

**DRAFT**

*Report #05-020*

**VARIABLE AFFECTING THE ACQUISITION OF  
NUCLEAR WEAPONS BY TERRORIST GROUPS:  
A SURVEY OF RECENT LITERATURE AND  
IMPLICATIONS FOR RISK ANALYSIS**

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## **Abstract**

This report examines the general consensus of very recent literature regarding the threat of nuclear terrorism, and seeks to outline any points of contention that are currently disagreed upon, as well as any assumptions that may be incorrect or skewed. This approach focuses solely on the acquisition of nuclear capability, and not on the delivery or ability to detonate weapons in a potential terrorist attack.

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## **Introduction**

The prospect of a nuclear attack by terrorist groups constitutes a “worst-case scenario” that would devastate a country both physically and psychologically. It is hard to imagine that assurance of national security would even be possible in the aftermath of such an event. Many have deemed this risk as “low-risk, high consequence” since it would be quite difficult from end-to-end for a terrorist group to produce or purchase a nuclear weapon, smuggle it into a country undetected, and detonate it. Nonetheless, there has been documented evidence that terrorists are indeed pursuing nuclear capabilities, and their zeal should not be underestimated. This report serves as an introduction and an investigation into recent developments regarding the acquisition of nuclear weapons by terrorists.

### **Terrorist motivation and desire for nuclear capability: Examples from Al Qaeda and Aum Shinrikyo**

Today, there are multiple sub-state terrorist groups that actively pursue nuclear capability to inflict mass destruction on innocent people. Their motivations and ultimate goals vary across a wide spectrum of political, religious, and nationalist beliefs. Due to the very nature of the concept of terrorism – “premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents”<sup>1</sup> – it is designed to influence an audience, and these groups will constantly seek to outdo past

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<sup>1</sup> Title 22, United States Code, Section 2656f(d)

terrorist attacks and pursue more deadly wide-spread destruction for their next attack.

Logic would argue that terrorists will pursue nuclear weapons, and concrete evidence has confirmed intentions to reach such capability. Groups such as Al-Qaeda have a confirmed specific intent to use nuclear weapons against the United States. Al-Qaeda's "defensive jihad" ideology suggests that they believe they should use weapons of massive destruction to remove western occupants from the holy land of Iraq, and to claim Jerusalem. This ideology urges Muslims to fight on behalf of what they believe to be attacks on Muslims all over the world<sup>2</sup>. Osama Bin Laden has personally vowed to kill at least four million Americans.

Documents like the "Superbomb," seized by Operation Enduring Freedom, confirm that Al Qaeda has at least begun climbing the learning curve in nuclear weapon science. This document was found in the home of a senior Al Qaeda member, and contains the author's notes regarding nuclear weapons, physics, materials, and ways to produce them. Although the text does not come close to being a recipe for making nuclear weapons, it shows the organization's interest and desire to pursue nuclear capability<sup>3</sup>.

In addition, Bin Laden received a fatwa – a religious ruling given by an Islamic scholar – that he is justified in using nuclear weapons against the United States. Former senior CIA analyst Michael Scheuer reports on the May 2003 decision by Saudi sheik Hamid bin Fahd, "... the treatise found that he was

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<sup>2</sup> "Al Qaeda," MIPT Terrorism Knowledge Base. Accessed at <http://www.tkb.org/Group.jsp?groupID=6>

<sup>3</sup> David Albright, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents". The Nautilus Institute, Special Forum 47: November 6, 2002.

perfectly within his rights to use [nuclear weapons]. [Some] Muslims argue that the United States is responsible for millions of dead Muslims around the world, so reciprocity would mean you could kill millions of Americans.”<sup>4</sup>

Other groups like Japan’s Aum Shinrikyo sought nuclear weapons for their religious beliefs. This Japanese cult believes that their leader, Shoko Asahara, has traveled in time to the future and seeks to trigger the apocalypse so that they may reach salvation in a final battle of good versus evil.<sup>5</sup> Their desire for nuclear weapons reflected this belief, and they attempted to both purchase a turnkey nuclear weapon and build their own nuclear material. Aum had connections with senior Russian officials that they intended to exploit for nuclear information and materials. In 1992, Shoko Asahara reportedly made a \$500,000 to \$1 million donation to Russian Security Council head Oleg Lobov in hopes of fostering a long-term relationship. Ultimately, Russian officials did not transfer sensitive nuclear technology, but Aum did succeed in accessing the Russian black market and gaining chemical weapons capabilities.

