relations Committee of "our concern that the Bushehr [reactor] project would be used by Iran as a cover for maintaining wide-ranging contacts with Russia's nuclear entities and for engaging in more sensitive forms of cooperation with direct applicability to a nuclear weapons program."<sup>8</sup>

On the demand side, the market for nuclear weapons components, unlike that for other illicit commodities, is narrow and rarefied. Nevertheless, a handful of anti-Western states with nuclear weapons programs and a few relatively well-heeled terrorist organizations appear to have joined the nuclear procurement game. For instance, the above-mentioned DOE report states, "Iran, among others, has tried to exploit Russia's nuclear security problems by attempting to acquire fissile materials." The cancellation of deals with Russia to purchase uranium enrichment technology may have lent urgency to such efforts. (Reportedly, Iran and Iraq maintain active networks of front companies and espionage agents inside Russia to advance their weapon procurement objectives.) Iraq also is said to be interested in purchasing nuclear materials, even though its multi-tiered agenda to develop atomic weapons was set back as a result of the Gulf War. Another nuclear-level state, North Korea, ostensibly halted plutonium extraction from spent fuel under a 1994 agreement with the United States, but recently admitted to having a clandestine uranium enrichment program. North Korea conceivably could continue to circumvent the agreement by acquiring HEU or plutonium covertly from foreign suppliers.<sup>9</sup>

With respect to terrorists and other non-state actors, the picture is somewhat murkier. Acquiring nuclear weapons capability clearly would be a difficult undertaking for such organizations. Unlike nation-states, terrorists cannot leverage official contacts and exchanges in the nuclear realm to advance military

procurement objectives. To maintain facilities for enrichment or reprocessing of fissile materials is probably out of the question. Whether terrorists could obtain the requisite weapons design expertise to manufacture a fission bomb (or to decode the elaborate safety devices of an illegally obtained one) is uncertain, although they may have tried to do so. For instance, reports have surfaced of contacts between Osama bin Laden and Pakistani nuclear scientists Sultan Bashiruddin Mahmood and Abdul Majid in which “long discussions” about nuclear, chemical, and biological weapons took place. During those meetings bin Laden reportedly said that he had acquired some type of radiological material from the Islamic Movement of Uzbekistan and wanted to know how to use it. The discussions, though, are described by Pakistani authorities as “academic”—i.e., not yielding information that resulted in “creation or production of any type of weapon.”<sup>10</sup>

It’s more likely that terrorists’ weapons of mass destruction would be chemical or biological weapons, which by most accounts are easier and cheaper to make than nuclear ones. For example, the Japanese cult Aum Shinrikyo experimented with chemical and biological agents and, as is well known, used the nerve agent sarin in a deadly attack on the Tokyo subway in March 1995. US intelligence sources in March 2002 reported discovery of a laboratory under construction in Afghanistan in which al Qaeda planned to develop biological agents, including anthrax.<sup>11</sup>

Even so, we can’t dismiss the possibility that terrorists could gain access to a nuclear device. A widespread consensus exists that nuclear terrorism scenarios would involve so-called radiological dispersal devices (RDD), which produce a conventional explosion designed to spread radioactive contamination over a wide area and to sow panic. RDDs present fewer technical challenges in manufacture than do fission weapons, and the source materials (such as spent reactor fuel and radioisotopes used in industry and medicine) are present in dozens of nations. Some reports suggest that Osama bin Laden’s al Qaeda might have sought ingredients for such devices. For instance, an October 2001 British newspaper account states that a bin Laden emissary in Pakistan offered visiting Bulgarian businessmen \$200,000 to set up a legitimate environmental firm to buy radioactive waste from an atomic power plant in Bulgaria.<sup>12</sup> In May 2002, an American al Qaeda follower was arrested by US authorities and accused by the Justice Department of “exploring a plan to build and explode” an RDD in the United States with the connivance of top al Qaeda leaders in Afghanistan and Pakistan.<sup>13</sup>

Bin Laden, if he is still alive, might have more exalted nuclear ambitions as well. A US federal indictment handed down in 1998 charges that beginning in 1993 al Qaeda members “made efforts to procure enriched uranium for the purpose of developing nuclear weapons.” It specified that the attempts were made “in the Sudan and elsewhere.” A November 1998 indictment of Osama bin Laden et al. refers to attempts “at least as early as 1993” to obtain the components of nuclear weapons. Later US court testimony by an al Qaeda turncoat referred to the latter’s role in helping to broker a deal in Khartoum in 1993 or 1994 in which

al Qaeda operatives intended to buy a cylinder of what was purported to be enriched uranium for \$1.5 million; whether or not the deal went through is unclear.<sup>14</sup> Al Qaeda is said to have made other attempts to acquire nuclear materials in the 1990s, for example in Germany, but these attempts cannot be documented.

