The U.S.-Russia Joint Threat Assessment of Nuclear Terrorism

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Belfer Center for Science and International Affairs

Institute for U.S. and Canadian Studies

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ABSTRACT

Nuclear terrorism is a real and urgent threat. Given the potentially catastrophic consequences, even a small probability of terrorists getting and detonating a nuclear bomb is enough to justify urgent action to reduce the risk. Al-Qaeda and North Caucasus terrorist groups have both made statements indicating that they seek nuclear weapons and have attempted to acquire them; these groups are presented together as a case study to assess nuclear terrorism as a present and future threat. (The only other terrorist group known to have systematically sought to get nuclear weapons was the Japanese cult group Aum Shinrikyo.) This study makes the case that it is plausible that a technically sophisticated group could make, deliver, and detonate a crude nuclear bomb if it could obtain sufficient fissile material. The study offers recommendations for actions to reduce this danger.

ABOUT THE U.S.-RUSSIA JOINT THREAT ASSESSMENT ON NUCLEAR TERRORISM

The U.S.-Russia Joint Threat Assessment on Nuclear Terrorism is a collaborative project of Harvard University's Belfer Center for Science and International Affairs and the U.S.A. and Canada Studies Institute of the Russian Academy of Sciences led by Rolf Mowatt-Larssen and Pavel Zolotarev.

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EXECUTIVE SUMMARY

- Nuclear terrorism is a real and urgent threat. Urgent actions are required to reduce the risk. The risk is driven by the rise of terrorists who seek to inflict unlimited damage, many of whom have sought justification for their plans in radical interpretations of Islam; by the spread of information about the decades-old technology of nuclear weapons; by the increased availability of weapons-usable nuclear materials; and by globalization, which makes it easier to move people, technologies, and materials across the world.

- Making a crude nuclear bomb would not be easy, but is potentially within the capabilities of a technically sophisticated terrorist group, as numerous government studies have confirmed. Detonating a stolen nuclear weapon would likely be difficult for terrorists to accomplish, if the weapon was equipped with modern technical safeguards (such as the electronic locks known as Permissive Action Links, or PALs). Terrorists could, however, cut open a stolen nuclear weapon and make use of its nuclear material for a bomb of their own.

- The nuclear material for a bomb is small and difficult to detect, making it a major challenge to stop nuclear smuggling, or to recover nuclear material after it has been stolen. Hence, a primary focus in reducing the risk must be to keep nuclear material and nuclear weapons from being stolen by continually improving their security, as agreed at the Nuclear Security Summit in Washington in April 2010.

- Al-Qaeda has sought nuclear weapons for almost two decades. The group has repeatedly attempted to purchase stolen nuclear material or nuclear weapons, and has repeatedly attempted to recruit nuclear expertise. Al-Qaeda reportedly conducted tests of conventional explosives for its nuclear program in the desert in Afghanistan. The group's nuclear ambitions continued after its dispersal following the fall of the Taliban regime in Afghanistan. Recent writings from top al-Qaeda leadership are focused on justifying the mass slaughter of civilians, including the use of weapons of mass destruction, and are in all likelihood intended to provide a formal religious justification for nuclear use.

- While there are significant gaps in coverage of the group's activities, al-Qaeda appears to have been frustrated thus far in acquiring a nuclear capability; it is unclear whether the group has acquired weapons-usable nuclear material or the expertise needed to make such material into a bomb. Furthermore, pressure from a broad range of counter-terrorist actions probably has reduced the group's ability to manage large, complex projects, but has not eliminated the danger. However, there is no sign the group has abandoned its nuclear ambitions. On the contrary, leadership statements as recently as 2008 indicate that the intention to acquire and use nuclear weapons is as strong as ever.

- Terrorist groups from the North Caucasus have in the past planned to seize a nuclear submarine armed with nuclear weapons; have carried out reconnaissance on nuclear weapon storage sites; and have repeatedly threatened to sabotage nuclear facilities or to use radiological "dirty bombs." In recent years, these groups have become more focused on an extreme Islamic objective which might be seen as justifying the use of nuclear weapons. These groups' capabilities to manage large, complex projects have also been reduced by counter-terrorist actions, though they have demonstrated a continuing ability to launch devastating attacks in Moscow and elsewhere in the Russian heartland.

- The Japanese terror cult Aum Shinrikyo pursued nuclear weapons in the early 1990s, but appears to have abandoned this interest. Few other groups have shown sustained interest in acquiring nuclear weapons. There is precedent to suggest that extremist groups such as Lashkar-e-Taiba or Jaish-e-Mohammed might cooperate with al-Qaeda (or that al-Qaeda and North Caucasus groups might cooperate) in pursuit of a nuclear bomb, as the Indonesian group Jemaah Islamiya (JI) rendered substantial assistance to al-Qaeda's anthrax project from roughly 1998 to 2001.

- Cooperation between Russia and the United States, the two countries with the largest nuclear stockpiles and the most extensive experience in cooperation to improve nuclear security and interdict nuclear smuggling, is particularly important in reducing the danger nuclear terrorism could pose to the security of those two countries and the world.

- International intelligence and law-enforcement cooperation targeted on countering nuclear smuggling and identifying and stopping terrorist nuclear plots are also important steps to reduce the danger of nuclear terrorism.

I. INTRODUCTION

Terrorists are aspiring to plot and execute attacks of increasingly catastrophic proportions. Terrorist groups have actively sought to acquire nuclear weapons. The nuclear terrorist threat is far greater today than it was during the Cold War, as a result of the confluence of four trends in the post-Cold War era: the rise of unlimited terrorism, i.e. terrorist groups who believe their objectives will be served by inflicting maximum possible damage, unconstrained by inhibitions created by concern that massive attacks might undercut political objectives by inspiring revulsion; the aging nature of nuclear weapons technology, which is no longer at the leading edge of science, at least for simple but effective designs; the vulnerability of weapons-usable nuclear material to theft or diversion; and globalization, which has given terrorists increasing access to reliable information and access to materials, designs, and potential victims.

Of all varieties of terrorism, nuclear terrorism poses the gravest threat to the world. The gravity of this threat is rooted in two factors. The first is that terrorist use of a nuclear weapon would result in a colossal scale of damage that essentially would redefine the threat posed by terrorism. The second factor is the lack of readily available means of protection against the impact of a nuclear explosion on vulnerable infrastructure in a densely populated urban environment. There are inadequate measures available to protect citizens from a nuclear explosion. Measures to protect and treat the survivors can save lives, but the impact of a nuclear detonation will still be overwhelmingly catastrophic, with effects that will be felt for decades. Arguably no other means of terrorism, with the exception of a large-scale biological-weapons attack, would approach the level of mass destruction, political and economic chaos, and widespread psychological trauma caused by nuclear weapons.

But nuclear terrorism is a preventable catastrophe. The international community and individual countries have taken a number of steps to combat the threat of nuclear terrorism. Moreover, global counterterrorism efforts have reduced the terrorists' capabilities. Many countries—including both Russia and the United States—have substantially improved security for nuclear weapons and materials in the aftermath of the September 11, 2001 (9/11) attacks in the United States and attacks by North Caucasus groups in Russia. While these efforts have made an important difference, much more remains to be done on an urgent basis. The world needs to devise and implement a comprehensive international strategy in order to significantly reduce this threat over time.

In this report, *nuclear terrorism* is defined as the use or threat of use of a nuclear explosive device of any type by an individual or a group for terrorist purposes. A *nuclear explosive device* is defined as a device capable of producing an explosive yield through a nuclear chain reaction.

Radiological terrorism is defined as the use or threat of use of radiation for terrorist purposes by means of such methods as a radiological dispersal device (RDD), or "dirty bomb," that would disperse radioactive substances, for example. Other methods include sabotage of nuclear-power plants, nuclear research units, or other nuclear facilities with the goal of causing a dispersal of radioactive material. The fundamental difference between nuclear and radiological terrorism is that the latter does not feature production of a nuclear yield achieved through a nuclear chain reaction.

Both of these types of terrorism pose different kinds of risks worthy of analysis. Dispersal of radioactive material with a dirty bomb or other device would be far easier for terrorists to accomplish than acquiring and detonating a yield-producing nuclear explosive. But while a radiological dirty bomb could make an expensive and disruptive mess, and provoke considerable fear, it would not incinerate the heart of a major city in an instant, as a nuclear explosive could do. (Successful sabotage of a major nuclear facility would be intermediate in both its difficulty and the scale of its effects.)

Bearing in mind the potentially history-changing consequences of a nuclear event, it is our judgment that the overall risk posed by nuclear terrorism (considering both probability and consequences) is higher than the risk posed by radiological terrorism, and this report therefore focuses on nuclear terrorism.

The expert community distinguishes pathways terrorists might take to the bomb (discussed in detail in the next section of the report). One is the use of a nuclear weapon that has been either stolen or bought on the black market. The probability of such a development is very low, given the high levels of physical security (guards, barriers, and the like) and technical security (electronic locks and related measures) of modern nuclear warheads. But we cannot entirely rule out such a scenario, especially if we recall the political instability in Pakistan, where the situation could conceivably develop in a way that would increase the chance that terrorist groups might gain access to a Pakistani nuclear weapon.

A second pathway is the use of an improvised nuclear device built either by terrorists or by nuclear specialists that the terrorists have secretly recruited, with use of weapons-usable fissile material either stolen or bought on the black market.[1] The probability of such an attack is higher than using stolen nuclear warheads, because the acceleration of technological progress and globalization of information space make nuclear weapons technologies more accessible while the existence of the nuclear black market eases access of terrorists to weapons-usable fissile materials.

A third pathway is the use of an explosive nuclear device built by terrorists or their accomplices with fissile material that they produced themselves—either highly enriched uranium (HEU) they managed to enrich, or plutonium they managed to produce and reprocess. Al-Qaeda and associated groups appear to have decided that enriching uranium lies well beyond the capabilities that they would realistically be able to develop.