Their next attempt involved purchasing a ranch in Banjawarn, Australia to test chemical weapons and mine uranium<sup>6</sup>. Although the uranium proved to be too sparse to extract, Aum succeeded in building a sarin nerve agent that they released into a Tokyo subway in 1995 causing 12 deaths and 5,000 injuries.<sup>7</sup>

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<sup>4</sup> “Bin Laden Expert Steps Forward”. CBS News. Nov. 15, 2004.

<http://www.cbsnews.com/stories/2004/11/12/60minutes/main655407.shtml>

<sup>5</sup> “Aum Shinri Kyo”. MIPT Terrorism Knowledge Base. Accessed at

<http://www.tkb.org/Group.jsp?groupID=3956>

<sup>6</sup> Sara Daly, John Parachini, William Rosenau. “Aum Shinrikyo, Al Qaeda, and the Kinshasa Reactor: Implications of Three Case Studies for Combating Nuclear Terrorism.” Rand Corporation, Project Air Force. 2005.

<sup>7</sup> “Sarin attack remembered in Tokyo.” BBC News, world edition. 20 March, 2005. Accessed at <http://news.bbc.co.uk/2/hi/asia-pacific/4365417.stm>

Sub-state terrorist groups have a unique proclivity to use weapons of mass destruction as a tool of terrorism. First, they are not deterred by the nuclear capability of their targets – Since they have no specific nation to call home, they are not threatened by nuclear retaliation. The nature of terrorist operations, much like organized crime, requires residence in a clandestine location where authorities cannot intervene. In addition, a military strike – let alone nuclear – from the United States sent to a country that is believed to have allowed the production of the weapon, or to have harbored terrorists, could result in an increase in the supportive base for the terrorist group if civilian casualties and emotional propaganda are sensationalized by the media. This would constitute a victory on multiple levels for a terrorist organization.

Due to their clandestine and criminal nature, terrorists can use means such as extortion and kidnapping to achieve the knowledge and materials that they need to build a nuclear weapon. Reports indicate that many groups use kidnapping, robberies, and extortion as fundraisers on a regular basis to raise funds.<sup>8</sup> Perhaps this scenario may have already occurred in secrecy, since the targeted official would certainly fear consequences for reporting the crime to the police/government. Since one nuclear scientist with extensive knowledge and experience in a state-sponsored nuclear program could reveal enough sensitive information to enable the construction of a nuclear weapon, this is a threat that should be carefully considered.

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<sup>8</sup> Yvon Dandurand and Vivienne Chin, “Links Between Terrorism and Other Forms of Crime”. International Centre for Criminal Law Reform and Criminal Justice Policy. Report submitted to Foreign Affairs Canada and U.N. Office on Drugs and Crime. April, 2004.

Finally, terrorist groups are naturally adept at influencing and coercing people into embracing their ideology. The same mechanisms which assimilate a normal person into a terrorist willing to give their life for a cause can be used to assert ideology upon a nuclear scientist or the like. For example, a number nuclear scientists and academics with graduate degrees were drawn into Aum Shinrikyo, whose charismatic leader convinced them to join the cause with promises of resources and flexibility in research, and the chance to reach divine salvation<sup>9</sup>.

## **Fissile materials and their use in nuclear weapons**

It is generally agreed that the biggest hurdle in achieving nuclear weapon capability is obtaining the fissile materials to create the fission core. The core, or “pit”, is the part of the bomb that sets off a nuclear fission reaction which is discharged at once to create an extremely powerful explosion. The two types of fissile materials that can be used in nuclear weapons are highly enriched uranium (HEU) and separated plutonium. These elements occur naturally in the earth, but they must be altered by man-made processes in order to be used in weapons.<sup>10</sup>

Natural plutonium must be processed and enriched at specially designed facilities in order to be converted into weapon grade material. First, the plutonium must be used in a nuclear reactor where it will end up in the spent

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<sup>9</sup> Sara Daly, John Parachini, William Rosenau. “Aum Shinrikyo, Al Qaeda, and the Kinshasa Reactor: Implications of Three Case Studies for Combating Nuclear Terrorism.” Rand Corporation, Project Air Force. 2005.