Accounts of varying credibility also point to efforts by terrorists to purchase finished nuclear weapons from inside the former USSR. The Aum Shinrikyo cult apparently harbored such intentions. Documents seized from the cult's "construction minister," who had visited Russia extensively in the early 1990s, contained the ominous notation, "How much is a nuclear warhead?" and listed several prices, though whether these references reflected actual negotiations was not clear. In the same vein, a Moscow news source reported that the Islamic Jihad organization, shortly after the collapse of the USSR, faxed a letter written in English to the Russian Federal Nuclear Research Center at Arzamas-16, offering to buy a single nuclear warhead and specifying "the parameters, the sum of the transaction, and the mode of shipment." Whether the incident was an elaborate hoax, intended perhaps to cause confusion in the West, or an incredibly obtuse solicitation by real terrorists cannot be determined with certainty. Finally, several media sources credit al Qaeda with attempting to buy, or even successfully obtaining, tactical or portable nuclear arms through contacts in Kazakhstan and Chechnya. For instance, a lurid story in the Paris-based *al Watan al Arabi* in November 1998 asserted that bin Laden concluded a deal with the "Chechen mafia" to buy 20 tactical nuclear warheads for \$30 million and two tons of Afghan opium. It seems unlikely that the Chechens had any such weapons to sell; nevertheless, the possibility that al Qaeda might rely on the services of ideologically sympathetic criminal organizations to promote its WMD objectives should not be ruled out.<sup>15</sup>

### ***Contours of the Nuclear Black Market***

Successful nuclear smuggling is largely a matter of establishing connections between likely end-users and would-be sellers of strategic nuclear material. As noted, rogue states and possibly terrorists are actively seeking nuclear bomb components and bomb-making technologies. On the supply side, employees of moribund nuclear design and fabrication plants and other troubled facilities might see theft and sale of fissile material as an alternative to economic ruin for their enterprises and their families.

Hard evidence of such a buyer-seller connection, though, barely exists, at least in the public domain. The Vienna-based International Atomic Energy Agency (IAEA) reports that more than 400 cases of nuclear trafficking occurred worldwide between January 1993 and December 2001—an impressive statistic on the face of it. The bulk of this flow, however, involved radioactive junk (contaminated scrap metal, low-grade uranium, cesium-137, and the like), which is useless in making fission weapons. Only 18 seizures of highly-enriched uranium and plutonium were recorded in the IAEA database. A report by the US General



Accounting Office, drawing on the IAEA and other sources, records 20 such cases, which totalled 8.7 kilograms of uranium-235 equivalent and 400-plus grams of plutonium, not enough to build an atomic bomb.<sup>16</sup>

Furthermore, the nuclear black market, such as it is, does not follow the pattern of conventional criminal businesses. The market as a whole is populated by amateur criminals, scam artists, and (on the demand side) undercover police and police decoys. Bona fide buyers are conspicuously absent, even in the handful of cases where weapons-usable substances are proffered. Significantly, the two highest-profile smuggling incidents in the 1990s, the seizure of almost a pound of plutonium in August 1994 and of 2.7 kilograms of HEU probably originating in the same Russian laboratory the following December in Prague, were both artifacts of undercover police stings.

In its visible manifestations, the nuclear black market thus seems fairly innocuous—more a minor international nuisance than a clear and present proliferation danger. This is taken by some as a cause for optimism. As a US expert on Russian nuclear security problems wrote in a Summer 2001 article in *The Non-proliferation Review*, “As we look back over the decade since the collapse of the Soviet Union, the good news is that nothing terrible happened within the Russian nuclear complex in spite of the terrible times faced by the Russian people.”<sup>17</sup>

