DISPROVING A CONVENTIONAL WISDOM: WHY NUCLEAR TERRORISM ORIGINATING FROM RUSSIA IS A MYTH

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Bilyana Tsvetkova

DISPROVING A CONVENTIONAL WISDOM: WHY NUCLEAR TERRORISM ORIGINATING FROM RUSSIA IS A MYTH

In his speech in Prague on April 5, 2009, President Barack Obama reiterated the widely accepted fear that “terrorists are determined to buy, build or steal” a nuclear bomb. Since the end of the Cold War it has often been asserted that nuclear weaponry and nuclear material from Russia’s vast nuclear arsenal remains a likely target for such terrorists. Furthermore, based on available information Russia is considered to be the country with the highest risk of nuclear theft. In contrast, this paper argues that the current preoccupation with Russia as a source of nuclear weapons and material for potential use in a nuclear terrorist attack is exaggerated and highly improbable for the following reasons:

- improved supply security in Russia;
- lack of established trafficking networks;
- insufficient demand; and
- difficulties in producing and delivering nuclear weapons.

Many experts and policymakers believe that nowadays nuclear terrorism poses an existential threat to the Western world. Smuggling nuclear weapons or nuclear material out of Russia is considered to be one of the options for terrorists aiming to acquire nuclear capabilities. Although hard to estimate, based on available information, in November 2008 Russia was reported to be the country with the highest risk of nuclear theft. Immediately following the demise of the USSR, former USSR nuclear stockpiles were seen as a major cause of concern because they were spread out across four Former Soviet Union (FSU) states causing difficulties of command and control. Programs aimed at consolidating the nuclear weapons of FSU states have proven to be very effective and consolidation within Russia of some 30,000 to 40,000 nuclear weapons has successfully taken place. After significant reductions under the provisions of the 1991 Strategic Arms Reduction Treaty (START) and the 2002 Strategic Offensive Reductions Treaty (SORT, also known as the Moscow Treaty), as of January 2009, Russia’s nuclear arsenal amounts to 3,909 nuclear warheads. Regardless of this progress, Russia remains the country possessing the world’s largest amount of nuclear weapons and materials, located in the world’s largest number of bunkers and buildings, estimated at approximately 250. It is estimated that as of October 2009, Russia possesses between 735 metric tons (MT) and 1,365MT of weapons usable highly enriched uranium (HEU) and between 106MT and 156MT of military-use plutonium. Many experts believe that these nuclear weapons and material are still vulnerable because of inadequate security at storage sites and a lack of government commitment to, accountability for, and monitoring of existing nuclear weapons and material. Additionally, deplorable economic conditions facing Russian nuclear scientists and workers in Russia’s closed nuclear cities are believed to compel individuals to clandestinely steal and sell nuclear knowledge or material for personal profit.
Contrary to these beliefs, by conducting a systematic analysis of the existing evidence this paper argues that the current preoccupation with Russia as a source of nuclear weapons and material for potential use in a nuclear terrorist attack is exaggerated for the following reasons: improved supply security in Russia; lack of established trafficking networks; insufficient demand; and difficulties in using nuclear material to produce and employ nuclear weapons.

First, international initiatives and aid programs spearheaded by the United States have been largely effective in bolstering the security and storage of Russian nuclear weapons and nuclear material. Programs such as those put in place by the U.S. National Nuclear Security Administration (NNSA), the U.S. Department of Energy (DOE) and the U.S. Department of Defense (DOD), agreements between U.S. and Russian presidents and initiatives such as the “Megatons-to-Megawatts” program have greatly reduced the likelihood of smuggling nuclear materials by securing the nuclear material and weapons sites within Russia and on the territory of all FSU states. By mid-2008 as much as 75 percent of the buildings that contain weapons-usable nuclear material on the whole territory of all FSU states have been secured.11 By June 2009, these programs had achieved almost full success in upgrading the security of the Russian nuclear sites with nuclear weapons and nuclear material. Therefore, the budget requested for these programs for fiscal year (FY) 2010 has decreased. It is projected that in the future the funding for these projects will experience a gradual and steady decline as the planned work in Russia is close to completion.12 Additionally, since the end of the Cold War, Russia has had effective monitoring mechanisms in place but they are often ill-understood and underestimated by U.S. experts seeking to safeguard Russian nuclear material.

Second, there is no evidence to support the claim that an established and stable trafficking network designed to smuggle nuclear weapons or material out of Russia exists. There is no proof of Russian organized criminal activity in this area as most attempted trafficking is undertaken by amateur individuals who are relatively inexperienced and unsuccessful.13 Illicit trade of this nature involves substantial risk and opportunity cost leading to an apparent unwillingness on the part of established smugglers to enter this unprofitable and risky business.

Third, the demand side of this equation seems to be quite weak. According to existing evidence and analysis, there appear to be only a limited number of states, groups, or individuals worldwide who desire to purchase nuclear weapons or material, and little conventional wisdom on how to proceed in any attempt to acquire such material. Additionally, much of the perceived demand side consists of state police and intelligence services conducting sting operations in an effort to prevent the flow of nuclear materials. The historical record shows that there is not one single reported case of a nuclear weapon having changed hands for money.14 Though the A.Q. Khan network was active during the 1970s and 1980s in supplying information, technology, and equipment necessary to conduct uranium enrichment to governments willing to pay for it,15 this is very different than acquiring and selling a nuclear device, something that even this network did not do. It is often said that the International Atomic Energy Agency’s (IAEA’s) confirmed cases represent only a minute picture of the reality of the trafficking situation and that we should fear what we do not know. However, an evenhanded approach demands that we review the existing facts and information in an attempt to avoid exaggeration of such fears.

Fourth, would-be nuclear terrorists face significant obstacles in seeking to produce and employ nuclear weapons. Though many experts claim that it is not hard to construct a nuclear device, this does not seem to be a compelling argument when one considers that potential terrorists would only have access to much of the necessary knowledge and equipment in the event of having a state sponsor willing to assist in the development of such weapons. It is unlikely that any state would view the benefits of harboring a terrorist group on its territory, and assisting such a group in developing a nuclear device, as outweighing the costs imposed by the international community once such a device is employed and, ex post, linked to the aforementioned state. Before presenting each of these arguments in detail, the paper will provide a brief technical background on nuclear weapons that will prove essential in conducting an analysis of the significance of the nuclear smuggling threat from Russia, and nuclear terrorism in general.

**TECHNICAL BACKGROUND**

Nuclear devices function through one of two processes: fission or fusion. Fission is the most commonly used process and is often the first process pursued when a state or other group desires to construct a nuclear device because it is simpler and requires less industrial
infrastructure than the fusion process. Fusion devices are commonly known as thermonuclear or hydrogen bombs and, as they are significantly harder to produce, will be excluded from the currently presented discussion.