<sup>10</sup> “Fissile Material Basics”. Institute for Energy and Environmental Research. Accessed at [http://www.ieer.org/fctsheet/fm\\_basic.html](http://www.ieer.org/fctsheet/fm_basic.html)

nuclear fuel along with other byproducts. Next, it must be sent to a reprocessing plant where it is chemically separated from the spent fuel. Only after these two steps will the plutonium be ready to be fitted into a nuclear weapon<sup>11</sup>.

The other type of fissile material, uranium, also must be enriched before it is usable in nuclear weapons. The enrichment of uranium is a difficult and expensive process that requires extremely technical facilities. The methods that are currently used to enrich uranium include using centrifuges, gaseous-diffusion, and electromagnetic separation<sup>12</sup>.

These processes are extremely expensive and require precisely engineered components to operate effectively. However, this does not stop terrorists from purchasing or stealing highly enriched uranium and separated plutonium to avoid this difficult process. Most experts focus on the newly independent states (NIS) that were formed when the Soviet Union collapsed in 1991. Table 1 illustrates the many reports of theft and smuggling of fissile materials in the NIS.

**Table 1:  
Overview of confirmed proliferation-significant incidents of fissile material trafficking in the NIS, 1991-2001**

<b>CASE NAME &amp; DATE OF DIVERSION</b>	<b>MATERIAL DIVERTED</b>	<b>ORIGIN OF MATERIAL</b>	<b>RECOVERY OF MATERIAL</b>
<b>Podolsk</b> 5/92-9/92	1.5 kg of 90% HEU	Luch Scientific Production Association, Podolsk, Russia	10/9/92: Russian police operation intercepted the smugglers in the Podolsk train station.
<b>Vilnius, Lithuania</b>	About 100 g 50%	Institute of Physics	5/93: Approximately 100 g HEU

<sup>11</sup> Ibid.

<sup>12</sup> Ibid.



early 1992	HEU	and Power Engineering, Obninsk, Russia	discovered in Vilnius bank vault embedded in portions of a shipment of four metric tons of beryllium.
<b>Andreeva Guba</b> 7/29/93	1.8 kg of 36% HEU	Naval base storage facility, Andreeva Guba, Russia	7/29/93: Russian security forces arrested the thieves before they could smuggle the material out of Russia.
<b>Tengen</b> Unknown	6.15 g of Plutonium-239	Unconfirmed; possibly Arzamas-16, Russia	5/10/94: Police in suspect's apartment for another reason, stumbled upon the cache of plutonium.
<b>Landshut</b> Unknown	800 mg of 87.7% HEU	Unconfirmed; likely Obninsk	6/13/94: Undercover German police acted as potential customers in a sting operation.
<b>Sevmorput</b> 11/27/93	4.5 kg of 20% HEU	Naval shipyard, Sevmorput, Russia	6/94: The brother of a suspect asked a co-worker for help finding a customer. The co-worker notified authorities.
<b>Munich</b> Unknown	560 g MOX fuel; 363 g of Plutonium-239	Unconfirmed; likely Obninsk	8/10/94: Undercover German police acted as potential customers in a sting operation.
<b>Prague</b> Unknown	2.7 kg of 87.7% HEU	Unconfirmed; likely Obninsk	12/14/94: Anonymous tip to police giving the material's location (a parked car). In two instances in June 1995, Czech authorities recovered small additional amounts of HEU believed to be from the same source.
<b>St. Petersburg*</b> Unknown	3.05 kg of 90% HEU	Unconfirmed; likely Machine Building Plant, Elektrostal, Russia	6/8/94: Russian news agencies report that in March 1994, Russian Federal Security Service agents arrested three suspects attempting to sell about three kg of HEU. Russian officials have confirmed the incident.
<b>Moscow</b> May 1994	1.7 kg HEU	Elektrostal	6/8/95: In a sting operation, Russian Federal Security Service agents arrested three suspects trying to sell HEU, one of whom was an employee of Elektrostal.
<b>Sukhumi</b> Unknown	Approximately 2 kg of 90% HEU	I.N. Vekua Physics and Technology Institute, Sukhumi, Georgia	12/97: Russian inspection team visited facility, which had been closed by 1992 Abkhazian-Georgian conflict, and found facility abandoned, and material included in 1992 inventory missing. Material has not been recovered.
<b>Chelyabinsk Oblast, Russia</b> Unknown	18.5kg HEU (enrichment level unspecified)	Unknown, possibly Mayak Production Association, Chelyabinsk-70, or Zlatoust-36	12/17/98: Russian Federal Security service reports that it thwarted an attempt by workers at a nuclear facility in Chelyabinsk Oblast to steal 18.5 kg nuclear material. 10/00:

			Russian Ministry of Atomic Energy official confirms incident involved HEU.
<b>Dunav Most, Bulgaria</b> Unknown	10 g 76% HEU	Unknown	5/29/99: Bulgarian customs officers discovered HEU hidden in the trunk of a car crossing into Bulgaria from Turkey. Driver said he had obtained material in Moldova.
<b>Batumi, Georgia</b> Unknown	920 g 30% HEU	Unknown	4/19/00: Georgian police arrested four suspects and seized HEU.