Yet the observed reality of the nuclear traffic may not accurately reflect the pattern of the traffic as a whole. The elements of a true market, so far undetected by Western observers, may, in fact, already be in place. (A US intelligence system that failed to detect and warn against the meticulously planned and coordinated terrorist attacks of 11 September 2001 also might fail to uncover a sophisticated conspiracy to smuggle militarily significant quantities of nuclear material out of Russia.) Indeed, who knows whether or not something “terrible” might have happened? In a revealing 1998 incident suggestive of a highly unstable security climate, the Russian Federal Security Service (FSB) foiled an attempt by “staff members” of a nuclear weapons plant in Chelyabinsk province to steal some 18.5 kilograms of what was believed to be highly-enriched uranium, possibly within the technical range for a workable atomic bomb. It is not clear where the material was headed or who the customer was. Also unclear is how much material might have been stolen and transferred before the FSB clamped down on the conspiracy.<sup>18</sup>

In other words, the actual design and extent of the illicit market for nuclear goods are largely a mystery. Still, a useful framework can be developed for comparing the visible supply and demand market with the hypothesized shadow market of functioning buyer-supplier connections. An initial assumption here is that the impetus for such connections is more likely to come from the demand side than the supply side. Some published information, as well as my own impressions drawn from numerous visits to Russia, suggest that would-be sellers inside the nuclear complex (especially in the rarefied and isolated environment of Russia’s formerly secret cities) generally lack the marketing savvy and outside

contacts to pursue successful deals on their own. In the 1990s, according to different accounts, desperate Russian managers resorted to asking visiting foreign specialists to help find international buyers for HEU or plutonium. “I was asked if I knew any Western company [that] would want nuclear material,” recalls one British engineering consultant.<sup>19</sup>

In a demand-side model, by contrast, the buyer or buyer’s agent comes to the seller. Adversaries would plan and organize a clandestine effort to obtain what they want rather than relying on stray bits of material to be stolen from laboratories and subsequently appear on the international black market. Also, a state planning to deploy nuclear warheads or missiles would want weapons-grade uranium or plutonium, enriched to more than 90-percent uranium 235 or plutonium 239; what fissile material does circulate through smuggling channels is generally of a lower standard. Additionally, an adversary such as Iran could use an umbrella of legitimate nuclear purchases from Russia to pursue a variety of illegal nuclear deals with respective suppliers. The elements of a sophisticated nuclear procurement chain—legitimate-seeming front companies, corrupt nuclear managers and officials, and smuggling stratagems to circumvent or overpower border defenses—might function for some time without being detected.

### ***A Demand-Driven Smuggling Model***

A proactive procurement strategy probably would be structured along the following lines.<sup>20</sup> The end-user or its agents would need to select among prospective suppliers, say the 50-odd nuclear sites in the former USSR. In addition to finding what materials are stored where, the adversary would need some idea of overall economic conditions and the state of security controls at different target sites (information on unpaid wages and morale problems, prior histories of nuclear theft, and susceptibility of individual employees to bribes or blackmail would be of use here). The next step is to craft an approach to the target. If this is a sensitive nuclear facility, a legitimate pretext and probably an official invitation would be required to gain entry.

The third and most critical problem would be to recruit inside collaborators at the site who could supply the desired materials. High-level officials from the region or the superordinate ministry might have to be brought into the scheme. The partners would then need to negotiate sales terms and financial arrangements. A condition of full payment almost certainly would include certification (chemical assay) of a sample of the nuclear material by a reputable Russian or Western laboratory. Issues such as choices of currencies, banks, and transfer modalities would have to be resolved.

Finally, a well-designed support structure would be needed to transport the stolen materials from the target facility to their ultimate destination. Experienced middlemen would be employed for this purpose. An array of sophisticated smuggling techniques is available; for example, interspersing the material with legally tradable radioactive isotopes, using false customs documentation, con-