In constructing a fission bomb, the two most important issues to determine are the type of nuclear material and explosion mechanism to use. Both of these considerations have ramifications for terrorist groups seeking to construct such a device because there are difficulties in smuggling certain types of material and complexities in engineering techniques requiring access to industrial machinery, resources, and know-how. There are two types of widely used explosion mechanisms in fission bombs, a gun-type mechanism and an implosion-type mechanism, and two types of fuel material, plutonium and highly enriched uranium (HEU). An implosion-type mechanism is a more complex device requiring specialized equipment and advanced engineering techniques and is believed to be beyond the capability of non-state actors. A gun-type mechanism is relatively simple and requires less specialized technical knowledge to build. This weapon type is only suitable for use with HEU as a fuel source and requires a minimum of 50kg enriched to 90 percent or more. As will be apparent later, this is quite a large amount of nuclear material when compared with confirmed accounts of previous smuggling activity.

Due to its highly radioactive nature and the technical requirements for producing a nuclear bomb with it, plutonium is not likely to be used by non-state actors to produce a nuclear device. HEU is seen as the preferred fuel material for a terrorist organization seeking to build a nuclear weapon because of its user-friendly properties. It is not immediately dangerous, is only mildly radioactive, can be handled with bare hands or transported in a backpack and will pass through most radiation monitors undetected. Additionally, it is the only alternative for use in the relatively less technologically advanced gun-type method of detonation.

There is an inverse relationship between the level of enrichment and the amount of HEU needed to reach the critical mass necessary to create fission. Weapons-grade HEU contains more than 90 percent of the fissionable isotope U-235 and, at this level of enrichment, only 25kg of HEU are necessary to reach critical mass if the technologically more advanced implosion-type mechanism is used. For instance, uranium enriched to the 20 percent level would require about a ton of HEU to reach critical mass. The relationship between level of enrichment and critical mass is extremely important when evaluating the danger of smuggled nuclear material and its usefulness in building a nuclear device.

TRAFFICKING BACKGROUND

According to the IAEA Illicit Trafficking Database, since the end of the Cold War until the beginning of 2008 there had been over a thousand confirmed cases of trafficking and other unauthorized activities in nuclear and radioactive material. However, the vast majority of these incidents have been determined to be false alarms or have involved nuclear material in such small amounts or such low quality as to allow no possibility for use in the production of a nuclear weapon. According to the most recent data available from the IAEA, between 1993 and the beginning of 2008 there were 1340 confirmed cases of trafficked nuclear material of some description. However, only 18 of these cases have involved plutonium or HEU (see Figure 1). Of these 18 cases, two involved the accidental loss of small amounts of nuclear material and one case involved the discovery of trace amounts of HEU on a pipe in a steel mill and thus cannot be considered cases of theft or trafficking. This suggests a total of 15 confirmed cases of unauthorized possession and trafficking of nuclear material globally between 1993 and the beginning of 2008. Regarding the HEU cases on this list, the enrichment levels are unknown, making it difficult to ascertain whether this material was weapons-usable or not. However, what is clear from this information is that the combined total of all the material smuggled globally since 1993 is far less than the amount of nuclear material that would be needed to construct a single nuclear weapon, and that only 1.3 percent of all confirmed cases of unauthorized possession and trafficking of nuclear material involved the material necessary for constructing nuclear weapons.

Not only has there not been very much nuclear material trafficked from Russia after the end of the Cold War, it is also interesting to note that IAEA most recently available data until 2007 indicates a steep decline in nuclear smuggling even after 1995 (see Figure 2).

Given the wealth of nuclear weapons and material present in Russia after the dissolution of the USSR and the significant public attention this issue has received, it is worthwhile investigating the
**Figure 1. Confirmed Trafficking Incidents of Plutonium and HEU, 1993–2007**

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Material Involved</th>
<th>Incident Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 24, 1993</td>
<td>Vilnius, Lithuania</td>
<td>150g HEU</td>
<td>4.4t of beryllium including 140kg contaminated with HEU were discovered in the storage area of a bank</td>
</tr>
<tr>
<td>March, 1994</td>
<td>St Petersburg, Russian Federation</td>
<td>2.972kg HEU</td>
<td>An individual was arrested in possession of HEU, which he had previously stolen from a nuclear facility. The material was intended for illegal sale</td>
</tr>
<tr>
<td>May 10, 1994</td>
<td>Tengen-Wiechs, Germany</td>
<td>6.2g of plutonium</td>
<td>Plutonium was detected in a building during a police search</td>
</tr>
<tr>
<td>June 13, 1994</td>
<td>Landshut, Germany</td>
<td>0.795g HEU</td>
<td>A group of individuals was arrested in illegal possession of HEU</td>
</tr>
<tr>
<td>July 25, 1994</td>
<td>Munich, Germany</td>
<td>0.24g of plutonium</td>
<td>A small sample of PuO₂–UO₂ mixture was confiscated in an incident related to a larger seizure at Munich Airport on August 10, 1994</td>
</tr>
<tr>
<td>August 10, 1994</td>
<td>Munich Airport, Germany</td>
<td>363.4g of plutonium</td>
<td>PuO₂–UO₂ mixture was seized at Munich airport</td>
</tr>
<tr>
<td>December 14, 1994</td>
<td>Prague, Czech Republic</td>
<td>2.73kg HEU</td>
<td>HEU was seized by police in Prague. The material was intended for illegal sale</td>
</tr>
<tr>
<td>June, 1995</td>
<td>Moscow, Russian Federation</td>
<td>1.7kg HEU</td>
<td>An individual was arrested in possession of HEU, which he had previously stolen from a nuclear facility. The material was intended for illegal sale</td>
</tr>
</tbody>
</table>

(Continued overleaf)
### Source:

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>HEU Quantity</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 6, 1995</td>
<td>Prague, Czech Republic</td>
<td>0.415g HEU</td>
<td>An HEU sample was seized by police in Prague</td>
</tr>
<tr>
<td>June 8, 1995</td>
<td>Ceske Budejovice, Czech Republic</td>
<td>16.9g HEU</td>
<td>An HEU sample was seized by police in Ceske Budejovice</td>
</tr>
<tr>
<td>May 29, 1999</td>
<td>Rousse, Bulgaria</td>
<td>10g HEU</td>
<td>Customs officials arrested a man trying to smuggle HEU at the Rousse customs border check point</td>
</tr>
<tr>
<td>December, 2000</td>
<td>Karlsruhe, Germany</td>
<td>0.001g of plutonium</td>
<td>Mixed radioactive materials including a minute quantity of plutonium were stolen from the former pilot reprocessing plant</td>
</tr>
<tr>
<td>July 16, 2001</td>
<td>Paris, France</td>
<td>0.5g HEU</td>
<td>Three individuals trafficking in HEU were arrested in Paris. The perpetrators were seeking buyers for the material</td>
</tr>
<tr>
<td>June 26, 2003</td>
<td>Sadahlo, Georgia</td>
<td>~170g HEU</td>
<td>An individual was arrested in possession of HEU upon attempt to illegally transport the material across the border</td>
</tr>
<tr>
<td>March, 2005 to April, 2005</td>
<td>New Jersey, USA</td>
<td>3.3g HEU</td>
<td>A package containing 3.3g of HEU was inadvertently disposed of</td>
</tr>
<tr>
<td>June 24, 2005</td>
<td>Fukui, Japan</td>
<td>0.0017g HEU</td>
<td>A neutron flux detector was reported lost at an NPP</td>
</tr>
<tr>
<td>February 1, 2006</td>
<td>Tbilisi, Georgia</td>
<td>79.5g HEU</td>
<td>A group of individuals was arrested trying to illegally sell HEU</td>
</tr>
<tr>
<td>March 30, 2006</td>
<td>Hennigsdorf, Germany</td>
<td>47.5g HEU</td>
<td>Authorities discovered trace amounts of HEU on a piece of tube found amidst scrap metal entering a steel mill</td>
</tr>
</tbody>
</table>
various explanations accounting for this. As previously stated, this study suggests four reasons for these phenomena: improved supply security in Russia; a lack of established trafficking networks; insufficient demand; and difficulties in using nuclear material to produce and employ nuclear weapons.

**IMPROVED SUPPLY SECURITY**

The perceived inadequacy in protecting Russian nuclear storage facilities causes anxiety for U.S. experts and policymakers when contemplating the possibility of global nuclear terrorism. Concerns of this nature and policy actions designed to correct deficiencies in this area are certainly prudent as Russia itself has approximately 70 percent of the world’s HEU, making nuclear leakage from this country an important focal point when seeking to prevent the proliferation of nuclear weapons and material. However, today this fear has become increasingly unjustified because measures taken by Russia and the international community, spearheaded by the United States, have been largely effective in improving accounting and security at nuclear weapons and material storage sites in Russia. Although it is difficult to measure the success of such a complex matter, the components that this paper uses to define the success of improving nuclear site security is whether the funded programs in place have completed executing the points on their agendas as initially negotiated. Particularly for the programs aiming at securing buildings with nuclear weapons and material, the measure of effectiveness and success is whether accounting and security upgrades for the respective nuclear sites in Russia and other FSU states have been installed. For programs aiming at reducing nuclear warheads and materials, success is defined as whether the disposal and destruction are going according to plan. For the programs aiming at stabilizing employment for nuclear personnel, success is defined by a combination of achieved goals on the program’s agenda and analysis of the current improved economic situation in Russia. The paper does not claim that these programs have fully secured the nuclear material and weapons sites in Russia. Due to the vast number of nuclear facilities, due to the difficulty of measuring and relativizing qualitative data and due to the restricted access to information and overall statistics on the topic, such a claim is beyond the scope of this study. Instead, the paper claims that the programs and systems highlighted here have been successful and, therefore, make a positive contribution in enhancing the security of nuclear sites in Russia.

Measures taken to protect the supply of Russian nuclear weapons and material since the dissolution of the USSR can be broadly categorized into measures taken by various administrative departments in the United States and other international partners in conjunction with the Russian
government, and measures taken by the Russian government itself. As will be shown, the second broad category of actions is controversial and not well understood and therefore its contribution has often been downgraded from the perspective of U.S. academics and policymakers.

The United States is the main sponsor of programs aimed at preventing "nuclear leakage" from Russian storage sites. The U.S. Department of Defense reports that it spent over $5 billion up to the end of 2007 on such initiatives and the spending was expected to exceed a cumulative amount of $6 billion by the end of 2008. The estimated total amount required to achieve the program objectives through FY 2013 is $8,137.5 million. The EU, Japan, and Canada have also partnered with the United States in preventing the proliferation of Russian nuclear material by reducing strategic nuclear resources, securing remaining stockpiles, decommissioning nuclear submarines, and employing former weapons personnel in alternative industries.

The most significant U.S.-sponsored programs addressing Russia fall into three basic categories: first, programs that seek the direct improvement of security of nuclear materials and weapons in the FSU; second, programs that seek the permanent disposal of nuclear weapons and material; and, third, programs that seek to stabilize employment for nuclear personnel.

The first category of U.S. initiatives is primarily carried out by the NNSA and the DOD. The NNSA has been responsible for the programs under the heading Material, Protection, Control and Accounting (MPC&A), which is given the largest budget share of the programs in this category. The DOD is mainly responsible for programs related to Nuclear Weapons Storage Security and Nuclear Weapons Transportation Security in Russia.

The NNSA has successfully denuclearized Former Soviet States by carrying out the complete consolidation of all nuclear weapons from Kazakhstan, Belarus, and Ukraine back to Russia. Thus, the main effort of NNSA programs is now securing stocks of nuclear material within Russia itself. These efforts are also proceeding rapidly and successfully. As of the end of 2008, the NNSA has provided comprehensive security upgrades to approximately 75 percent of the buildings that contain weapons usable nuclear material on the whole territory of all FSU states by mid-2008. It has been estimated that the MPC&A programs in Russia are close to completion and, therefore, their budgetary allocation is expected to decline steadily from FY 2010. Initiatives for increasing the transparency of U.S. and Russian nuclear establishments have also been progressing. Efforts have focused on improving the accounting and control of nuclear material. Material accounting measures are crucial for determining whether a theft has occurred and can also serve as deterrence to thieves who would have stolen only if the theft would be unnoticed. At many Russian sites such measures to date have not been adequately installed or not been consistently used. For instance, many nuclear material sites in the past decade have not conducted annual counts of their available nuclear containers. Other abuses include marking the nuclear weapons and material with wax seals, which can be easily erased. To improve the accounting mechanism, together with Russia, the NNSA has launched a series of initiatives to provide Russian facilities with the necessary equipment for effective accounting, which are also proceeding with the predicted speed and efficiency.

The other set of U.S.-sponsored programs aiming at improving Nuclear Weapons Storage Security is mainly managed by the DOD. Similar to the MOC&A programs by the NNSA, the DOD programs also enjoy considerable success in achieving the goals initially outlined in their agendas. As these programs are also finishing their upgrade work and nearing completion, the budgetary request for FY 2010 is $15 million, which is $8 million less than FY 2009. Moreover, the FY 2010 funds are allocated primarily for training activities. The other program under DOD management, namely Nuclear Weapons Transportation Security in Russia, aims at shipping Russian nuclear warheads to secure central storage locations or to dismantlement sites. This program has experienced a rise in its budget, which signals success because it reveals Russia’s willingness to cooperate in securing and reducing its nuclear warheads arsenal. These programs have greatly facilitated the Russian technology-based capacity for monitoring and security and therefore have reduced the likelihood of theft for the execution of a nuclear terrorist attack.