\* This case is included in the list of confirmed trafficking incidents largely on the basis of reports made to the International Atomic Energy Agency by the Russian Federation. Additional corroborating evidence, however, is not readily available.

Source: Monterey Institute of International Studies. Accessed at <http://cns.miis.edu/pubs/reports/traff.htm>

## Security and Sources of Fissile Materials

A major point of contention in which many experts disagree is the security of the various facilities that house HEU and plutonium across the world. In particular, there is great concern over Russian and NIS facilities which may have had less than adequate security due to the hardships that they faced following the fall of the Soviet Union. It is still unclear whether nonproliferation efforts by the US Department of Energy's Material Protection, Control, and Accounting Program (MPC&A), which was created to coordinate with the Russian Ministry of Atomic Energy (now as Federal Agency of Atomic Energy) have been effective and consistent in securing fissile material sources.

It appears that experts and officials have a wide spectrum of opinions on the matter. The 2004 Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces by the National Intelligence Council (NIC) outlines this discussion. Even among Russian officials themselves,

there is much disagreement on whether or not nuclear materials have been stolen in the past or are currently insecure.

The head of the Russian Federal Inspectorate for Nuclear and Radiation Safety Gostomnadzor (GAN), Yuri Vishnevskiy, reported that nuclear materials such as grams of weapons-grade uranium have disappeared from Russian nuclear facilities in November 2002. In response, Minister of Atomic Energy Rumyantsev states, "Everything that was lost was subsequently traced and returned to the relevant arsenals. It may not have been instantly, it may have taken several years, but all these thefts were carefully investigated and prevented." The NIC is extremely skeptical of these claims, and suspects that Russian authorities would not have been able to recover all lost materials. In addition, a March 2003 memorandum from GAN reported "...there are serious flaws in the physical protection of nuclear risky facilities in the industry... the unauthorized use of radioactive materials and their theft cannot be ruled out."<sup>13</sup>

To further confound the issue, other Russian officials adamantly insist that there are no missing Russian nuclear weapons, and that the current stockpile is safe and secure. In April 2004, Russian Defense Minister Sergei Ivanov made a statement in Washington that it is impossible for terrorists to obtain a Russian nuclear weapon from Moscow stockpiles. Furthermore, in 2002 former Minister of Atomic Energy Adamov reported, "Neither Bin Laden nor anyone else could

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<sup>13</sup> National Intelligence Council. Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces. December 2004.

steal a nuclear warhead from anywhere in the former Soviet Union...Nothing was stolen from us.”<sup>14</sup>

Experts William C. Potter and Fred L. Wehling from the Monterey Institute for International Studies noted in their analysis, “Nevertheless, the foundation for nonproliferation safeguards in Russia and other post-Soviet states remains at best a very rudimentary one. It has major gaps in its coverage, is uneven in its application, and in some crucial respects relies upon inappropriate building blocks for its strength. At several sites, the foundation has even begun to crumble, notwithstanding DOE commissioning ceremonies that sometimes have conveyed the impression that the construction task is complete or at least that the integrity of the structure is sound.”<sup>15</sup> Table 2 reviews the relevant US programs to address Russian fissile material security.

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<sup>14</sup> Ibid.

<sup>15</sup> William C. Potter and Fred L. Wehling, “Sustainability: A Vital Component of Nuclear Material Security in Russia”. Monterey Institute for International Studies – Center for Nonproliferation Studies (CNS). Spring 2000, Volume 7, Number 1