A fourth pathway is that terrorists might receive a nuclear bomb or the materials needed to make one from a state. North Korea, for example, has been willing to sell its missile technology to many countries, and transferred its plutonium production reactor technology to Syria, suffering few consequences as a result. Transferring the means to make a nuclear bomb to a terrorist group, however, would be a dramatically different act, for the terrorists might use that capability in a way that could provoke retaliation that would result in the destruction of the regime. A far more worrisome transfer of capability from state to group could occur without the witting cooperation of the regime. A future A.Q. Khan-type rogue nuclear supplier network operating out of North Korea or out of a future nuclear-armed Iran could potentially transfer such a capability to a surrogate group and/or sell it for profit to the highest bidder.

Global trends make nuclear terrorism a real threat. Although the international community has recognized the dangers of nuclear terrorism, it has yet to develop a comprehensive strategy to lower the risks of nuclear terrorism. Major barriers include complacency about the threat and the adequacy of existing nuclear security measures; secrecy that makes it difficult for states to share information and to cooperate; political disputes; competing priorities; lack of funds and technical expertise in some countries; bureaucratic obstacles; and the sheer difficulty of preventing a potentially small, hard-to-detect team of terrorists from acquiring a small, hard-to-detect chunk

1 In this report, "weapons-usable materials" refers primarily to highly-enriched uranium (HEU) and plutonium separated from spent fuel; the phrase as used here is essentially the same as the set of materials the IAEA refers to as "unirradiated direct use nuclear material." Both "reactor-grade" plutonium and HEU enriched to levels well below the 90% usually referred to as "weapon-grade" are weapons-usable.

of nuclear material with which to manufacture a crude bomb. These barriers must not be allowed to stand in the way of the panhuman universal priority of preventing this grave threat from materializing. If current approaches toward eliminating the threat are not replaced with a sense of urgency and resolve, the question will become not if, but when, where, and on what scale the first act of nuclear terrorism occurs.

The goal of this research project, completed by participants of the U.S.-Russia Initiative to Prevent Nuclear Terrorism, is to assess the threat of nuclear terrorism and propose concrete steps that the governments of the United States, Russia, and other countries can take to strengthen current efforts to reduce the risk. Implementation of the recommendations that we have developed will allow governments of the Russian Federation and United States to not only once again display leadership in combating nuclear terrorism, but also, more importantly, to define the fundamental principles of countering nuclear terrorism and to formulate approaches toward shaping a common strategy aimed at preventing acts of nuclear terrorism. It would be expedient to assign the development of such a strategy to the U.S.-Russian Working Group on Foreign Policy and Fighting Terrorism, with contributions by non-governmental experts. Such a strategy would be a very valuable contribution of Russia and the United States to increasing the effectiveness of the international community's efforts toward countering nuclear terrorism.

II. PATHWAYS TO THE BOMB

How might terrorists acquire the capability to create a nuclear blast? They might obtain an assembled nuclear weapon and attempt to set it off, or they might steal weapons-usable nuclear material and attempt to make it into a crude nuclear bomb. In either scenario, they might try to steal the nuclear weapon or material; they might try to buy it on the black market from others who had already stolen it; or they might try to persuade a state to sell or give it to them. In this section, we consider each of these pathways in turn.

Purchase or Theft of a Nuclear Weapon

There is no convincing evidence to support any of the many press reports suggesting that terrorists have managed to steal or purchase stolen nuclear weapons. Each nation that possesses nuclear weapons maintains a substantial security regimen and a rigorous accounting system to track every device in its inventory.

Theft of a complete weapon is the least likely pathway to nuclear terrorism, given the levels of security at facilities and the multi-layer systems they deploy in order to prevent unauthorized detonation. However, measures should be considered to eliminate any risks, particularly in unstable areas of the world, that terrorists could steal a nuclear bomb and then take it to a safe facility to defeat whatever measures it may have for preventing unauthorized detonation.

If a nuclear weapon is seized, terrorists are likely to deploy it rapidly in order to deny authorities the opportunity to interdict the plot and seize the weapon before the group has a chance to use it in an attack. This raises the possibility of terrorist planning for an attack in-theater where a bomb might be stolen, e.g., while weapons are in transit.

Terrorists can gain access to silo-based ICBMs only if they overcome these facilities' extensive security and hardening measures. Therefore, it is improbable that terrorists will manage to access and blow up silo-based ICBMs, let alone seize the nuclear warheads mounted on these missiles.

The situation is somewhat different in the case of mobile ICBMs. The level of security at permanent facilities—where these ICBMs are based when they are not patrolling—is high. Seizure of ICBMs at their bases with subsequent retrieval of warheads from them is next to impossible with the resources plausibly available to terrorist groups. If terrorists attack mobile ICBMs when

the latter are on patrol or in field positions, they could perhaps succeed in rendering a missile launcher inoperable or even blowing it up, but it would probably still be a very difficult matter to seize the warheads.

As for submarine-launched ballistic missiles, or SLBMs, a seizure by pirates or terrorists of a submarine with strategic delivery systems on board is beyond the realistic realm of plausible risks. The only way such a scenario could become reality is if members of a ballistic-missile submarine crew decide to mutiny and seize their vessel.

Theoretical scenarios could also make room for consideration of the actions of insiders serving at command and control facilities or staffing technical maintenance units of strategic nuclear forces. Even in such a scenario, security arrangements for these weapons would be extremely difficult to overcome, swift pursuit would be certain, and the perpetrators would have to overcome technical safeguards built into the weapons (though the effectiveness of both security measures and technical safeguards may vary from one country to the next).

Air-delivered nuclear weapons, whether tactical or strategic, are typically stored in special storage facilities at air bases. Other nuclear weapons stored in special storage facilities include tactical nuclear weapons and reserve weapons for strategic ballistic missiles. Theoretically, it is possible to breach security at such a storage facility and steal a nuclear weapon. However, security at these facilities is substantial throughout the world, and it would be difficult for terrorists to succeed in removing a nuclear weapon from such a storage site, much less use it before being interdicted and neutralized.

In the event of theft, terrorists would have to overcome safeguards against unauthorized use incorporated into the weapons. Many modern nuclear weapons are equipped with sophisticated electronic locks, known in the United States as "permissive action links" or PALs, intended to make it difficult to detonate the weapon without inserting an authorized code, which terrorists would find very difficult to bypass. Older weapons may not be equipped with PALs or may be equipped with older versions that lack some of the highest-security features (such as "limited try" features that would permanently disable the weapon if the wrong code is inserted too many times or attempts are made to bypass the lock). Many nuclear weapons also have safety features designed to prevent the weapon from detonating unless it had gone through an expected flight to its target—such as intense acceleration followed by unpowered flight for a ballistic missile warhead—and these would also have to be bypassed, if they were present, for terrorists to make use of an assembled nuclear weapon.

If they could not detonate a stolen weapon, terrorists might remove its nuclear material and fashion a new bomb. Some modern, highly efficient designs might not contain enough material for a crude, inefficient terrorist bomb; but multistage thermonuclear weapons, with nuclear material in both the "primary" (the fission bomb that sets off the fusion reaction) and the "secondary" (where the fusion takes place) probably would provide sufficient material.

Some countries (including Pakistan and India) reportedly maintain nuclear weapons in a disassembled form at storage facilities. Terrorists might try to assemble such weapons if they manage to steal them. Components of such weapons are said to be stored in different facilities located some distance from each other, requiring terrorists to breach security at two heavily guarded facilities.

While there is a low probability that a tactical nuclear warhead would be stolen from special storage facilities of advanced nuclear states, that probability is not so low when it comes to nuclear weapons in states outside the nuclear Nonproliferation Treaty (NPT). For example, there is practically no information on nuclear warhead storage in Israel, which has not even acknowledged that it has these weapons. That being said, Israel has no doubt put in place a robust system to deny terrorists any possible access to nuclear weapons. The limited information available on measures taken by India and Pakistan to protect their nuclear weapons from terrorists suggests that those countries' organizational and technical measures are reasonably stout.

If terrorists managed to obtain a nuclear device, they would be in a position to make credible threats, including blackmail, because no one would be certain (probably including the terrorists themselves) whether they could make good on their threat to detonate it.

Constructing an Improvised Nuclear Device (IND)

Counting assembled nuclear weapons is far easier than accounting for nuclear material in bulk form. Some weapons-usable nuclear material (particularly in the civilian sector) does not have the same level of security that nuclear weapons have. As a result, terrorists' best chance of achieving a WMD capability may be a long-term effort to construct an IND with weapons-usable material stolen or purchased on the nuclear black market.

Total world stockpiles of highly enriched uranium (HEU) and plutonium separated from spent fuel amount to nearly 2000 metric tons. Such weapons-usable nuclear materials exist in hundreds of buildings in over 30 countries, under security conditions that range from excellent to appalling. The International Atomic Energy Agency (IAEA) has documented 20 cases of theft or loss of HEU or plutonium confirmed by the states concerned, and additional cases are known to have

occurred.[2] What is not known is how many cases may have gone undetected, or how much stolen material may still be outside of state control. Theft of weapons-usable nuclear material, in short, is not a hypothetical concern but an ongoing reality.

Making weapons-usable nuclear material is by far the hardest part of making a nuclear bomb. Over 90% of the effort in the Manhattan Project went to producing the plutonium and the highly-enriched uranium. This is why it is plausible that a terrorist group could make a nuclear explosive—if it could get the needed nuclear material—even though it has required massive efforts on the part of states to do so. Moreover, it is far easier to build a crude, unsafe, unreliable bomb of unknown yield that might fit in a truck or a ship than it is to build a weapon that a state would want—a safe, reliable weapon of reasonably predictable yield that can be delivered by missile or military aircraft. As Harold Agnew, the former head of the Los Alamos National Laboratory has put it, "those who say that building a nuclear weapon is easy, they are very wrong, but those who say that building a crude device is very difficult are even more wrong."[3]

There are two basic types of INDs terrorists might make. A "gun-type" bomb made from HEU, in particular, is basically a matter of slamming two pieces of HEU together at high speed. An "implosion-type" bomb—in which precisely arranged explosives crush nuclear material to a much higher density, setting off the chain reaction—would be substantially more difficult for terrorists to achieve, but still plausible, particularly if they were able to obtain knowledgeable help (as they have been actively attempting to do).[4] A crude implosion-type design does not have to be as complex and sophisticated as the Nagasaki bomb.