Another area that the DOE has addressed is improving the security culture among personnel at nuclear sites. Security culture is broadly defined as the level of competence and commitment of the employers. In contrast to the nuclear weapon sites, which are guarded by highly professional military personnel, most weapons usable nuclear material sites are guarded by poorly paid and trained conscripts. To improve the quality of the security culture in Russia and
make Russian guards more cautious in their duties, the DOE has initiated a pilot program focusing on improving security culture at several selected Russian nuclear sites. The initiative includes “security culture coordinators” who promote security awareness through training sessions, seminars, and videos provided for Russian nuclear security personnel. Since the Bratislava nuclear security summit in 2005, the security culture program has been expanded to cover more Russian nuclear storage facilities.

Initiatives to achieve goals in the second category of U.S.-inspired programs aimed at permanently disposing of Russian weapons-usable nuclear material and weapons include the “Megatons-to-Megawatts” program, also known as the HEU Purchase Agreement or simply The Agreement, in which Russia began converting 500MT of weapons-grade HEU to non-weapons-usable low-enriched uranium (LEU) to be purchased by the United States for use as nuclear reactor fuel in 1993. This process is known as “down-blending” because it reduces the proportion of uranium that is enriched, rendering the fuel non-weapons-usable. Since the first Russian LEU shipment, made on May 31, 1995, approximately 11,000MT of LEU down-blended from 375MT of HEU has been transferred to the United States. This amounts to 75 percent of the total 500MT negotiated at the signing of the HEU Purchase Agreement. These results indisputably show the effectiveness of this Agreement. The program has another advantage to Russia because it uses part of the money earned from the down-blended shipments (the overall sum exceeding $8.5 billion) to finance the improvement of its national nuclear safety and conversion programs.

The third set of measures spearheaded by the U.S. departments aims at stabilizing employment for nuclear personnel. Such programs focus on redirecting nuclear scientists to civilian job positions after their retirement or in the case where they are no longer employed by the nuclear facility or institution. Such efforts are exerted with the purpose of preventing these scientists from selling their knowledge to terrorist groups or other interested buyers who may later on resell it to terrorist organizations. The EU and Japan have also sponsored a number of such programs. Until recently there were fears that due to deplorable financial conditions Russian scientists may be induced to sell their knowledge for personal profit, but these have now been increasingly unjustified. The economic growth in Russia has reduced the risk of desperation-driven sales to such a level that recently the United States has been expanding these programs to meet more urgent contemporary threats of the same sort but at a different location. New areas where scientists are believed to be at risk of selling their know-how to prospective terrorist groups are Iraq and Libya. Moreover, some of the programs such as the Global Initiative for Proliferation Prevention have been criticized in recent years for requesting an increase in their budgets when it has been argued that the current economic improvement in Russia renders them unnecessary.

The second broad category of measures taken to protect Russian nuclear weapons and material are those taken by the Russian government itself. In the opinion of many U.S. academics and experts, Russian initiatives in this area are not adequate enough. This paper argues that this perception can be largely attributed to differences in beliefs and methods between U.S. and Russian officials concerning intelligence operations and best practices regarding prevention of theft and smuggling of nuclear material. Moreover, the paper claims that differences in Russian methods do not necessarily imply less effectiveness. It is frequently overlooked that Russia itself is greatly concerned by the prospect of a nuclear terrorist event on its territory and is at a substantial risk of this happening, largely because of the intense and protracted conflict in Chechnya on its southern border. Chechen groups have demonstrated their brutality and willingness to sacrifice civilian lives. Their interest in acquiring nuclear material is undoubted.

Consequently, it seems incongruous to claim that Russia is doing nothing to prevent this sort of occurrence. Moreover, though attempted, such an event has thus far been thwarted. While acknowledging the present room for improvement and the justified criticism by academics and policymakers, the argument presented below attempts to highlight the positive aspects of the currently existing Russian supply security system in order to demonstrate their valuable contribution to the overall security of Russia’s nuclear complex.

A major criticism of Russian nuclear storage methods by Western academics is the lack of central control, serious commitment, and sufficient investment in the security of nuclear sites by the Russian government. Following the collapse of the Soviet Union, Moscow followed a policy of decentralization and division of power and decisionmaking between the central government in Moscow and the regional federal constituencies. This had the effect of empowering regional administrations and municipal leaders with more governing autonomy regarding Russian nuclear
facilities. From 2000, former Russia President Vladimir Putin transformed this arrangement and started a policy of re-centralization, characterized by improved federal governance and control across the country. Nowadays, the legacy of relative regional autonomy founded on legal authority has essentially taken the form of concentric circles of oversight and monitoring emanating from local administration of the nuclear facility and incorporating regional and federal oversight agencies. These various levels of administration have simultaneously independent and overlapping mandates to supervise the nuclear complex and have created what is essentially a legal division of responsibility known as “matryoshka.” This existing, complex center–periphery relationship has been a major concern for the Russian central government because of the lack of coordination and the existing confusion of authority over nuclear sites. However, for certain areas this tendency for overlapping power structures has the likelihood of increasing the control of nuclear sites. In some regions local and federal partners have learned to share the burden of responsibility and the economic benefits. More particularly, in recent years the Russian government has increased its control over nuclear sites through the Federal Security Service (FSB) representatives who restrict access to formerly secret nuclear cities and have increased their presence in nuclear facilities as well. According to certain information, FSB representatives claim to be “deputy directors of security” within the sites. These individuals are perceived as impediments to the MPC&A program by U.S. experts because they restrict their access to the nuclear facilities. However, the stronger control of the FSB can also be seen in a positive way because it has been helpful in contributing the prevention of nuclear material thefts since 1996. Overall, the cooperation between the center and the regions is still in many cases problematic due to the unwillingness of regional elites to yield their regional autonomy and political influence to the Russian government; however, in certain regions it contributes to enhancing the security of nuclear weapons and materials. Moreover, according to Dr. Vladimir Orlov, who is a specialist on the issue, “most of the challenges [related to nuclear regionalism] of the previous decade were adequately addressed, both domestically and with international support.” Therefore, the issue of regional autonomy is “definitely not [a] significant factor any longer.”