|                                     | <b>High End</b>   | <b>Low End</b>  |
|-------------------------------------|---|---|
| <b>Item</b>                         | Weapons-grade HEU, plutonium, or equivalent; possibly a finished weapon   | Radioactive junk, sub-weapons-grade material  |
| <b>Certification</b>                | Definitely  | Mostly none or faked  |
| <b>Inside Conspirators</b>          | Responsible managers, probably plant director and senior staff  | Mid- or low-level employees   |
| <b>Smugglers</b>                    | Front companies, officials with access to government transport, organized crime formations  | Amateurs, part-timers, scam artists   |
| <b>Market Characteristics</b>       | Demand-driven, highly organized, stable product flows   | Supply-driven, fragmented, few real buyers  |
| <b>Shipping Methods</b>             | Sophisticated: concealment in legal radioactive cargo, in shipments of bulk or semi-finished metals, or export via diplomatic luggage                   | Unsophisticated: minimal concealment, often in suitcases or with personal effects                                     |
| <b>Official Cover or Corruption</b> | Possibly extensive, depending on amount of material diverted; payoffs to local authorities, security officials, and ministry officers might be required | Infrequent and episodic   |
| <b>Routes</b>                       | Transcaucasus: Turkey, Central Asia   | Various European and Asian routes   |
| <b>Detection Probability</b>        | Low: deception and corruption prevail   | High: thieves caught by enterprise security, smugglers manage to irradiate themselves, or they fall into police traps |

Figure 1. High-End vs. Low-End Nuclear Smuggling

cealing it in bulk metal cargo, or shipping it out in diplomatic luggage, which is seldom checked by the authorities. Consignees outside the NIS might take possession of the material—for example, an import-export firm in Dubai’s Jebel Ali free-trade zone—and then re-export it to a Middle Eastern buyer.

The distinction between high-end and low-end nuclear smuggling scenarios is drawn in Figure 1. The low-end scenario is equivalent to the visible supply-driven black market described earlier. The high-end represents an end-user-driven procurement chain. Current US nuclear containment efforts in Russia and other post-Soviet states are not designed to counter such operations, which in any case are likely to be well-concealed. Nevertheless, the chains would

leave traces—such as records of invitations and visits, unexplained changes in lifestyles of plant employees (the \$60-a-month engineer who sports a new Mercedes), or just loose conversation by the schemers themselves—that could be uncovered by a comprehensive and well-focused human intelligence effort.

### *Policy Issues*

Washington's nuclear security policy toward Russia and the other new states is supply- and containment-oriented, focused on shoring up security at nuclear installations and (secondarily) at NIS border crossings and on checking the dissemination of militarily significant nuclear knowhow. Representative of the approach is a DOE program aimed at improving "materials protection, control, and accounting" (MPC&A) at 95 NIS storage locations for fissile materials and Russian naval warheads. The Energy Department touts MPC&A as "the nation's first line of defense" against the proliferation danger represented by leaky Russian stockpiles.<sup>21</sup>

This description, though, is not entirely reassuring. As of year-end 2001, roughly ten years after the collapse of the USSR, only half of the 600-odd tons of fissile material potentially at risk was protected in some fashion by the new systems. DOE projections call for fully safeguarding all of the material by 2008.<sup>22</sup> Yet opportunistic nuclear criminals might not obligingly wait until all nuclear sites were MPC&A-ready before initiating a major nuclear diversion, so the strategic rationale for the program diminishes as the timeframe for completing it lengthens. The sluggishness of the program to date is attributable to "bureaucratic inertia, bolstered by mistrust and misperception on both sides," as two keen observers note. An additional factor might be weak administration by DOE itself, which until the end of 1999 put more than half of every dollar spent on MPC&A into the US national laboratories providing oversight instead of into the Russian laboratories and enterprises themselves.<sup>23</sup>

Furthermore, DOE's hard technical fixes will not necessarily deter theft even where they have been introduced. The program is best designed to thwart spontaneous theft attempts by solitary employees, who perhaps are collaborating with groups of criminals on the outside—admittedly a fairly common pattern in Russia in the 1990s. However, collusive relations among well-placed insiders (those able to shut down alarm systems, bribe guards, and alter relevant paperwork) can defeat most internal safeguards. The possibility of a consensual "company" decision by top managers to sell off fissile material stocks likewise "is simply beyond the capacity of security systems being installed to effectively address," according to an authoritative 2000 study by the Russian-American Nuclear Security Advisory Council (RANSAC) in Princeton, N.J.<sup>24</sup>