One study by the now-defunct U.S. Congressional Office of Technology Assessment summarized the technical reality (referring to both the gun-type bomb and the implosion-type bomb): "A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device. Only modest machine-shop facilities

2 IAEA generally cites a figure of 18 in documents, but a figure of 20 is now used by IAEA and other experts.

3 Quoted in U.S. Senate, Committee on Foreign Relations, "Dirty Bombs and Basement Nukes: The Terrorist Nuclear Threat," S. Hrg. 107–575, 107th Congress, 2nd Session, March 6, 2002 (Washington, D.C.: U.S. Government Printing Office, 2002), p. 22. Siegried Hecker, a subsequent director of Los Alamos, frequently makes the same summary assertion, attributing it to Agnew. Personal communication of one of the authors, December 2010.

4 For an unclassified discussion, with relevant references, see Matthew Bunn and Anthony Wier, "Terrorist Nuclear Bomb Construction: How Difficult?" Annals of the American Academy of Political and Social Science, Vol. 607, pp. 133–149, and Stanislav Rodionov, "Could Terrorists Produce Low-Yield Nuclear Weapons?" from "High-impact Terrorism," proceedings of a joint U.S.-Russian workshop, the National Academy of Sciences and Russian Academy of Sciences, 2002.

that could be contracted for without arousing suspicion would be required."[5] Indeed, even before the revelations from Afghanistan, U.S. intelligence concluded that "fabrication of at least a 'crude' nuclear device was within [al-Qaeda]'s capabilities, if it could obtain fissile material."[6]

Building an IND would be a major challenge for terrorists, however. It would require terrorists to get enough weapons-usable nuclear material, recruit or develop needed expertise, and manufacture the IND, all in complete secrecy. Even if such an operation passed undetected up to the final moment, until the device was detonated a terrorist group would never know for certain whether it was viable and whether it would result in a substantial nuclear yield.

Sabotage of a Nuclear Facility

Both al-Qaeda and North Caucasus terrorist groups have considered sabotage of nuclear facilities and dispersal of radioactive material in a dirty bomb.

Terrorists could attack a nuclear facility in the hope of causing a large release of radioactivity. There is evidence that al-Qaeda's leadership considered such a possibility prior to September 11, 2001, when operatives reportedly conducted some light casing of U.S. nuclear reactor facilities.[7] However, given the enhanced security and reinforced defenses at U.S. nuclear sites, al-Qaeda presumably concluded that it would be too difficult either to crash a plane into a nuclear facility or to sabotage a plant by means of insider infiltration or external attack. This optimistic appraisal may not apply to all facilities in all countries, including the United States and Russia. Terrorists will certainly be searching for a "weakest link" facility in an otherwise well-defended nuclear establishment. Moreover, the dramatic developments associated with the Fukushima disaster might awaken terrorist interest in this path to nuclear terrorism.

One important lesson of the Chernobyl and Fukushima accidents is that what can happen as a result of an accident can also happen as a result of a premeditated action. Indeed, today's high levels of nuclear safety are dependent on the high reliability of components such as cooling systems; if these are intentionally destroyed, the probability of a large release would increase greatly. Terror-

5 U.S. Congress, Office of Technology Assessment, "Nuclear Proliferation and Safeguards" (Washington, D.C.: OTA, 1977), available at http://www.princeton.edu/~ota/disk3/1977/7705/7705.pdf (accessed 30 October 2009), p. 140. OTA reached this conclusion long before the Internet made a great deal of relevant information much more widely available.

6 Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, "Report to the President" (Washington, D.C.: WMD Commission, 2005), available at http://www.gpoaccess.gov/wmd/index.html (accessed 30 October 2009), p. 276.

7 "Al-Qaeda Suspect Worked at U.S. Nuclear Plants," *MSNBC*, March 12, 2010, available at http://www.msnbc.msn.com/id/35822126/ns/us_news-security/

ists will most likely try to damage a reactor's support and water supply systems as well as its control and protection system to cause a heat explosion of the reactor with subsequent demolition of the reactor and the building in which it is located. Even if terrorists fail to cause a wide-scale dispersal of radioactive material, their sabotage efforts may still provoke widespread terror, shut down a reactor, and cause significant economic and socio-political damage (as the Fukushima accident has done). Overfilled spent fuel pools may also be potential sabotage targets; in some cases, if terrorists managed to drain the cooling water—as occurred without human intervention at Fukushima—a zirconium fire and large-scale dispersal of radioactivity could potentially result.

Other potential sabotage targets include research reactors, nuclear waste reprocessing plants, or during the transportation of spent nuclear fuel or high-level waste. Another scenario of a radiological terrorism act could involve hijacking a vehicle or vessel that is transporting radioactive materials and threatening to blow it up.[8]

Radiological Dispersal Device or "Dirty Bomb"

Radiological dispersal devices simply spread radioactive material over an area—they cannot destroy the heart of a major city in a flash as a nuclear explosive can. Given the public fear of radioactivity, however, contaminating many blocks of a major city with radioactive material could create panic and substantial evacuation, disruption, and clean-up costs.

Terrorists usually consider it extremely important that their attack produces an immediate effect. Detonation of a radiological weapon by terrorists will not cause immediate human deaths as a nuclear explosion would. The deaths, if any, would be caused by cancer many years later, and would be difficult to detect against the normal background incidence of cancer in human populations. The impact of radiation cannot be sensed by humans. Hence the terrorists might choose to announce that they had dispersed radiation over an area, or they might wait for the attack to be detected. The quantity of radioactive material needed to contaminate several blocks of a city is not substantial. Radioactive sources that would be very dangerous if dispersed are widely used in hospitals, industry, and agriculture. Control and accounting of these sources remains insufficient in practically all countries. Therefore, acquiring radioactive material for a dirty bomb would be far easier than obtaining the HEU or plutonium needed for an actual nuclear bomb—and making the dirty bomb itself would also be a far smaller technical challenge.

8 For an assessment of sabotage threat, see Vladimir Belous, Chapter 8 "Threat of Sabotage of Nuclear Facilities" in "Threat of Nuclear Terrorism", edited by Alexei Arbatov, Institute of World Economy and International Relations, (Moscow, Russia, 2008).

III. STEPS TO CONSTRUCT AN IMPROVISED NUCLEAR DEVICE

Terrorist Tasks in Making a Nuclear Bomb

What tasks would terrorists have to accomplish to make a nuclear explosive? The specifics would vary depending on the types and forms of material they managed to get, and the circumstances. But in most cases, terrorists would need to do the following:

- Develop a bomb design that includes detailed drawings of the various necessary components and instructions for their assembly.
- Perform at least some modest chemical processing of the nuclear material, to put it in the desired form (for example, converting oxides to metal).
- Cast the nuclear material into the desired shapes (a somewhat difficult task, given the unusual properties of uranium and the still more problematic properties of plutonium, which has several different crystalline forms).
- Machine the cast pieces, for example with a lathe, to achieve a properly calibrated fit.
- Make and shape the explosives to be used in the bomb.
- Acquire or manufacture the other components, such as the detonator or other device to be used in setting off the explosives.
- Assemble all of these parts.

Carrying out these tasks would require people with a number of specialized skills. It is not just a question of designing a workable nuclear bomb, but of actually building the complex object based on that design, with its various parts. A capable machinist might play as large a role as a nuclear scientist. Part of the debate over whether it is plausible that terrorists could make a bomb is the debate over the plausibility of a terrorist group acquiring all of these specialized abilities, and convincing these specialists to devote themselves to the bomb project over an extended period of time.[9]

9 For a skeptical discussion, see Michael Levi, "On Nuclear Terrorism" (Cambridge, Mass.: Harvard University Press, 2007), pp. 35–49; for a similar step-by-step analysis that raises more substantial concerns, see, for example, Peter D. Zimmerman and Jeffrey G. Lewis, "The Bomb in the Backyard," *Foreign Policy,* October 10, 2006.

IV. TERRORIST GROUPS

This section explores the nuclear intent and capability of al-Qaeda and of North Caucasus terrorist groups. The threat of nuclear terrorism is fueled by the broader trends of terrorism. Increasing radicalization and extremism may lead to more devastating attacks, unless the underlying causes are addressed. A very small number of terrorist groups have concluded that inflicting large-scale, mass-casualty attacks can contribute to their objectives. In the case of al-Qaeda in particular, their objectives are global, and their terrorist alliances are global in reach. Similarly, a number of North Caucasus terrorist groups now seek to establish an Islamic Caliphate in their region and to push Russia out—and they are cooperating with international groups such as al-Qaeda and its allies.

Al-Qaeda's Nuclear Intent

Using nuclear weapons to win a war

Obtaining high-end weapons of mass destruction has been a high priority for a terrorist group that harbors ambitions of defeating the U.S. and its allies, overthrowing so-called apostate regimes, restoring the Islamic Caliphate, and expanding it to cover the globe. Al-Qaeda leaders have consistently noted in public pronouncements spanning more than two decades that they are willing to employ all available means at their disposal to achieve their objectives. They have mastered the art of surprise with each successive attack. In this context, they do not appear to be interested in chemical, biological, or radiological/nuclear weapons for their own sake, apart from their potential effectiveness against specific targets. The leadership's pursuit of a nuclear bomb in parallel to the group's known efforts to develop anthrax in the late 1990's suggests that either a nuclear or a biological weapon would be suitable for use in a future attack that was being contemplated, depending on which means (if any) they could acquire.

Justifying WMD under Islam

Recent writings from top al-Qaeda leadership (2003 and 2008) offer a meticulously researched religious ruling, or *fatwa,* for the use of weapons of mass destruction in the mass slaughter of civilians. It is clear that the group desires high-end WMD, whether in the form of biological weapons or of nuclear weapons capable of killing millions of people and causing mass economic damage.