Additionally, regional political actors have strong incentives to effectively monitor and control nuclear facilities primarily due to the strong linkage of this issue with their political popularity among local electorates. Nuclear safety is a highly significant issue for the Russian populace because of the serious associated environmental and health considerations. An example of such action is shown by Murmansk Governor Yury Yevdokimov, who alerted the national administration to a serious problem regarding the financing of nuclear submarine dismantlement within his region and the lack of security inherent in the process. He cooperated with the Russian government and provided relevant and informed recommendations for action to Moscow. Accordingly, it appears that local leaders believe that successfully addressing nuclear issues, such as in the manner already described, within their sphere of influence, will enhance their value in the eyes of their superiors and will further their political careers. In addition, if local and regional administrators are viewed as proactive on nuclear issues, it increases the chances that Moscow will fund programs at their nuclear facilities and that they will be able to attract funds to projects in their local constituencies.

Another positive area of cooperation between the central government and the regional governments concerns the new relationship that has emerged between the military and local political leaders. Financial shortages in the 1990s led to the inability of the central government periodically to pay the military personnel at nuclear sites. Therefore, security conducted by military units was not adequate at many nuclear storage facilities. Because of severe financial problems affecting the Russian military after 1990, in several regions Moscow developed arrangements with regional governments for joint financing of the Russian military. This policy has increased the quality of security services provided by Russian military personnel at nuclear storage sites.

The development of unique coping mechanisms by regional actors, coupled with center–periphery cooperation programs inherent in the regionalism approach described earlier, though different from U.S. methods, appears to contribute to the overall maintenance of security of Russian nuclear weapons and material. Therefore, their role should be included when analyzing the overall level of security of Russian nuclear weapons and material.

A second source of friction and misunderstanding for Western experts is Russia’s reliance on what amounts to a model of human intelligence rather than technological methods of monitoring and enforcement. When U.S. scientists and program managers travel to Russia and observe few
radiological monitors and security cameras they quickly draw the conclusion that Russian safeguards are inadequate. The Russian government employs the traditional practice of fences and guards at gates, but supplements this with a network of intelligence officials and agents tasked with monitoring the attempted smuggling or sale of nuclear weapons and material from Russian facilities. This is largely because implementing advanced technological detection devices that are extremely sensitive to trace amounts of nuclear material in a country with widespread radiological contamination is an exercise in futility. Under these conditions such technological devices cannot discriminate between smuggled material and contaminated objects and therefore turn on constantly, giving false alarms. For example, such detection devices are constantly sounding the alarm when a tree, contaminated with low levels of radiation, is transplanted close to one, or someone goes to work with a lunch made of fish caught from a local lake that is also contaminated with radiation. Therefore, upon inspection, U.S. personnel often discover that the technologically advanced radiological monitors they have paid for and installed are turned off. In the nuclear site areas of Russia there is enough radiological material present in objects such as trees and fish to trigger radiation detectors, making it easier to smuggle material concealed in proximity to other innocuous objects such as one’s lunch, causing faith in advanced technological devices to be misplaced. In these cases, it is simply ineffective to rely on advanced technology to prevent the theft of nuclear material. A further flaw in the radiation detectors currently being installed in Russia is that they are incapable of detecting HEU material if it is shielded even slightly. Additionally, it is argued that due to their large size and visibility, they are not likely to deter intelligent adversaries who can notice them and circumvent them by choosing alternative routes. Due to these limitations, the radiation detectors seem to be insufficient in protecting the Russian sites so local methods may be a useful addition to strengthen the security of nuclear material. These local methods, sometimes ill-understood or simply unknown to U.S. experts, lead to them doubting their efficiency. Although one cannot claim that these methods are sufficient in themselves to protect the nuclear material within Russia, evidence (or the lack of such) suggests that these alternative monitoring techniques may have a certain level of effectiveness, as there has not yet been a nuclear terrorist attack on Russian territory or, for that matter, anywhere in the world.

Furthermore, the fears that Russian nuclear scientists will steal the nuclear material out of need for profit are much fewer than before as the economic situation in Russia has improved. The 2,000 percent inflation that occurred after the end of the Cold War was contained and in the last decade Russia has experienced economic growth due to increased oil revenues and a significant budget surplus. By 2002 the average monthly salary of a worker at a nuclear research and development facility in Russia has amounted to $209, which is substantially above the average $146 Russian salary. Moreover, since the increase in the average salary, workers have been paid on a regular basis.

An indicator of the trust of the Russian government in the human intelligence Russian model can be seen when analyzing the mid-2007 Russian program for improving radiological and nuclear safety over 2008–2015. The overall budget for this program is $5.8 billion. Although, up to November 2008, the full text of the program had not been released, it is known that there is very little budget allocation for improving security measures. The largest budgetary fractions have been assigned for nuclear cleanup and safety improvements. This financial allocation signals that Russia does not put a high priority on improving the security of its nuclear buildings and bunkers, which is likely to suggest that Russia does not regard the current combination of human intelligence and physical intelligence as posing an urgent security threat that needs to be duly addressed and modified by the Russian government.

Moreover, evidence shows that most of the past success cases of seizing illicit nuclear material have been attributed to conspirators and good police and intelligence rather than radiation detectors. Only one of the 18 IAEA-reported cases of seized stolen HEU or plutonium has involved radiation detectors. This was the 2003 case of HEU seizure in Georgia. All the remaining 17 cases have been successful either due to information from a person involved in the robbery or a bystander, or alternatively due to sting operations.

LACK OF ESTABLISHED TRAFFICKING NETWORKS

There is little evidence that suggests the existence of a trafficking network designed to smuggle nuclear weapons and material out of Russia and aimed at delivering these materials to willing
buyers. The reported cases have involved amateurs attempting single illegal sales or at large being bribed to allow unauthorized passage at nuclear sites, without creating a sustainable trafficking network. There is much conjecture that Western authorities are not aware of everything being smuggled, but what is known with certainty is that the vast majority of trafficking takes place by amateur individuals in one-shot transactions, which are poorly organized. Moreover, it is known that very few of them involve actual weapons-grade nuclear material (less than 2 percent).

There are fears concerning the involvement of Russia’s organized crime networks in the trafficking of nuclear weapons and material out of Russia. However, there is little evidence to suggest this and, indeed, the opposing viewpoint is more likely to be true. The main reason for this is that the nuclear market is economically inefficient: it is too risky and provides no guaranteed profits. In Russia, the Federal Security Service says that nuclear trafficking does not fall within the sphere of interest of major organized crime groups. There are other, less risky and more profitable sources of income for organized crime. "Why drive across multiple frontiers kilograms of uranium that requires years of reworking and enrichment and then spend months looking for a potential buyer," asks Kirill Belyaninov, a long-time observer of Russian criminal trends, "why not ship non-ferrous metals out of the country or make millions from banking manipulations and ruble-dollar exchange transactions?" Moreover, it is unlikely that a trafficking network for nuclear material will ever be created because the nature of the commodity is such that there is no continuous flow of material to be trafficked.