Washington is also trying to build complementary lines of defense against nuclear smuggling—by training and equipping NIS customs officials to intercept radioactive contraband at airports and border checkpoints. Various US government agencies are involved in this effort, including DOE, the State and De-

fense Departments, and the Customs Service. Improved border surveillance is a desirable complement to MPC&A, at least in theory. Yet the task is daunting by any standard. Russia's frontiers with Georgia, Azerbaijan, and Kazakhstan alone—perhaps the most likely conduits to Middle Eastern states and groups of concern—run nearly 5,000 miles, partly through inhospitable terrain traditionally inhabited by bandits and narcotics traffickers. Even with sophisticated radiation monitors installed at main transit points across Russia's vast southern tier, interdiction successes are likely to be episodic and partial. Furthermore, the detection equipment has distinct technical limitations. While DOE's more advanced equipment can pick up neutron emissions from lead-shielded plutonium, HEU—which basically has a weak neutron signature—cannot be detected easily if properly shielded. Such realities suggest that US border activities in the NIS might be more effective in measuring general patterns and trends in nuclear smuggling than in intercepting serious smugglers with the technical expertise and the knowledge of the terrain to move their wares covertly.

Limitations of containment are also reflected in several US and international initiatives to prevent dissemination of nuclear intelligence and other WMD knowledge from NIS weapons establishments. Programs such as “The Initiatives for Proliferation Prevention” (IPP) and the “Nuclear Cities Initiative” (NCI) focus on creating civilian jobs and research opportunities for former Soviet weapons specialists who might otherwise contemplate selling their expertise to Iran, Iraq, or North Korea. Some of these specialists reportedly are workers on commercial projects or are employed on part-time contracts for US national weapons laboratories. Also, efforts are under way to attract foreign investment to Russia's formerly secret cities. It is not clear, though, how many of the estimated 20,000 NIS scientists with nuclear weapons expertise have benefited and to what extent, and in any case the economy of the nuclear sector by many accounts still is deeply depressed.<sup>25</sup> Additionally, foreign investment may be a two-edged sword, facilitating the process of defense conversion but also possibly allowing adversaries' representatives to set up commercial fronts in close proximity to major centers of nuclear activity.

For instance, according to a recent Carnegie Endowment survey, in 1999 the average pay of a nuclear worker in Russia's formerly closed cities was a miserable \$43 per month, and 66 percent of the specialists surveyed reported having to supplement their salaries with outside work. Salary conditions in certain nuclear facilities have improved markedly since then. (For instance, in Sarov, formerly Arzamas-16, the average monthly salary reportedly reached \$150 in 2001.) Nevertheless, some nuclear specialists seeking greener pastures already have departed from Russia, mostly for Western Europe, the United States, and Israel. Whether any have headed for the three main countries of proliferation concern (Iran, Iraq, and North Korea) is not clear from available data. Yet Russia's international technology transfers to countries such as Iran and India are accelerating the drain of WMD expertise and risk undercutting the US nonproliferation effort.<sup>26</sup>

Furthermore, scientists who remain in their home bases in Russia can easily supply nuclear or ballistic missile designs to foreign clients via the Internet. Military knowledge is universally difficult to contain within national boundaries. If America could not prevent its own closely held atomic secrets from gravitating to the Soviet Union in the 1940s, and apparently to China in the past decade, how can it possibly expect to keep Iran or Iraq from obtaining nuclear bomb-making specifications from an unemployed Russian scientist, even one receiving stopgap assistance from the United States?

### ***Rethinking the Problem***

Advocates of current US nonproliferation programs in the NIS attribute their deficiencies to inadequate funding and resources. The total US outlay for MPC&A and “anti-brain-drain” efforts was roughly \$1 billion from 1993 to 2000, which seems insufficient given the enormous scale of Russia’s proliferation problems. Increased funding to accelerate the pace of the programs thus has a certain face validity. Concern over the terrorism threat also is strengthening the advocates’ case. In the Emergency Supplemental Appropriations Bill for FY 2002, Congress increased funding for MPC&A and export control-border security programs from a requested \$193 million to \$383 million, and also added an additional \$15 million to the NCI and IPP (combined into a single Russian Transition Initiative) for a total of \$57 million. A 2001 report by a DOE-sponsored bipartisan task force called for expenditures of up to \$30 billion on nuclear safety measures in the NIS, including \$5 billion for MPC&A, over the next eight to ten years, to be financed jointly by the United States, other Western nations, and Russia.<sup>27</sup> Proposals also have been advanced in Congress and elsewhere to swap some of Russia’s \$147 billion in external debt for proliferation prevention projects in that country. In such a scheme, Russia would underwrite a fund in local currency to finance such projects, and management responsibility for the fund would be shared with representatives of creditor nations. (Whether Russia would agree to such a power-sharing arrangement is another question.)