The al-Qaeda leadership's justification for the use of WMD on religious grounds cannot be dismissed as a theological exercise. In all probability, the group's leaders are explaining why the use

of WMD is necessary because they are actively planning to use these weapons; if 9/11 was a declaration of war against America, a Hiroshima bomb is a way to win the war. Nuclear and "big bio" weapons are desirable because they can produce global economic disruption, cause mass casualties, and perhaps most importantly, create widespread doubts concerning world order and governance.

In this context, there are chilling similarities between the warning and planning cycle associated with the 9/11 attack, and rituals associated with al-Qaeda's WMD statements. Osama bin Laden issued 1998 *fatwa* that served as a harbinger of the 9/11 attack that followed three years later. The al-Qaeda leader's declaration of war against America not only fulfilled a religious obligation, it launched a secret planning process for an unprecedented attack that was carried out with devastating effect. The timing of al-Qaeda deputy leader Ayman al-Zawahiri's 2008 *fatwa*—which meticulously justifies an unprecedented attack on an almost unimaginable scale of destruction—may have started the clock ticking for an attack capable of fulfilling al-Zawahiri's promise to elevate the level of violence to a new scale.

The high-end scale of al-Qaeda's intent to produce mass destruction is clearly evident from a 26-page fatwa entitled A Treatise on the Legal Status of Using Weapons of Mass Destruction Against Infidels, published by radical Saudi cleric Nasir al-Fahd on May 21, 2003.[10] Al-Fahd offered three central arguments justifying the use of WMD. First, one kills in a good manner only when one can. If those engaged in jihad cannot do so, for example when they are forced to bomb, destroy, burn or flood, it is permissible. Second, one avoids killing women and children only when one can distinguish them from men. If one cannot do so, as when infidels make a night attack or invade, a Muslim may be killed as collateral damage in killing the fighters. And third, killing a Muslim is forbidden and not permitted; but if those engaged in jihad are forced to kill him because they cannot repel the infidels or fight them otherwise, it is permitted, as when the Muslim is being used as a living shield.[11] But al-Fahd also argued that using nuclear weapons against U.S. civilians was justified because it was a proportionate response to the harms inflicted on the Islamic community: "If a bomb that killed 10 million of them and burned as much of their land as they have burned Muslims' land were dropped on them, it would be permissible."

On March 2, 2008, al-Zawahiri released a lengthy document entitled *The Exoneration: A Treatise Exonerating the Nation of the Pen and the Sword of the Denigrating Charge of Being Irresolute and*

10 "Saudis Say 330 Convicted in Terrorism Trials," *CNN*, July 9, 2008, available at http://articles.cnn.com/2009-07-08/world/saudi.terror.trials_1_deviant-group-saudi-authorities-saudi-television?_s=PM:WORLD

11 Nasir Bin Al-Fahd, "A Treatise on the Legal Status of Using Weapons of Mass Destruction Against Infidels," Carnegie Endowment, May 2003, available at: www.carnegieendowment.org/static/npp/fatwa.pdf.

Weak, in which he revisited al-Fahd's *fatwa* and strengthened the argument for conducting mass casualty attacks. Specifically, al-Zawahiri raised key Quranic themes to justify the use of WMD to include the legality of killing women, children, and the elderly; the use of Muslims as human shields; the inevitability of environmental destruction; notions of retaliatory use and deterrence; attacking in the night and unintentionally harming noncombatants; and other such issues. Al-Zawahiri explained why he considers the United States to be the "*main enemy of all Muslims*" and a "*single juridical entity*" under Islam. This judgment means all Americans are valid targets, whether they are men, women, or children. Indeed, not only are the same scholars, clerics and quotations of "Exoneration" also referenced in al-Fahd's fatwa, but many of the same examples from the former are used nearly verbatim in the latter.

Al-Qaeda's Pursuit of Capability

Producing a mushroom cloud, not a dirty bomb

In 1998, Osama bin Laden publicly declared that it was his "religious duty" to acquire WMD, thereby making this task a top priority for his lieutenants. Al-Qaeda has adopted a long-term approach in efforts to fulfill its leader's pledge.[12] While lower-level operatives have long experimented with crude, improvised biological and chemical weapons, the senior leadership of al-Qaeda has preferred a long-term approach to acquire not just the means to make an expensive mess, but the means to incinerate the heart of a major city. Based on what is known, there has not been a natural progression in senior al-Qaeda leadership's use of terminology and concepts that point to the existence of an active, steadily maturing nuclear plot. This suggests the group has not enjoyed systemic success in developing high-end WMD, but has likely experienced several fits and starts in the course of pursuing materials, technology and expertise on an opportunistic basis.

Simple and innovative approach

Al-Qaeda lacks any known strategy of the sort that a state would implement to justify its costly pursuit of nuclear weapons. Terrorists tend to operate in a more ad hoc manner and are prone to making abrupt, sometimes disruptive changes to their plans. Such characteristics are not helpful in planning a nuclear attack. However, the group's modus operandi poses some dangers of its own: keeping planning as simple as possible plays to strengths al-Qaeda has displayed in conducting its most successful operations. In the past, the al-Qaeda core has managed to overcome the formidable odds of simultaneously attacking seemingly impregnable, multiple, strategic targets with innovative weapons—like airplanes. Against the standards they have set for themselves, nuclear planning is

12 Rahimullah Yusufzai, "Conversations with Terror," *Time,* January 11, 1999.

likely to not stray far from fundamental principles of physics. The leadership appears to have given no consideration to such distractions as developing a nuclear infrastructure of any kind. Rather, they have displayed an affinity for insiders who might provide access to nuclear capabilities.

In this vein, Osama bin Laden's fireside chat with Pakistani nuclear scientist Bashiruddin Mahmud offered a revealing glimpse of the nature of his curiosity. He got straight to the key point: "If I have the material … how can I build a bomb?"[13] Mahmud's sketch for bin Laden of a crude image of a uranium gun-type device promoted the idea that the design and construction obstacles to building a bomb could be overcome, if the group managed to gain access to sufficient weapons-usable material. Indeed, the Pakistani plutonium reactor chief modified his design to include some lenses that might improve efficiency, i.e., produce a yield with less material than might otherwise be required.

Long term, opportunistic planning

The leadership's patient, step-by-step approach became evident in the early 1990s, when the group's interest in possibly building a bomb was revealed by a black market scam that took place in Sudan in 1993. Even at this early date, the al-Qaeda leadership understood that buying or stealing an assembled bomb was highly unlikely. However, the group learned important lessons from the scams of the 1990s. It took stronger precautions to protect itself from stings during fruitless negotiations to purchase "Russian nuclear devices" in 2003—which apparently turned out to be another scam. Notably, the members of the senior leadership of al-Qaeda controlled and made all decisions related to this potential transaction. It was they who arranged to bring in a "Pakistani specialist" to inspect the merchandise, they who recognized the need to "test" the devices for authenticity.[14]

Taking the "middle path"

The group's limitations and the uncertainties associated with planning a nuclear attack are significant obstacles for the al-Qaeda leadership's decision making process. Will the group try to detonate an IND, even if it is highly questionable whether it will produce a nuclear yield? The senior leadership of al-Qaeda cannot test a device, and hence can not know for certain what will happen when it attempts to detonate one. The leadership must be willing to accept a "middle path" in which a result can fall on either side of the nuclear spectrum: either the bomb will produce a yield, or it will be a dirty bomb. Al-Qaeda cannot know for certain what will happen, and must be prepared to herald either outcome as a success.

13 George Tenet, *At the Center of the Storm,* (New York: HarperCollins, 2007), p.268.
14 Rolf Mowatt-Larssen, "Al-Qaeda Weapons of Mass Destruction Threat: Hype or Reality?" Paper, Belfer Center for Science and International Affairs, January 2010.

Nuclear Threat from North Caucasus Terrorist Networks

The first decade of this century saw Russian authorities score important victories over these networks, crushing separatist forces in Chechnya and beheading their leadership. However, after a relative lull of several years, terrorism is now staging a deadly comeback in Russia. The number of terrorist acts has been growing steadily in Russia at least since 2008, according to government statistics on terrorism in Russia. Just as significantly, terrorist networks have resumed attacks outside the North Caucasus to target "mainland" Russia. In addition to resuming attacks beyond the North Caucasus, these regional networks have also been establishing ties with Islamist groups and setting up their own cells across Russia, in accordance with their leader Doku Umarov's vows to engage the Muslim population of mainland Russia. The past several years have seen Russian law-enforcers uncover and dismantle militant salafite cells in the Volga region and beyond, including Tatarstan, Bashkortostan, and the Chelyabinsk region. The Chechen faction of the North Caucasus-based networks dispatched groups to the Urals region in order to possibly case one of the many nuclear facilities located in that area. The capabilities of these networks remain robust enough to prompt Russia's political, security and military leaders to continue acknowledging that the threat of nuclear terrorism remains real and serious.[15]

North Caucasus-based terrorist nuclear intent

Of all the agents plotting and executing acts of terror in Russia, terrorist networks based in the

15 In July 2006, then-President of Russia Vladimir Putin issued a joint statement with then-U.S. President George Bush, calling the threat of nuclear terrorism "one of the most dangerous international security challenges we face." Joint Statement by U.S. President George Bush and Russian Federation President Vladimir Putin announcing the Global Initiative to Combat Nuclear Terrorism, official web site of the President of the Russian Federation, July 15, 2006.

Russian President Dmitry Medvedev said: "We live in a very dangerous and complicated world when the number of nuclear countries is increasing, when there is a high threat of nuclear terrorism." Interview with Dmitry Medvedev, Financial Times, March 24, 2008.

Army General Nikolai Patrushev, secretary of Russia's Security Council said: "With international terrorist organizations, radicalism and insurgencies an unfortunately common part of today's security environment, Moscow and Washington must take the lead by ensuring nuclear weapons do not fall into the wrong hands." Nikolai Patrushev, "New Era for Russia-U.S. relations," Politico, April 8, 2010.