Practical logistics are another obstacle to the potential creation of such a network. Even if an individual or group is successful in buying or stealing nuclear material from somewhere in Russia, the next steps involved in smuggling the material out of the country are highly risky. There appear to be three main trafficking routes that various commodities take when making their way out of Russia: through Europe, through Kazakhstan, or through Turkey via the Caucasus.

In the past, Europe has been the most popular destination for would-be sellers of nuclear material but has become much less popular now due to the advanced intelligence networks of law-enforcement officials with high success rates of interdicting nuclear materials before they are sold.

It is unlikely that Kazakhstan, a closely regulated police state, would look favorably upon smugglers attempting to pass through its border with nuclear material as Kazakhstan voluntarily returned all nuclear weapons to Russia after the dissolution of the USSR years ago. Moreover, Kazakhstan has demonstrated that it desires to cooperate in the fight against the proliferation of nuclear material as evidenced by the presence of radiation monitors installed by the United States on its borders with Russia (as well as the Turkish border). Additionally, Kazakhstan is participating in the WMD Proliferation Program, launched in 2003 and managed by the DOD. This program aims at reducing the likelihood of illicit trafficking of nuclear weapons and material from FSU states. The program has received an increase in its budget for FY 2010 and it has been reported that the main share of this increase, approximately $62.4 million, is to fund programs preventing fissile and radioactive material proliferation in Kazakhstan.

In order to smuggle materials to Turkey via the Caucasus region, one would need a three-day head start on Russian law enforcement officials and the ability to pass through challenging terrain. Additionally, by taking this route to Turkey there is a high risk of detection through human intelligence action. In areas where the government cannot control national borders, such as Russia’s border with Turkey, local tribal leaders, in this case Kurds, control the region and know who and what is transporting and being transported through their territory. Therefore, identifying and apprehending individuals involved in trafficking nuclear material through these areas is made significantly easier because the local population takes note of foreigners who appear out of place in the region. On Russia’s southern border in particular, it is suggested that no stranger can cross without the knowledge of the tribal leader. Even if smugglers manage to successfully pass the border and enter Turkey, they face the additional risk of being detected by the Turkish Village Guards who monitor the Turkish territory near the border. Similar to the Kurds on the territory of Russia, the Turks have created a local human intelligence network to protect the local villages.
INSUFFICIENT DEMAND

One of the fundamental reasons for the delinking of Russian nuclear material from the threat of a nuclear terrorist attack is that the demand side of the equation seems to be almost non-existent. Indeed, even authors whose books focus on the existential threat that these issues seem to pose to the world make it clear that there is little or no demand for nuclear weapons or material and that no established market seems to exist. Renesslear Lee, in his provocatively titled book Smuggling Armageddon, states that, “markets for stolen or diverted nuclear materials are narrow, rarified and inaccessible to many aspiring merchants.” Graham Allison, a U.S. expert who has written on this topic extensively, asserts in his book Preventing Nuclear Anarchy that there is little evidence that either demand for stolen or illicitly purchased nuclear material or a nuclear black market actually exist at all. Furthermore, in an article in 2004, Allison reports that until 2004 there has not been “a single former Soviet Union nuclear weapon” that was “found in another country or in an international bazaar.” Numerous more recent publications confirm the same fact. The 2009 National Security and Nonproliferation Briefing Book states that “there is no convincing evidence that any terrorist group has yet gotten a nuclear weapon or the materials needed to make one.” Furthermore, in Securing the Bomb, Matthew Bunn indicates that there is evidence proving the existence of confusion and even lack of nuclear knowledge in Al-Qaeda top operatives. Bunn explains: “Both Khalid Sheikh Mohammed and Abu Zubaydah are reported to have believed that uranium, which is only weakly radioactive, would be a good material for a dirty bomb—and there have been other Al-Qaeda operatives arrested for seeking uranium for dirty bombs as well.” Bunn further concludes that both Al-Qaeda and the Japanese terrorist group Aum Shrikiyo seem to have encountered significant challenges in attempting to organize a nuclear attack. This fact demonstrates that obtaining a nuclear bomb is a difficult task even for terrorist groups with financial capacity.

Modern terrorist organizations can, at least in a limited sense, be regarded as rational utility-maximizers because they do not want to get caught prematurely trying to acquire elusive and heavily monitored WMD when other weapons will seemingly serve the same purpose. This appears to lead such organizations to avoid the “nuclear black market” because, from the perspective of the demand side, the risks of detection and capture are quite great and far outweigh the chances of being able to acquire enough nuclear material to construct an effective nuclear weapon. Thus, the historical record seems to suggest that terrorists prefer to use weapons, or objects as weapons (for instance aircraft), that do not immediately attract massive international attention and interdiction efforts by law-enforcement agencies globally. Osama bin Laden’s right-hand man, Ayman al-Zawahiri, himself said about weapons of mass destruction that “We only became aware of them [the nuclear weapons] when the enemy drew our attention to them by repeatedly expressing concerns that they can be produced simply with easily available material.” This quotation further reinforces the argument about the meager existing demand for nuclear weapons by terrorists today.

Additionally, according to experts’ guesstimates, the price of weapons-usable HEU must be very high, which makes the material unaffordable to most terrorist organizations. This fact further forces the terrorist groups, such as Al-Qaeda, who could afford to pay such a high price, to contemplate carefully whether this money will be wisely spent, considering the difficulties in every way of the process of nuclear attack. Though it is difficult to estimate accurately what nuclear material would actually cost on the black market, because there are almost no recorded transactions to guide a process of estimation, guesses as to the HEU price per kilogram on the black market in the 1990s range from $16,000/kg to between $1 million and $60 million. A more recent comment in 2004 by the former Chief of Russia’s Strategic Missile Troops, General Staff Colonel-General Viktor Yesin, confirmed the high price of such material and weapons. He states that although nuclear “suitcase devices” of approximately 15kg–20kg are possible to create, they “would be so expensive that no state could afford them.” Regardless of the price, the current state of the “nuclear black market” indicates that a terrorist’s money would better be spent elsewhere as the majority of transactions are attempted by amateurs and are badly organized, adding one more reason to doubt the successful completion of the process. This could help explain why it appears that terrorists prefer to use conventional weapons or explosives that they know rather than expensive, risky, and difficult to acquire WMD.
Apart from the economic arguments based on a simple cost-benefit analysis, a new debate on the moral legitimacy of murdering innocent civilians has recently emerged among the Muslim community itself. This debate has spread even among the extremist violent Muslim groups. One of the founding fathers of Al-Qaeda, who has written two of the fundamental books containing principles that the group adheres to, has recently disseminated another book arguing that indiscriminate killing of civilians is forbidden by Islamic law. This book triggered a heated debate among the Al-Qaeda top operatives on whether their operations are excessively violent. Although it has not been reported that the debate has triggered any concrete changes, it is evidence for the beginning of a rift in the ideological foundations of Al-Qaeda. This rift may add another hindrance to the pursuit of a nuclear attack because more Muslims are likely to oppose it on moral grounds.