The limitations of the US supply-control approach to nuclear security, though, also need to be spelled out. Spending more money on protection regimes—walls, fences, alarms, radiation detectors, inventory controls, and the like—would not close the now partly open proliferation window in the NIS. As already suggested, clever adversaries and their inside collaborators can find various ways to defeat or circumvent the new systems; also, the problematic state of the nuclear economy increases the range of potential suppliers of strategic nuclear goods. Containing the spread of nuclear intelligence, while eminently desirable, is an intrinsically difficult objective, given the A-bomb’s long history and the variety of channels through which military secrets can be disseminated.

Furthermore, reviewing the assumptions of MPC&A and other US programs, the United States should consider the experience of supply-side programs in other fields—most notably in the failed US international war on drugs. In that

sphere, Washington provides the funding and agenda for a multitude of efforts elsewhere in the world, but has had little success in countries whose own leaders lack the political will to control lucrative narcotics exports. Similarly, nonproliferation programs that emanate from Washington may well be headed for defeat if NIS governments are too weak or corrupt to keep their own nuclear houses in order, or if they place a low priority on nuclear security. Besides, Moscow's own evaluation of the significance of the nuclear proliferation threat differs from Washington's, as its cozy, commercially-driven relationship with Iran seems to suggest.<sup>28</sup>

Viewed from almost any perspective, the stationary lines of defense that Washington is establishing in the NIS do not add up to an adequate response to the threats of nuclear smuggling and nuclear terrorism. The United States, together with its allies, needs to fashion a more dynamic security policy—one that goes beyond containment, or at least broadens the definition of it. Specifically, a reconfigured policy should focus significantly more attention and resources on the demand side of the proliferation equation, on the machinations and intentions of the adversaries themselves.

An immediate priority is to detect and, if possible, disrupt adversaries' WMD procurement operations—demand-driven smuggling chains—within the former USSR. Not a great deal currently is known about such activities—how they are organized and financed, what front companies, criminal groups, and other intermediaries are used, which specific suppliers have been targeted, what smuggling pipelines have been established, and so on. Yet such information is of vital importance; the United States cannot implement a credible nuclear security policy in the NIS in a vacuum, without reference to adversaries' weapons programs, procurement plans, and prospective targets. Furthermore, where leakages of nuclear materials or weaponry have already occurred, intelligence is potentially a key to identifying the perpetrators and the recipients, and to devising necessary countermeasures.

A demand-side threat reduction policy would presuppose an international intelligence and law enforcement undertaking of unprecedented magnitude. A *sine qua non* would be closer collaboration between US and other intelligence agencies and Russia's own security services, especially in exchanging information on terrorists' WMD acquisition plans inside the former USSR. Opportunities for cooperation may well be expanding, given the current pro-Western orientation of the Putin government and the blossoming Moscow-Washington relationship in the aftermath of 9/11. A vehicle for advancing intelligence-sharing might be the newly formed US-Russian Working Group on Terrorism, which last summer issued a statement stressing the importance of cooperation against the "threats posed by nuclear, biological, and chemical weapons."<sup>29</sup> Nevertheless, Russia and other NIS countries have different interests from the United States, as well as differing assessments of the nuclear proliferation threat; hence, expanding a unilateral US capability to collect nuclear intelli-

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***“A reconfigured policy should focus significantly more attention and resources on the demand side of the proliferation equation.”***

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gence may be of central importance. Conditions inside Russia’s formerly secret cities, as well as in proliferation-sensitive transit zones, would be of particular interest. A spectrum of groups—nuclear insiders, scientists who have worked abroad, traders in metals and military goods, and even professional criminals—might be tapped in a comprehensive collection effort. Ideally, a well-designed effort would provide advance warning of covert nuclear deals; failing that, it might pick up clues (such as sudden displays of wealth by low-salaried nuclear employees) that a smuggling conspiracy already was afoot.

Finally, a new nonproliferation concept must emphasize demand-reduction—influencing the will of adversary nations and groups to prevent the spread of nuclear weapons capacity. As Senator Joseph Biden, then Chairman of the Foreign Relations Committee, remarked in a June 2001 speech to the Carnegie Endowment, “Why is proliferation such a hard issue? Because demand breeds supply; just as with narcotics, countries that want weapons of mass destruction are usually fairly desperate or convince themselves that they are.”<sup>30</sup> By extension, if adversaries already are stockpiling nuclear materials (not exactly a remote possibility, given the largely open proliferation window in Russia), then the imperative is to prevent them from building and deploying a nuclear arsenal.