Anatoly Serdyukov, Russia's defense minister said: "Had the perpetrators of the attacks on our capital, or on London's Underground in 2005, or on the United States on Sept. 11, 2001, had access to weapons of mass destruction, the history of the civilized world would be quite different than it is today." Anatoly Serdyukov, "A Fresh START on Arms Control," Wall Street Journal, April 7, 2010.

Col. General Alexander Bortnikov, director of Russia's Federal Security Service said: "We have information which indicates that terrorists are continuing to try to get access to nuclear materials as well as to biological and chemical components." Terrorists "are increasingly active in ... their aspirations to acquire newest technologies and to gain access to elements of weapons of mass destruction." CIS news summary, Itar-Tass, June 2, 2010.

North Caucasus have the strongest motivation to commit WMD terrorism, including nuclear terrorism. As demonstrated by some of their previous attacks, such as apartment bombings in Russian cities and the Beslan hostage-taking raid, these networks are prepared to inflict massive, indiscriminate casualties, making no distinction between state or civilian targets. These networks have plotted to hijack an atomic submarine with nuclear weapons on board, have acquired radioactive materials, have threatened to attack Russia's nuclear facilities, have tried to recruit an insider at a Russian NPP, and have even attempted to pressure the Russian leadership by planting a container with radioactive materials in Moscow and threatening to detonate it.[16] They have also scouted Russian military nuclear facilities, including nuclear weapon storage sites. As far as is known, those attempts proved to be futile. However, as demonstrated by their attacks resulting in the killing of hundreds of people, including children, these terrorist groups have clearly crossed the moral threshold between conventional and catastrophic terrorism. As they increasingly struggle to put government forces on the defensive in the North Caucasus through acts of conventional terrorism and guerilla warfare, the motivation of more radical terrorist leaders to attempt acts of catastrophic terrorism increases.

North Caucasus-based terrorist capability

Of all the agents plotting and executing acts of terror in Russia, terrorist networks based in the North Caucasus have the greatest capability to commit acts of WMD terrorism, including nuclear terrorism. Factions of these networks in the North Caucasus republics of Chechnya, Dagestan, Ingushetia, Karachayevo-Cherkessia, and Kabardino-Balkaria have shown they have the capability to plan and execute complex attacks hundreds of kilometers away, such as taking an entire theatre hostage in downtown Moscow and executing synchronized suicide-bombing attacks against civilian airliners and subway trains. And while the plot to hijack the atomic submarine and the scouting of military nuclear facilities demonstrate these groups' intentions, it is the attacks, facilitated by turncoats and executed by well-trained, well-armed terrorists—some of them desiring to achieve martyrdom via suicide attack—that showcase their capability to attempt acts of WMD terrorism, because such attacks are particularly hard for guards of nuclear facilities to defeat.

16 Simon Saradzhyan, "Russia: Grasping Reality of Nuclear Terror," The Annals of the American Academy of Political and Social Science, September 2006. For a more recent review of North Caucasus-based groups' nuclear terrorism aspirations see Vladimir Belous, Chapter 8 "Threat of Sabotage of Nuclear Facilities" in "Threat of Nuclear Terrorism", edited by Alexei Arbatov, Institute of World Economy and International Relations, (Moscow, Russia, 2008).

Factors that Increase the Threat of Nuclear Terrorism posed by North Caucasus-Based Networks to Russia:

- Insufficient financing of security at nuclear facilities.
- Possibility that insiders will share information with terrorists.
- Declining military discipline among personnel serving in units that guard nuclear facilities.
- Widespread crime in the armed forces.
- Corrupt bureaucracies and law-enforcement agencies whose personnel allow terrorists to cross from one Russian region to another, carrying illicit cargo.
- A black market for arms in the Urals that allows terrorists to move around unarmed and buy weapons on the spot.

Factors that Decrease the Threat of Nuclear Terrorism Posed by North Caucasus-Based Networks to Russia:

- Substantial disruption of earlier levels of terrorist capability.
- The difficulty of carrying out a complex, long-term nuclear project without detection.
- A lack of evidence that North Caucasus groups have focused on acquiring the expertise needed to make a crude nuclear bomb from HEU or plutonium.
- The multi-layer system of nuclear security. In peacetime, all warheads with the exception of those on ICBMs and SLBMs are located in special high-security storage facilities, and their transfer to combat units requires an order of the commander-in-chief of the Russian armed forces.[17]
- Strict procedures for storage, transportation and maintenance of nuclear warheads. These procedures are implemented only by groups of personnel.
- The equipping of warheads with special sensors that allow detonation only after the sensors detect pre-selected environmental and atmospheric conditions after launch.
- Permissive-action links and other locks that render a warhead inoperable if tampered with.
- The law on terrorism has catalogued facilities that may represent a nuclear hazard.

17 For measures taken by Russian authorities to secure nuclear facilities, see: Vladimir Belous, "Nuclear Terrorism: Attempts Have Already Been Made," Nezavisimoye Voeynnoye Obozrenie, October 8, 2004, available at http://nvo.ng.ru/concepts/2004-10-08/4_terrorism.html

Ties Between al-Qaeda and North Caucasus-Based Networks:

- Since 1995, Osama bin Laden was actively involved in the terrorist insurgency in Chechnya, sending al-Qaeda agents to the North Caucasus and sponsoring local networks. And in 1996, al-Zawahiri, was detained in the North Caucasus.[18]

- Bin Laden had ties with Jordanian-born warlord Khattab, who entered Chechnya in 1995 to set up a terrorist training camp. Bin Laden also met several times in 1997 with Chechen and Dagestani jihadists and agreed to financially support Chechen jihadists.[19]

- There have been a number of reports of natives of the North Caucasus training or fighting in Afghanistan and Pakistan. In 2010 Aleksei Sedov, head of the Federal Security Service's department for counter-terrorism and protection of the constitution said suicide bombers have been trained in Afghan-Pakistan border areas to be then deployed for terrorist attacks in Russia and Central Asia.[20]

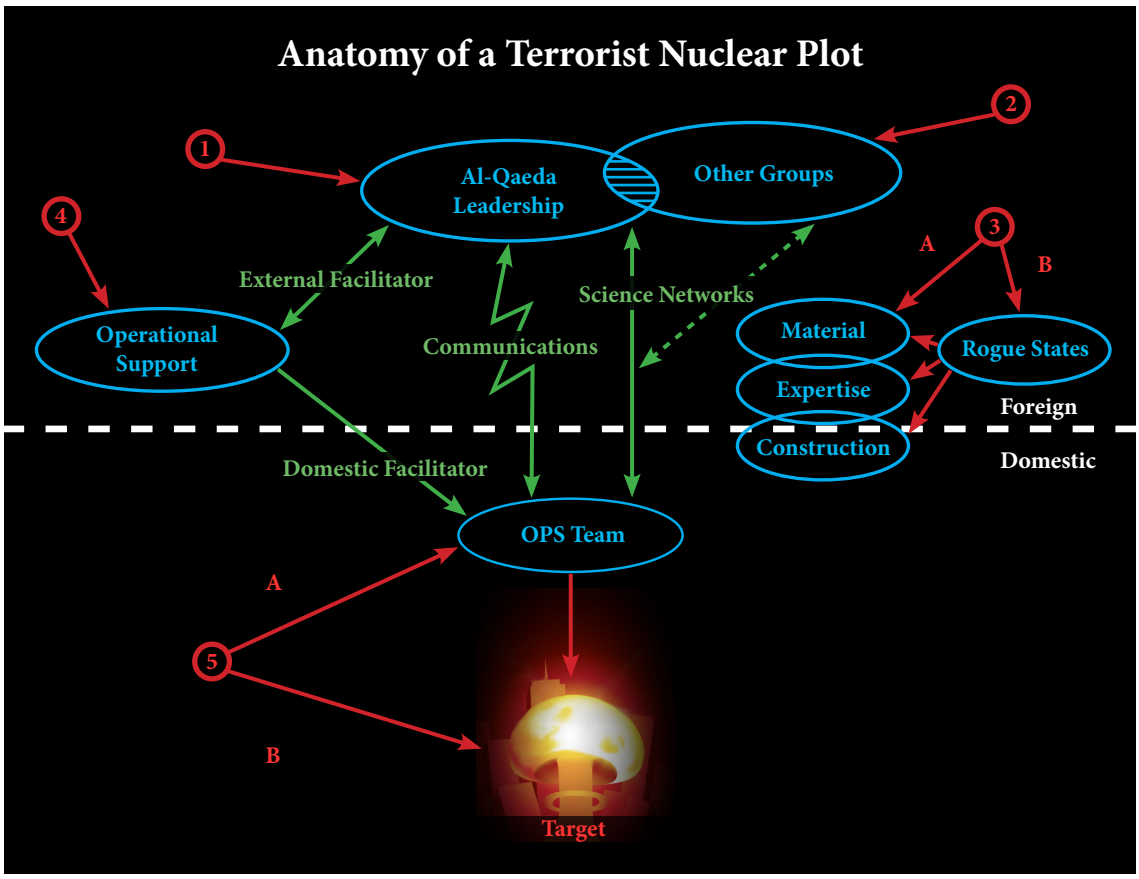
18 Rolf Mowatt-Larssen, "Al-Qaeda Weapons of Mass Destruction Threat: Hype or Reality?" Paper, Belfer Center for Science and International Affairs, January 2010.

19 Simon Saradzhyan and Nabi Abdullaev, "Disrupting Escalation of Terror in Russia to Prevent Catastrophic Attacks," Paper, Belfer Center for Science and International Affairs, December 2005.

20 "Main Threat to Russia's Security Named," Dni.ru, April 15, 2009.

V. ANATOMY OF A TERRORIST NUCLEAR PLOT

This section covers the essential planning elements for a terrorist nuclear plot. Al-Qaeda is offered as a case study, because more is known about its nuclear-related plans and intentions than about those of North Caucasus terrorist groups. The planning, however, would follow a generally similar pattern for any terrorist group.