In light of the foregoing cost-benefit analyses and the recent moral debates, one logically wonders whether a nuclear terrorist attack is as likely and imminent as some experts claim.

**COMPLEXITY OF PRODUCING AND EMPLOYING NUCLEAR WEAPONS**

There are three possible ways for terrorists to acquire nuclear weapons capability: steal a pre-existing nuclear device, buy one, or build it after acquiring the necessary nuclear material to fuel it. There is wide consensus in academic and political circles that the first two alternatives are currently broadly infeasible for nuclear terrorists and that the third option is the most promising. Moreover, it is strongly argued that no terrorist organization possesses the necessary capability to produce its own weapons usable nuclear material using either uranium or plutonium because of the complexities of the production process. Consequently, if a terrorist group wants to develop a nuclear weapon of some description it must purchase, be supplied with, or steal the requisite nuclear material and, subsequently, construct a device capable of effectively detonating this nuclear material in the intended fashion. However, although experts raise fears that this is the most likely form of nuclear terrorist attack, undertaking this process is still fraught with difficulties.

To begin with, acquiring a pre-existing, functional nuclear device seems to be very challenging. Democratic governments and even dictatorial regimes consider these weapons to be critical national assets and secure, monitor, and account for these devices in a corresponding fashion. Given the dynamics of the international community and the seriousness with which nuclear proliferation is considered, it is, by extension, extremely unlikely that a state would give or sell a nuclear weapon to a terrorist organization. The guaranteed consequences for any state assisting a terrorist organization in such a way makes it unlikely that even a “rogue state” would find the benefits to outweigh the repercussions of this action.

Furthermore, even if a nuclear weapon is stolen from a Russian storage facility, the chances that it will be a functional device are very slim. Russian nuclear weapons need comprehensive maintenance every six to seven years, and if this maintenance is not performed these weapons will be ineffective. Because of these known time limitations, the fact that we have not experienced a nuclear terrorist strike since the dissolution of the USSR suggests that nothing was stolen during the transportation of nuclear material and weapons to Russian territory in the first place or, if it was, it is no longer functional. Moreover, Russian nuclear weapons are protected by complex electronic locks that will defeat any attempt to detonate the weapon in an unorthodox fashion.

For the terrorist organization desiring to steal nuclear material and fashion its own bomb, challenges still abound. This task is especially difficult should the terrorist organization not have a state sponsor to assist in the process. Keeping in mind the brief technical description of how a nuclear device functions and the type of devices it is possible to construct, it follows that any group desiring to construct such a device will need a myriad of technical equipment, advanced engineering knowledge, and an appropriate place in which to carry out the assembly of the nuclear weapon. No terrorist organization is believed to currently have the intellectual capability to build a nuclear device, not even the infamous Al-Qaeda. In fact, the Japanese terrorist group, Aum Shinrikyo, attempted to enrich uranium itself in Australia in 1993, but eventually failed and abandoned the project due to the insurmountable technical challenges involved in this process. Consequently, a terrorist organization will need to import foreign scientists to assist with the production processes involved in constructing a nuclear weapon. This exposes the entire operation to a serious security risk. Getting the scientists into the country and having them exist as a group in any community where nuclear weapons manufacturing is likely to take place are
significant obstacles for success. It is highly unlikely that such scientists will entirely escape the notice of the local population, especially in states based on close-knit cultures of community and personal interaction where a group of foreign scientists may be quickly detected, like many Middle Eastern states.\textsuperscript{107} This makes the complicity of the state in which this activity is taking place almost a necessity if the process is to proceed in an efficient manner, owing to the significant risk of detection and apprehension. It is extremely unlikely, as discussed earlier, that any state would dare to be associated in the eyes of the international community with the construction of nuclear weapons by a terrorist organization.\textsuperscript{108} The costs of retribution to the harboring state after the nuclear device was detonated in a terrorist attack would far outweigh the material or ideological benefits derived from assisting such a terrorist group.\textsuperscript{109} For all of these reasons, the chances of a terrorist organization being able to successfully construct a nuclear weapon appear to be quite slim.

\section*{Policy Recommendations}

First, to further secure the protection of Russian nuclear stock weapons and material, supervision can be always enhanced. Many of the usual recommendations for improving policies and SOPs are applicable here, such as: strengthening the rule of law in Russia and fighting corruption, improving central control and coordination of nuclear accounting, and monitoring and additional dedicated human intelligence officers tasked solely with tracking these types of issues within Russia.

Second, it could be beneficial for U.S. experts to reduce the focus on Russian nuclear weapons and focus on potentially more relevant security issues that are currently not receiving as much attention from the academic community or policy funding from the U.S. government.\textsuperscript{110} In the nuclear area, an example of this could be to give much more policy attention to reducing the chances that a terrorist group could obtain nuclear weapons or material with the assistance of ideologically sympathizing states such as Pakistan, Iran, Iraq, North Korea or Libya.\textsuperscript{111} Indeed, the world has already witnessed the willingness of Pakistani nuclear scientists to share their know-how with ideologically similar states through the eventual disruption of the A.Q. Khan network.\textsuperscript{112}

The EU has begun to pursue this avenue in the last several years. This information was confirmed in personal correspondence with Lars-Gunnar Wigemark, Head of Unit for Security Policy of the Directorate General for External Relations at the European Commission. When asked to assess the threat of Russian nuclear weapons and material being used in a nuclear terrorist attack he stated that:

\begin{quote}
It should be noted that the main nonproliferation threat in recent years has not come from Russia or other parts of the FSU but rather from other countries and regions, including Asia, the Middle East and Northern Africa. The EU is currently, together with other partners in the G8, considering how to counter the growing threat of WMD proliferation in regions outside of the former Soviet Union. When identifying suitable programs under the new ‘Instrument for Stability’ we try to take account of these new threats.\textsuperscript{113}
\end{quote}