In contemplating demand-reduction there is no “one size fits all” policy. An array of economic, diplomatic, and military options could come into play, the choice of which could depend on the nature and motivations of the adversary’s leadership, the state of its WMD programs, its external behavior, and other considerations. In general, though, policies emphasizing negotiations and engagement offer more promise of reducing the nuclear danger, at least in the long run, than those emphasizing containment or confrontation. Excluding designated states from the international community reinforces their perceived strategic rationale for nuclear and other WMD programs; also, preemptive military action—though a short-term necessity in certain cases—could well heighten the craving of small states for a nuclear deterrent of their own. Engagement with terrorists probably can be ruled out; the nuclear threat from al Qaeda and its ilk must be dealt with by other means. Yet with nation-states of concern, the possibility exists of a strategic dialogue to reverse or limit their nuclear arms programs. Instead of merely punishing these states, this approach would incorporate positive incentives—relaxation of



sanctions, improved political ties, and perhaps targeted economic assistance—to promote the de-nuclearization objective.

In fact, this approach already has been tried. The model case was the US-North Korean Agreed Framework of 1994, which effectively halted the North's plutonium production program and subjected the known associated facilities to IAEA inspection. The principal quid pro quo was an international contribution of more than \$4 billion to North Korea's energy sector. Also, the signatories agreed to reduce barriers to trade and to open liaison offices in each other's countries. The agreement was imperfect in certain respects and, according to Pyongyang's recent admissions, it did not definitively halt Pyongyang's nuclear designs.<sup>31</sup> Still, the Agreed Framework reportedly cut off a major line of nuclear weapons development. (By 1994, the North Koreans already had extracted sufficient plutonium to build one or two bombs, according to US intelligence experts.)

At this point, the future of the Agreed Framework is highly uncertain, and the Bush Administration recently announced a decision to suspend oil shipments to North Korea called for under the agreement. Yet some US observers, such as incoming Senate Foreign Relations Committee Chairman Richard Lugar, believe that "creative diplomatic solutions" are needed to prevent production of nuclear weapons by North Korea. Coercive alternatives to negotiation, such as bombing suspected nuclear sites, are widely viewed as extremely risky. (The possibility that such action could precipitate an all-out war on the Korean Peninsula looms large in US calculations.) Conceivably, diplomatic and economic pressure from the United States, Russia, China, South Korea, and Japan might convince the North to rethink its nuclear objectives, though this remains to be seen.<sup>32</sup>

The question is raised whether US critical dialogue with North Korea could serve as a model or process for addressing possible dangers from other aspiring nuclear states. The most obvious case in point is Iran, which today makes little secret of its WMD ambitions and which is said to operate active procurement networks for nuclear-related materials in Russia and elsewhere. According to recent US and Israeli intelligence reports, Iran could be three to five years away from producing a nuclear bomb.<sup>33</sup> Iranian-US relations warmed temporarily in the context of the recent US military campaign against a common enemy, the Taliban regime in Afghanistan; further interaction concerning political reconstruction in Afghanistan, US war plans vis-à-vis Iraq, and other issues could provide opportunities for opening a dialogue with the Iranians on nuclear matters.<sup>34</sup>

The case for engagement and dialogue in Iraq, which still harbors expansionist designs in the Middle East, is admittedly weaker; yet current international sanctions against Iraq are not particularly effective—they help to legitimize Saddam Hussein's regime while doing little to restrain his nuclear ambitions. Saddam's ouster may well be a prerequisite for the elimination of nuclear, biological, and other WMD programs that are alleged to exist in Iraq. A policy of constructive engagement is not necessarily incompatible with the objectives of promoting internal political change in Iraq (and in other rogue states

as well) and of fostering the emergence of more moderate leaders willing to forego such programs; yet as of this writing Washington is actively contemplating military intervention to oust Saddam, pending the outcome of United Nations inspections in Iraq.