No. 1: Al-Qaeda Leadership

After a decade of severe disruption to the al-Qaeda organization that existed before 9/11, there likely remain very few experienced al-Qaeda operatives who possess the requisite skills to plan a nuclear or high-end WMD attack. In addition, there is little evidence suggesting that a WMD interest exists below the level of the few remaining al-Qaeda senior leaders, namely deputy chief Ayman al-Zawahiri, Egyptian chief of operations (before 9/11) Sayf al-Adl, and external operational planner Adnan Shukrijumah. This small core of men represents the continuity of WMD-

related thinking and planning that extends back to the group's early days. Without their personal involvement, it is questionable whether the group would remain focused on obtaining WMDs.

A key nuclear figure in al-Qaeda is Abdul Aziz al-Masri, who carried out explosives experiments for maximizing the compression of a nuclear device in the late 1990s, before the group had achieved any substantial success in its nuclear efforts, or had obtained any fissile material, based on available reporting.[21] It is not clear whether al-Masri had any specific threshold for the type and amount of material that was required for a successful nuclear attack. But the fact that al-Masri focused on explosives-related experiments at an early stage of al-Qaeda's planning suggests that the group was assessing what it might be able to do with weapons-usable materials, if it could one day obtain such materials.

No. 2: Collaboration with Other Groups

Overcoming the formidable obstacles in planning a nuclear attack would be facilitated by the collaboration of like-minded groups. Al-Qaeda has a history of working with other groups on WMD. Ayman al-Zawahiri solicited the assistance of JI leader Riduan Isamuddin (also known as Hambali) to help create a Southwest Asian-based anthrax network, which was led by hard-core JI operative Yazid Sufaat. This network complemented al-Qaeda's Pakistan-based anthrax network, which was led by a mid-level government biologist named Rauf Ahmed. Al-Zawahiri personally supervised the two networks, keeping them separate and independent of each other. He personally tasked each group with somewhat redundant missions in pursuit of a single objective: the development of a lethal strain of anthrax capable of producing mass casualties and economic damage. Al-Zawahiri's tradecraft in recruiting and handling the operatives in these two networks was well-disciplined and fairly effective, although it appears that the roughly two-year project was abandoned in the summer before 9/11, probably without reaching fruition.[22]

Due to the fact that planning is being directed by the same narrow circle of people, the methodology of the al-Qaeda leadership's nuclear efforts is likely to share certain similarities with the anthrax project. While assessing al-Qaeda's options in acquiring nuclear-related capabilities, the possibility must be taken into account that the al-Qaeda core might consider joining forces with senior leaders of North Caucasus terrorists, and groups like Lashkar al-Tayyib, in a joint effort to acquire a nuclear bomb.

21 Tenet, 275.

22 Rolf Mowatt-Larssen, "Al-Qaeda Weapons of Mass Destruction Threat: Hype or Reality?" Paper, Belfer Center for Science and International Affairs, January 2010.

No. 3: Nuclear Material and Expertise

Over the years, available reporting points to highly enriched uranium as being al-Qaeda's bomb-making material of choice. This likely relates to the reported availability of HEU on the black market, as well as the relative ease of handling, smuggling, transporting, and fashioning HEU into a bomb. However, bad experiences with the black market have likely deterred al-Qaeda from exploiting opportunities to acquire materials. Al-Qaeda is wary of stings and provocations from scam artists and intelligence services. For reasons of counterintelligence, al-Zawahiri restricted involvement in anthrax planning to trusted agents.[23] This has likely slowed al-Qaeda down and presented opportunities for disruption; it takes time to spot, assess, develop, and recruit ideologically compatible insiders in the nuclear establishment.

Although HEU may be preferred, terrorists are likely to opportunistically procure any material that they think might work in a crude device. To this end, they are likely to turn to available information on the Internet to study the possibilities of various materials at different enrichment levels and forms. Various types and quantities of weapons-usable material could be accumulated from multiple sources and placed into storage over a period of years. Material is less likely to come from a single facility and insider source, given the difficulties of circumventing inventory and security procedures and gaining access to materials in such large quantities.

Before 9/11, when al-Qaeda developed a relationship with the Pakistani "WMD-for-hire" consortium of active and retired scientists and military officers called Ummah-Tameer-E-Nau (UTN), Osama bin Laden and Ayman al-Zawahiri understood they needed ideologically committed specialists to assist with the acquisition of WMD capabilities. Although UTN was disbanded before the NGO was able to render material assistance to terrorists, many of its members continue to harbor extremist views and are free to associate with whomever they please. A similar problem exists with the defunct A.Q. Khan network. Although the network was disbanded, its associates remain at large and it is possible that some of them still maintain access to sensitive information and materials.

No. 4: Operational Support

A litmus test of the status of al-Qaeda's nuclear planning would be the identification of a nuclear mastermind, analogous to Khaled Shaykh Muhammed's role in planning 9/11. In essence, an

23 Maria Ressa, "Al-Qaeda Operative Sought Anthrax," *CNN*, October 10, 2003, available at http://edition.cnn.com/2003/WORLD/asiapcf/southeast/10/10/alqaeda.anthrax/

al-Qaeda nuclear plot would only be as good as the "brains" behind it. Notably, Egyptian jihadists have consistently held key planning roles in al-Qaeda's WMD efforts, hearkening back to the earliest days of the group. A prime candidate to play a leading role in planning a nuclear attack is senior al-Qaeda operative Sayf al-Adl. The wily Egyptian ex-Army captain has strong operational skills, key connections to the more scientifically oriented Egyptian wing of al-Qaeda, and two decades of insider knowledge concerning al-Qaeda's WMD-related efforts. It bears noting that Sayf al-Adl and nuclear-experimenter and explosives expert al-Masri were last reported to be under house arrest in Iran.[24]

Adnan Shukrijumah, who is believed to be based in Pakistan's Federally Administered Tribal Areas (FATA), is another strong candidate to manage a WMD operation. The FBI's most-wanted fugitive would be uniquely qualified to manage the operation because he possesses intimate knowledge of the U.S, has ties to al-Qaeda's past WMD efforts, and is currently charged with the responsibility of planning attacks against the U.S. and Western countries.[25]

No. 5: Attack Team

If al-Qaeda manages to build a bomb, the success of the plan will then hinge on the ability of its operatives to carry out the attack. Muhammed Atta was arguably the pivotal factor in the 9/11 plot, which he executed almost flawlessly.[26] Going forward, the exacting standard set by Atta and his team presents something of a challenge for the al-Qaeda leadership. An unprecedented attack would create formidable unknowns and uncertainties for the terrorist. Only a highly flexible, creative and focused team leader would be capable of carrying out a high-end WMD attack.

One vital question that must be answered is whether the leadership identified promising operational leaders from the Afghanistan training camps years before the need for such a person was anticipated. Is there one more Atta in the al-Qaeda ranks capable of pulling off a worthy sequel to 9/11? It is an open question whether 9/11 represented the zenith of al-Qaeda's operational history—it is possible the group will never to able to replicate this success. However, if al-Qaeda had the foresight to identify such a candidate, he might have been lying low for years, studying and working in the U.S., Europe or Asia, far from the daily disruptions of the Afghanistan-Pakistan front, patiently biding his time before being activated to plan a large scale attack requiring long-term preparation and planning.

24 Maria Ressa, "Al-Qaeda Operative Sought Anthrax," *CNN,* October 10, 2003, available at http://edition.cnn.com/2003/WORLD/asiapcf/southeast/10/10/alqaeda.anthrax/

25 Susan Candiotti and Ross Levitt "From Dishwasher to Al-Qaeda Leadership: Who is Adnan Shukrijumah," *CNN* August 6, 2010, available at http://edition.cnn.com/2010/CRIME/08/06/terror.qaeda.leader/index.html

26 Lawrence Wright, "The Looming Towers" (New York: Vintage, 2007), pp. 349–350.

In assembling such a cast, it must be assumed for planning purposes that the attack team will be as small as possible to get the job done—probably fewer than the number of operatives involved in 9/11. A small action team could smuggle a bomb into the target country whole or in pieces that could be readily assembled, or it could bring in the nuclear material and manufacture a weapon in the target state—perhaps with the front of a legitimate business, such as a machine shop or foundry, to hide its activities.

For operational security reasons, an IND is likely to be assembled as close as possible to the target where it will be detonated. A truck, a cargo plane, or possibly a private aircraft would be used to transport the device from the staging area to the target. It is evident that an IND will have greater dimensions and weight than "standard issue" nuclear warheads of similar yield; an IND would likely weigh a ton or more. Transporting separate pieces of an IND to the vicinity of the target for assembly may be less risky—depending on the specific scenario—than transporting a fully assembled one.

VI. VULNERABILITY ANALYSIS

Challenges in Identifying a Terrorist Nuclear Plot

It is uncertain whether there is an active al-Qaeda nuclear plot, but one thing is clear: such a plot would be very hard to find. The footprint would be small. Al-Qaeda would likely be using the special tradecraft utilized for 9/11—specifically, the extraordinary precautions that were taken to ensure absolute compartmentalization and secrecy. Moreover, the signatures of an impending nuclear attack would not be the same as those of a small-scale attack such as a Times Square bombing, or a shoe bomber trying to take down an airplane. Unlike the more predictable pathways that a state follows in developing a nuclear program, a terrorist group could carry out most tasks in any order, and at any time; this non-linear approach allows it to repeat steps as necessary, as long as central planning is not compromised.

Moreover, the odds of interdicting a nuclear plot diminish over time from inception of the plot to the attack. The chances of detecting the smuggling of nuclear material in transit are low. However, dynamic interdiction opportunities do present themselves, and it is critical for law-enforcement agencies to recognize such opportunities at the moment they occur. For instance, an operative might volunteer, or be detained, and offer details about a plot. A small amount of nuclear material from a larger amount being smuggled into the target country might be seized. Multiple layers of defense provided by radiation detectors, customs and border inspections, intelligence and law-enforcement efforts, and other initiatives might produce potential tip-offs of a terrorist nuclear plot-in-progress—provided there is a sense of awareness and urgency to exploit any opportunity, however small, to identify and neutralize an impending attack. In such a case, speedy identification and forensic analysis of a sample of material might become crucial in unraveling a broader plot.