\section*{Conclusion}

This study has sought to provide an insightful analysis of the linkage between the smuggling of Russian nuclear weapons and material and the threat of international nuclear terrorism. The paper acknowledges it is a challenging task to measure qualitative issues such as level of security and level of threats, draw clear conclusions about topics with little publicly available information, and assess evidence that is at times anecdotal at best. Nevertheless, admitting these limitations, the paper makes use of the available data to systematically disprove the conventional wisdom that smuggling nuclear weapons and material from Russia is an alarming concern. The paper does not aim at disproving this grim possibility altogether and agrees that much more could be done in securing the nuclear sites. Instead, it argues that the current preoccupation with Russia as a source of nuclear weapons and material for potential use in a nuclear terrorist attack is exaggerated for the following reasons: improved supply security in Russia mainly with the assistance of the United States and due to improvements within Russia; a lack of established trafficking networks; insufficient demand; and difficulties in producing and employing nuclear weapons.
Undoubtedly, the mission of preventing nuclear terrorism is of paramount importance. As former U.S. President George W. Bush has asserted, Americans’ “highest priority is to keep terrorists from acquiring weapons of mass destruction.” President Barack Obama again reminded us in Prague of the seriousness of this issue by stating that “terrorists are determined to buy, build or steal” a nuclear bomb. However, in the current world of economic crisis and funding shortages in many areas of global concern, the need to protect and safeguard millions of people from nuclear terrorist attack requires a more relevant and accurate assessment of potential threats and better allocation of resources that can enhance our capacity to deter the ultimate preventable catastrophe.

NOTES
1 The author thanks Jon Strandquist for the contribution to this article.
8 Nuclear Threat Initiative, Russia Profile, Introduction.
9 Ibid., pp. 23–28.
11 Bunn, Securing the Bomb 2008, p. x.
14 IAEA, IAEA Database on Illicit Trafficking.
16 Allison et al., Avoiding Nuclear Anarchy, Appendix B.
18 Ibid., p. 5.
20 Ibid., p. 24.
For reasons of completeness it is worthwhile mentioning a third type of nuclear device known as a radiological weapon (RDD) or “dirty bomb.” An RDD is often called a poor man’s nuclear weapon because it is far easier to construct than a nuclear weapon and requires less costly nuclear material but still requires considerable skill. Many analysts consider an RDD to be more a weapon of mass disruption than a weapon of mass destruction because such a device would cause few, if any, fatalities but would be more effective in engendering panic and possible mass disorientation. Thus, this type of weapon is in another category altogether and will not be addressed further in this study.

IAEA, IAEA Database on Illicit Trafficking.

IAEA, IAEA Database on Illicit Trafficking.


For a more detailed discussion on definitions of success, please refer to Bunn, Securing the Bomb 2008, Chapter 1 and Chapter 2.


Ibid., pp. 3–4.

Ibid., pp. 3–5; Bunn, Securing the Bomb 2008, pp. 21–23.

Bunn, Securing the Bomb 2008, p. x.

Ibid., pp. 21–23; Newman and Bunn, Funding for U.S. Efforts, p. 5.

Bunn, Securing the Bomb 2008, pp. 31–32.

Newman and Bunn, Funding for U.S. Efforts, p. 6.

Ibid., 3–5; Allison et al., Avoiding Nuclear Anarchy, p. 14; Bunn, Securing the Bomb 2008.

Nathan Busch defines security culture as containing three main components: first, the level to which all personnel are aware and committed to accepted norms such as best practices and nonproliferation; second, the usage of available security technology; and third, the effectiveness of implementation of security rules and procedures. An acceptable security culture would consequently entail: first, clearly defined and strictly enforced standards; second, that workers know how to and use the available security technology and third, that personnel follow the procedures and rules at place. E. Nathan Busch and James R. Holmes, “The ‘Human Factor’ and the Problem of Nuclear Security in Russia.” Perspectives on Political Science 34, no. 3 (2005), pp. 154–161. For further information on the theory of security culture, see Igor Khripunov et al., Nuclear Security Culture: The Case of Russia (Athens, GA: Center for International Trade and Security, 2004), pp. 5–17.

Bunn, Securing the Bomb 2008, pp. 26–27; Allison, “Nuclear Terrorism.”

Bunn, Securing the Bomb 2008, p. 31.


Ibid.

There are a number of programs sponsored by the U.S. government that also aim at reducing the plutonium nuclear material and warheads in Russia; however, due to there being little likelihood of plutonium being used in a terrorist nuclear attack, which is discussed in this paper under Technical Background, these programs will not be discussed in this section. For further information, please refer to Newman and Bunn, Funding for U.S. Efforts, pp. 10–12. For more detailed information on legal issues related to the U.S.-Russia

45 The EU is the main supporter of the International Science and Technology Center (ISTC) in Moscow and its sister organization the STCU in Kiev, together with the United States and Japan. These centers are primarily engaged in the redirection of former WMD weapons scientists and engineers. Important work as also been carried out over the past 15 years in other parts of the former Soviet Union, including Central Asia and the Caucasus. Lars-Gunnar Wigemark, Head of Unit for Security Policy of the Directorate General for External Relations at the European Commission, email message to author, April 4, 2008.


51 Ibid., 27.


53 Ibid., pp. 21–22.

54 Ibid., pp. 35–36.


56 Evstafiev and Orlov, *Center–Periphery Relations*, pp. 35–36.

57 Dr. Vladimir Orlov, founding Director of the Moscow-based PIR Center, email message to author, November 17, 2009.

58 Evstafiev and Orlov, *Center–Periphery Relations*, p. 31.

59 Ibid., p. 30.


63 Ibid., p. 45; Bukharim, The FSB, pp. 137–146.


65 Ibid., p. xiv.


67 Ibid., p. 8.


71 Ibid., p. xiv; IAEA, *IAEA Database on Illicit Trafficking*.


Ibid., p. 63.

Ibid., p. 73.

Lee, *Smuggling Armageddon*, p. 73; Wigemark, email message to author.


Langewiesche, *The Atomic Bazaar*, p. 64.


Allison, “Nuclear Terrorism.”


Ibid., p. 12; Ferguson, *Preventing Catastrophic*, p. 5.


Lee, *Smuggling Armageddon*, p. 43; IAEA, *IAEA Database on Illicit Trafficking*.


IAEA, *IAEA Database on Illicit Trafficking*.


In 2004 Graham Allison has estimated that the chance for a nuclear terrorist attack is over 50 percent for the next 10 years and Matthew Bunn estimated in 2006 that the chances for a nuclear terrorist attack in 10 years are 29 percent. Bunn, *Securing the Bomb 2008*, p. 14.

Allison, “Nuclear Terrorism.”


Ibid., p. 19.

Ibid., p. 19.


Ferguson, *Preventing Catastrophic*, p. 5.


Ibid., p. 20.

Ibid., 65.

111 Newman and Bunn, Funding for U.S. Efforts, p. 8; Bunn, Securing the Bomb 2008, pp. 32–35.


113 Wigemark, email message to author.