Certainly the demand-side strategy outlined here is not without risk. Bringing rogue states more fully into the international community will be a protracted process involving difficult negotiations and trade-offs. Reversing nuclearization will doubtless require large infusions of Western money, as the North Korea case suggests. The use or threat of military force as a last resort cannot be excluded along the way. The rogue states' military programs and procurement efforts would have to be constantly monitored and evaluated, which in itself will require a significant upgrading of US intelligence capabilities. But in confronting proliferation there are no risk-free alternatives. If current containment regimes in Russia and elsewhere are pursued without simultaneous progress in reducing international demand for nuclear arms, the world will become less secure even as nuclear weapon stockpiles in the United States and Russia are reduced.

#### NOTES

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26. Valentin Tikhonov, *Russia's Nuclear and Missile Complex: The Human Factor in Proliferation* (Washington: CEIP, 2001), pp. 27, 42; "Former Atomic Minister Plays Down Possibility of Passing Nuclear Material Abroad," ITAR-TASS News Agency, 23 November 2001; Fred Weir, "Once-Secret Russian Research Hive Opens for Business, Offering Commercial Spinoffs," *The Christian Science Monitor*, 29 May 2001, p. 8. In contrast to Sarov, the average salary of specialists in Obninsk, a nuclear center near Moscow, was only \$60 a month in 2001. On technology transfers, see CIA, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions; 1 January through 30 June 2001*, <http://www.insidedefense.com/secure/specials/cia-wmd.htm>.

27. William Hoehn, "Analysis of the Bush Administration's Fiscal Year 2003 Budget Request for U.S.-Former Soviet Union Nonproliferation Programs," RANSAC, Washington, D.C., April 2002, pp. 1-10; Howard Baker and Lloyd Cutler, "A Report Card on the Department of Energy's Nonproliferation Programs with Russia," DOE, The Secretary of Energy Advisory Board, Washington, D.C., January 2001, Appendix A.

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29. Joint Press Statement by the U.S.-Russia Working Group on Counterterrorism," Office of the Spokesman, Annapolis, Md., 27 July 2002.

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31. Robert Litwak, *Rogue States and U.S. Foreign Policy* (Washington: Woodrow Wilson Center Press, 2000), pp. 218-19, 274-76. Under the agreement the United States would oversee a consortium to construct two light water reactors "of proliferation-resistant design" and to supply 500,000 tons of fuel oil to the North annually while the reactors were being built. The original target date for the reactors was 2003, but this has been moved back. In return the North would freeze and dismantle graphite-moderated reactors that produced spent fuel (from which plutonium could be extracted) and also seal its plutonium reprocessing facility.

32. David Sands, "Lugar to Pursue N. Korea Nuke Deal," *The Washington Times*, 19 November 2002, pp. A1, A14.

33. "Nyet to Nukes for Iran," *The Boston Globe*, editorial, 3 December 2001; see also Carnegie Endowment for International Peace, *Proliferation News*, 4 December 2001, <http://www.ceip.org/npp>.

34. Litwak, p. 248; David Rogers, "Iran, an Old Nemesis, Has Become an Important New Ally for the United States," *The Wall Street Journal*, 31 October 2001, p. A6. Of course the designation of Iran by President Bush as a constituent member of the "axis of evil" may have shut the door on better US-Iranian relations for the time being.

Smuggling of migrants affects all regions of the world. Different areas are affected to varying degrees. This Study describes some 30 smuggling routes, from internal African routes towards North and Southern Africa, to Asian routes towards Europe and the Middle East, or to wealthier countries in South-East Asia and the Pacific. From the Mediterranean sea routes, to land routes between Latin America and North America; and from the myriad air passages usually undertaken with counterfeit or fraudulently obtained documents, to hazardous overland journeys across deserts and mountains. In this paper, a spatial information-theoretic model is proposed to locate sensors for detecting source-to-target patterns of special nuclear material (SNM) smuggling. In order to ship the nuclear materials from a source location with SNM production to a target city, the smugglers must employ global and domestic logistics systems. This paper focuses on locating a limited set of fixed and mobile radiation sensors in a transportation network, with the intent to maximize the expected information gain and minimize the estimation error for the subsequent nuclear material detection stage. A Kalman filter for Criminal entities can be seen forming new bonds, with trafficking routes intersecting and zones of influence shifting - consequently, an unusual level of criminal involvement in nuclear smuggling is observed, alongside a geographic shift of smuggling patterns. In addition, states seeking materials and technologies for their military programs have taken a notable interest in this region as a way of circumventing international transit regulations. The article looks at the likely implications of these new nuclear smuggling trends for the security of the Baltic states. It suggests that Lithuania m