Nuclear Security

Terrorists are seeking nuclear materials more actively than they have in decades past, and these materials continue to exist in hundreds of buildings in dozens of countries with widely varying levels of security and accounting accuracy.

As discussed earlier in this report, terrorists might obtain an assembled nuclear weapon or the nuclear material needed to make one by stealing it, buying it on the black market from others who had stolen it, or having a state consciously decide to transfer it to them. Among these

scenarios, the most plausible involve theft or black-market purchase of previously stolen nuclear material. This pathway likely dominates the overall risk of nuclear terrorism—which is why improving nuclear security has been a central element of the response so far.

Assembled nuclear weapons exist in the arsenals of nine states; some U.S. nuclear weapons are stored in several additional states in Europe. HEU and plutonium outside of nuclear weapons exist in a wide variety of forms and circumstances. From 98 percent to 99 percent of the world's HEU is held in military stockpiles, where in most cases substantial levels of security are in place. Civilian HEU is often kept at research reactors—some of which are located on university campuses—and often with minimal security measures in place. Roughly half of the world's plutonium separated from spent fuel is held in military stockpiles (or former military stockpiles now declared excess to military needs), while the rest is in civilian-controlled storage. As with HEU, security measures are generally higher in the military sphere, though large plutonium-handling facilities in the civilian sector are also often controlled by substantial security measures.

The risk of nuclear theft from any given facility is determined by the quantity and quality of material at that facility (that is, how hard it would be to make a bomb from the material that could be stolen); the kinds of threats the security measures at that facility can protect against; and the kinds of threats adversaries are able to pose in the area near that facility.

All but one of the known thefts of HEU or plutonium appear to have involved theft by insiders from facilities where material was being handled in bulk, a circumstance that makes it easier for a thief to steal material without detection. Today, many tons of HEU and plutonium continue to be processed in bulk every year. Below, we discuss several regions and circumstances that may pose particular concerns.

The fact is that illicitly acquired material occasionally turns up for sale on the nuclear black market. Most known black-market seizures have originated from sites in the FSU or in Eastern Europe. In a number of cases, the material was seized in Russia or shortly after crossing the Russian border into another state.

Georgia appears to be a hotbed of nuclear trafficking, with HEU seizures having been recorded there in 2003, 2006, and 2010.[27] Central Asia is also one of the centers of the international black

27 Lawrence Scott Sheets "A Smuggler's Story" *The Atlantic.* April 2008, available at http://www.theatlantic.com/magazine/archive/2008/04/a-smuggler-8217-s-story/6736/1/

market for uranium trading. There are two major terrorist organizations active in Central Asia that may develop interest in nuclear material: the Islamic Party of Turkestan (formerly the Islamic Movement of Uzbekistan) and the Islamic Jihad - Jammat of Mujahideen. It is not clear whether the known cases of nuclear trafficking are illustrative of more, as-yet-undetected material trafficking, or whether already-stolen material may be stashed for future sale.

Based on available information held by the IAEA, reported seizures of materials have been largely serendipitous. Facilities from which the materials originated did not report them as being missing. Not all materials have been recovered. Typically, potential buyers have not been identified. There have been incidents that have not been reported publicly, and presumably others which have occurred but have never been detected. The existence of a nuclear black market provides empirical evidence that inaccuracies and discrepancies in inventory procedures continue to result in nuclear materials in bulk form disappearing from their facilities of origin without being noticed. The 20 or so publicized cases of weapons-usable materials that have turned up over the past two decades serve as an important metric in assessing global standards of nuclear security.[28]

U.S., UK, Russia, France, China, India, and Israel

The scope of this report does not allow for a state-by-state assessment of nuclear security problems and challenges. That said, all states possessing nuclear weapons or the materials needed to make them can suffer breakdowns in security, even if normative standards are high. All such states must do more to ensure their nuclear stockpiles are secure and accounted for, to strengthen nuclear security culture, and to assess and implement best practices in nuclear security. Every nuclear establishment has malicious insiders at one time or another who might be in a position to exploit lapses in security and inventory procedures. All potential leads to material in any country in the world must be treated with utmost seriousness, because no country is immune to the possibility of becoming a source of nuclear capability for a terrorist group.

Russia has been the source of a number of past thefts of nuclear material. Fortunately, nuclear security measures in Russia have improved dramatically in the years following the disintegration of the Soviet Union, both because of Russia's own efforts and through international cooperation under Nunn-Lugar and related programs. There is more to do, however, to ensure effective

28 Lawrence Scott Sheets "A Smuggler's Story" *The Atlantic.* April 2008, available at http://www.theatlantic.com/magazine/archive/2008/04/a-smuggler-8217-s-story/6736/1/

nuclear security regulations, adequate funding of enforcement, and consistent efforts to combat corruption in the nuclear sphere.

At present, two states face unique challenges that merit special attention. This is not to say that authorities charged with managing nuclear arsenals in these states take their responsibilities any less seriously than their counterparts in other states. However, the specific circumstances surrounding nuclear insiders, materials and weapons in these states are cause for greater concern.

Pakistan

The Pakistani military is very professional and takes its responsibility to safeguard its nuclear establishment extremely seriously. But its security measures face substantial challenges, and would face still more severe problems in a crisis. Three trends are exerting mounting pressure on the Pakistani military's capacity to prevent any sort of nuclear loss or theft. First, growing extremism in Pakistan increases the odds of insiders in the nuclear establishment collaborating with outsiders seeking access to weapons, materials, and/or facilities. Second, the rapid expansion of Pakistan's nuclear-weapons program means more bulk processing and more weapons to guard, and the shift to smaller, more-mobile weapons will introduce new elements that will also have to be guarded against. Finally, growing instability within the country could result in a "loose nukes" scenario, a takeover of a facility by extremist rogue agents, or, in the worst case, a coup resulting in the takeover of the nuclear arsenal by fundamentalist Taliban elements.

The insider problems that Pakistan has suffered are a matter of record, including the A.Q. Khan and Umma-Tameer-E-Nau (UTN) nuclear supplier networks, or the assassination attempts against Pervez Musharraf carried out by serving members of the Pakistani military in league with al-Qaeda. The potential to recruit insiders in Pakistan is recognized by al-Zawahiri, who has publicly called on Pakistanis to choose between Muslim possession of nuclear weapons and U.S. military intervention and seizure of Pakistan's arsenal in a crisis. Such conspiracy thinking plays to the prevailing sentiments in the country and may well inspire an insider to assist terrorists. Bashiruddin Mahmud, CEO of the UTN, has also called publicly on Pakistan to expand its weapons program as both a deterrent and a hedge against U.S. intervention.[29]

29 "Transcript of Sultan Bashiruddin Mahmood's Interview on Pakistan Nuclear Program," *WAQT News TV*, July 23, 2009, available at http://www.pakistantalk.com/forums/nuclear-missiles/3102-sultan-bashiruddin-mahmood-interview-pakistans-nuclear-program.html

North Korea

The worst-case scenario would be that North Korea sells a nuclear weapon or its components to terrorists. The discovery of Syria's al-Khibar reactor, which was built with North Korean assistance, suggests Pyongyang may not possess long-assumed, self-imposed constraints on transferring nuclear weapons technologies to other parties. Although there have been no reported ties between North Korean officials and Islamist terrorists, the al-Khibar precedent raises fresh questions concerning North Korea's nuclear behavior—specifically, whether the regime or elements of the regime (an "A.Q. Kim network"?) could wittingly or unwittingly assist a sub-state actor in acquiring a nuclear capability.[30] Transfer to terrorists, however, would pose the major threat that they would use what was transferred in a way that would provoke retaliation and, ultimately, lead to the removal of the regime from power. Such a scenario would very likely deter a conscious state decision to make such a transfer, though it might not deter rogue elements of a regime from making such a transfer if they believed they could do so without detection.

Non-Nuclear-Weapon States

A significant amount of HEU and plutonium separated from spent fuel exists in non-nuclear-weapon states. Most of these states, like most of the aforementioned states with nuclear weapons, pose no unique dangers. But as noted earlier, security standards in the civilian sector are often lower than in the military sector. Here, too, all states where these stocks exist have more to do to ensure that they are protected against the kinds of theft attempts that terrorists and malicious insiders are capable of.

Nuclear Supplier Networks

A wide variety of non-state organizations could potentially serve as witting or unwitting enablers of a terrorist nuclear plot. Illicit nuclear networks constitute an enabling element in acquiring nuclear capability. In this connection, UTN and A.Q. Khan's associates remain at large. They maintain access to sensitive documents, technologies and industries. Moreover, UTN members have not renounced their extremist views or ties. Past precedent suggests that the A.Q. Khan and UTN networks are probably not the first or the last "WMD-for-hire" global supplier networks. We have been fortunate in that thus far, rogue nuclear suppliers have not been implicated in providing substantial nuclear capabilities to terrorist groups.

30 David Sanger, "U.S. Awaits North Korea Response to Reactor Photos from Syria." *New York Times,* April 25, 2008, available at http://www.nytimes.com/2008/04/25/world/asia/25iht-nukes.4.12354437.html

People and Material-Smuggling Networks

The leaders of organized criminal groups surely understand the consequences of smuggling and trafficking in nuclear technologies and materials. The question is whether such prudence extends downward through the ranks of those organizations—and how much real control their leaders have over their subordinates. Like nuclear supplier networks operating on behalf of states, organized crime has its own rogue elements who are willing to engage in nuclear trafficking when there is money to be made. Anyone trying to move genuine weapons-usable material to a customer will have a good feeling for the value of the merchandise. Trusted venues will be used when possible, e.g., terrorists are likely to turn to "dirty" Islamic charities (some of which fund and provide logistical support for terrorist operations) and the people-smuggling networks that they use to move operatives around the world.

Availability of Nuclear-Related Information on the Internet

Sensitive nuclear weapons-related information is widely accessible and has become a critical factor in nuclear terrorism. If a terrorist group accesses the main streams of information that apply to the fundamental physics of nuclear weapons, it is likely to head in the right direction in terms of obtaining reliable information about all of the main elements required to construct a simple yet effective crude device.

VII. LONG TERM TRENDS

Terrorism is but one means of achieving the political goals of separatists and representatives of other political movements. Types of terrorism include ethnic terrorism, religious terrorism, extremist terrorism, economic terrorism, technological terrorism and state terrorism. Most terrorist groups are unlikely to be interested in causing mass violence on a nuclear scale, which might do more to undermine than to promote their political objectives.

But as the cases of al-Qaeda, the North Caucasus groups, and Aum Shinrikyo demonstrate, some terrorists do seek to inflict mass casualties, and have sought nuclear weapons. With three groups having already gone down this road in the last 15 years, the world cannot expect that they will be the last. The long-term threat is broader than al-Qaeda associates and North Caucasus groups, is not confined to Islamic extremists, and is likely here to stay.

Some aspects of contemporary terrorism differ greatly from the terrorism of the 19th and 20th centuries. Modern terrorism has the following distinct features:[31]

- It poses a much greater threat to public safety, with some terrorist groups seeking to maximize casualties and damage, without restraint or concern that backlash could threaten their political objectives.
- It is public in nature, in that its attacks are designed to provoke a specific public reaction to the terrorist's narrative, as well as a specific government response.
- Its main goal is to create an atmosphere of fear to coerce the entire society.
- It is characterized by acts of violence inflicted upon one group of people with the aim of influencing a different group of people.

Internal and External Factors

Certain factors motivating acts of terrorism predate the age of nuclear terrorism and are unlikely to ever be eradicated. While these factors neither justify nuclear terrorism nor form its proximate

31 For a discussion of factors that facilitated transformation of terrorism into a global threat, see Pavel Zolotarev, "International terrorism: sources and scenarios of development," *Finansovy Kontrol*, Issue No 6, 2003.

cause, they may present warnings and indicators of impending acts of large-scale terror. These factors are not limited to, but include the following:

- Substantial declines in the standard of living in certain countries; the deepening gap between rich and poor.
- High unemployment, leading to economic migration and feelings of individual degradation and disorientation.
- Additional societal conditions that leave individuals feeling humiliated and/or deprived of dignity and rights.
- The ability of terrorist groups to give their members a sense of belonging and commitment to a larger cause.
- State repression of opposition and dissent.
- Ethnic repression.
- Widening access to information that propagates violence and intolerance and glorifies terrorism.
- The relative availability of nuclear weapons, whether illicitly acquired or manufactured with crude methods.
- Concealed sponsorship of terrorism by certain countries in other countries with the aim of achieving concrete foreign policy goals.
- Sociopolitical conditions of relative transparency and vulnerability that leave certain societies particularly vulnerable to the staging of more spectacular and effective terrorist attacks.

Nuclear Renaissance in the 21st Century

Nuclear terrorists could seek material from the nuclear fuel cycle to use in a bomb. As rising demand for energy drives more countries to develop nuclear power programs, this global expansion must be carefully managed to minimize the potential proliferation risks associated with the nuclear fuel cycle, and to provide effective security for the use, storage, transportation and disposal of nuclear materials that might become accessible to terrorists.

HEU and plutonium separated from spent fuel—the essential ingredients of nuclear weapons—exist in more than two dozen countries. Some 30 countries operate nuclear reactors that could

potentially be targets for sabotage. That number will increase as additional countries adopt nuclear power. Some of the existing countries with nuclear material or facilities of concern are politically unstable or fare poorly in international assessments of regulatory effectiveness or control of corruption, and the same is true of many of the states now considering launching nuclear-power programs of their own. Moreover, nearly all states and thousands of facilities store radioactive materials that could be used in a dirty bomb, and many of these facilities do not meet the highest security standards.

Erosion of Non-Proliferation Regimes

It will be difficult to systematically lower the risks of nuclear terrorism as long as the number of nuclear weapons states and arsenals continues to grow. The Treaty on the Non-proliferation of Nuclear Weapons (NPT) has been undermined by North Korea becoming the first state ever to withdraw from the treaty and test nuclear weapons; by Iran's refusal to comply with legally binding UN Security Council resolutions; by the A.Q. Khan black-market nuclear network; by increasing North-South divides over what nuclear activities are reasonable and what nuclear restraints deserve support; by the nuclear weapons programs of states outside the treaty, including Israel, India, and Pakistan; and by a widespread perception among the non-nuclear-weapons states that the nuclear-weapons states have not adequately fulfilled their obligation to negotiate in good faith toward nuclear disarmament. Failure to address these issues could lead to additional nuclear proliferation.

Iran

IAEA inspections have exposed serious violations of Iran's obligations as an NPT signatory. Moreover, there is some evidence that Teheran has been secretly acquiring technologies and materials important in the production of nuclear weapons on the black market. This and other evidence, such as the behavior of the Iranian leadership, strongly suggests that Iran aspires to eventually become a full-fledged nuclear power—or to have the option to build nuclear weapons at any time of its choosing.

Factors that Reduce the Threat

International cooperation: [32]

- Treaty on the Non-Proliferation of Nuclear Weapons
- Nuclear-weapons-free zones
- United Nations Security Council (UNSC) Resolutions 1373, 1540, and 1887 [33]
- International Convention for the Suppression of Acts of Nuclear Terrorism
- International Convention on Protection of Nuclear Material
- Global Initiative to Combat Nuclear Terrorism
- International Atomic Energy Agency Safeguards Agreements, including the Additional Protocol to IAEA Safeguards Agreements
- G-8 Global Partnership vs. the Spread of Weapons and Materials of Mass Destruction
- Proliferation Security Initiative

Major organizations and events:

- International Atomic Energy Agency
- Nuclear Suppliers Group
- Australia Group
- Zangger Committee
- World Institute for Nuclear Security
- Nuclear Security Summits

32 For assessments of international efforts to prevent nuclear terrorism see Alexander Pikayev, Chapter 2 "International Law in Countering Nuclear Terrorism Threat" in "Threat of Nuclear Terrorism", edited by Alexei Arbatov, Institute of World Economy and International Relations, (Moscow, Russia, 2008) and Konstantin Kosachev, Introduction to PhD Candidate's Thesis "Concept of Development of International Law in the Sphere of Countering Nuclear Terrorism," (Moscow, Russia, 2003.)

33 For one assessment of the UN's role in preventing nuclear terrorism, see Alexander Kalyadin, Chapter 5 "UN's Role in Preventing Nuclear Terrorism" in "Threat of Nuclear Terrorism", edited by Alexei Arbatov, Institute of World Economy and International Relations, (Moscow, Russia, 2008).

Bilateral cooperation:

- Nunn-Lugar Cooperative Threat Reduction Program
- Cooperative nuclear security and accounting upgrades, including the Bratislava Nuclear Security Initiative
- Efforts to convert HEU-fueled research reactors and remove their HEU, including the Global Threat Reduction Initiative
- U.S-Russia Highly Enriched Uranium Purchase Agreement
- U.S-Russian Plutonium Management and Disposition Agreement
- U.S.-Russia Strategic Framework Declaration
- U.S.-Russia Agreement for Peaceful Nuclear Cooperation/123 Agreement
- U.S.-Russia Working Group on Nuclear Energy and Nuclear Security
- U.S-Russian Working Group on Foreign Policy and Fighting Terrorism
- U.S-Russian Working Group on Arms Control and International Security

VII. RECOMMENDATIONS

- Nuclear terrorism must be addressed as part of the broader phenomenon of terrorism and extremism. Al-Qaeda and other groups draw motivation for the pursuit of WMD from the belief that escalating the conflict by inflicting mass casualties is necessary to win a perceived "clash of civilizations" between Islam and the West.
- The United States and Russia must lead international efforts to encourage states to cooperate more closely to ensure terrorists do not succeed in acquiring nuclear weapons-usable material. These efforts should be closely coordinated with the UN and the IAEA. Despite the fact that nuclear security continues to improve globally, due in part to increased investments in material, personnel, control and accounting procedures, urgent work remains to be done to fully secure all nuclear weapons-usable materials. All stocks of nuclear weapons, HEU, and plutonium must be protected against all plausible terrorist and criminal threats, and the number of locations where these stocks exist must be reduced as much as practicable.
- The image of one of the most senior scientists in Pakistan's nuclear-weapons program drawing an improvised nuclear device for Osama bin Laden serves as a jarring reminder of the importance of continuing to eliminate al-Qaeda's senior leadership. Killing of Osama bin Laden is likely to damage al-Qaeda's ability to pull off a large scale WMD attack, to the extent such a plan may not have matured and there are few high level leaders in the group with the known interest in planning such attacks. But these remaining few leaders can still serve as the key drivers of al-Qaeda's nuclear ambitions, and therefore capturing or killing them would be an important victory in the campaign to prevent nuclear terrorism.
- Senior leaders should encourage and support enhanced intelligence and law-enforcement cooperation between Russia and the U.S., particularly in resolving past, present and future cases of weapons-usable nuclear material found to be outside of state control.
- U.S.-Russian international leadership is critical in promoting and supporting the roles of intelligence and law enforcement, the IAEA, and international police organizations as appropriate.

- International cooperation should encourage the development of national and jointly tailored intelligence tradecraft to detect and neutralize any existing or prospective terrorist nuclear plot, thereby strengthening interdiction and attribution, nuclear-exercise cooperation, and contingency planning. Special attention should be paid to cooperation between the law-enforcement and security services of those Islamic states which are fighting terrorist organizations and constraining the actions of Islamic extremists.
- The insights into al-Qaeda's strategic and operational thinking afforded by *Exoneration* and other discourses must be exploited to prepare for future terrorist attacks. Counterterrorism strategies too often depend on current trends shaping al-Qaeda's status and activities. This is a prescription for being once again surprised by the unanticipated.

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