**Table 2:  
U.S. Programs to Secure and Reduce Russian Fissile Materials**

Program	Goal	Status	Completion Date
<i>Securing Fissile Material</i>			
Material Protection, Control, and Accounting (MPC&A)	Secure fissile material outside weapons	Rapid upgrades completed on 43% of material; comprehensive upgrades complete on 22% of material	2008
Mayak Fissile Material Storage Facility	Secure 50 tons of weapons-grade plutonium, but could secure HEU, as well	Loading to begin in 2004 depending on completion of transparency agreement	2020?
<i>Eliminating Fissile Materials</i>			
HEU Purchase Agreement	Down-blend 500 metric tons of weapons-grade HEU for sale as commercial nuclear power plant fuel	About 200 tons of HEU rendered unusable for nuclear weapons as of end of 2003; additional conversion at the rate of 30 tons/year	2012
MPC&A HEU Consolidation and Conversion	Consolidate and down-blend HEU from research centers and reactors in former Soviet Union and Eastern Europe	4.3 tons of HEU rendered unusable for nuclear weapons as of end of 2003; an additional 4 tons to be eliminated by the end of 2005	2005
Plutonium Disposition	Use 34 tons of weapons-origin plutonium as power reactor fuel, rendering it very difficult to use for weapons	First use in a Russian reactor scheduled for 2008, depending on resolution of liability agreement and completion of MOX fuel facility	2025
<i>Ending Production of Fissile Materials</i>			
Elimination of Weapons-Grade Plutonium Production	End production of 1.2 tons/yr of weapons-grade plutonium by providing fossil fuel plants as alternative sources of heat and power for three Russian production reactors	Revised agreement signed between the United States and Russia in 2003; DOE expects to complete design work for fossil fuel plants by end of 2004 and then provide Congress with an updated cost estimate	2011
Elimination of Civilian Plutonium Separation <i>No U.S. or international program</i>	End added accumulation of 1+ tons/yr of separated plutonium from Russian VVER nuclear power plants	No program	N/A

Source: Charles D. Ferguson and William C. Potter, "Improvised Nuclear Devices and Nuclear Terrorism". The Weapons of Mass Destruction Commission (WMDC)  
Accessed at <http://www.wmdcommission.org/>

Civil HEU stocks account for the amount of HEU that is used in civil nuclear programs to produce electricity, research, and radioisotopes for a variety of uses. Although recent nonproliferation treaties and legislation have begun to limit and provide alternatives to HEU, there are still facilities that use it in varying

levels of enrichment. Many countries keep their civil HEU stock numbers secret, and the only way to assess the global amount is via the IAEA's total HEU safeguarded figure. An important variable in considering the risk of nuclear terrorism is the amount and prevalence of civil HEU. Since this material is inherently less secure than weapons grade military HEU, it poses a great risk for insider/outsider theft. A recent GAO report in July 2004 emphasized the need to continue limiting weapons-usable HEU in civilian reactors<sup>16</sup>. Some of the major roadblocks include developing adequate LEU fuels to replace the HEU in use and lack of DOE funding to finance the conversion<sup>17</sup>.

**Table 2:**  
**Global Plutonium and Highly Enriched Uranium (HEU) Stocks, by Origin, end 2003, in tones\***

<b>Category</b>	<b>Plutonium</b>	<b>HEU</b>	<b>Total</b>
<b>Civil Origin</b>	1595	50? **	<b>1645</b>
Irradiated	1365	?	
Unirradiated	230 ***	?	
<b>Military Origin</b>	260	1850	<b>2110</b>
Primary	153	1250	
Naval and other		175	
Excess	107	425	
<b>Total</b>	<b>1855</b>		<b>3755</b>

\*These stocks of HEU and plutonium are organized by origin, which is defined here as which entity, military or civilian, had custody of the material as of January 1, 1994. This date was selected, because in 1994 the United States declared excess plutonium and HEU. Some of this excess material was then

<sup>16</sup> U.S. Government Accountability Office. Report to the Chairman, Subcommittee on Emerging Threat and Capabilities, Committee on Armed Services, U.S. Senate. Nuclear Nonproliferation – DOE Needs to Take Action to Further Reduce the Use of Weapons-Usable Uranium in Civilian Research Reactors.

<sup>17</sup> David Albright, "Civil Inventories of Highly Enriched Uranium." Institute for Science and International Security. October 8, 2003. Revised June 11, 2004. Accessed at [http://www.isis-online.org/global\\_stocks/civil\\_inventories\\_heu.html](http://www.isis-online.org/global_stocks/civil_inventories_heu.html)

assigned to civil inventories. In this table, those quantities are listed as the excess stock in the military origin category.

\*\*The civil HEU stock does not include roughly 10 tonnes of US and foreign civil HEU that is owned by the Department of Energy. This amount is included in the excess HEU amount.

\*\*\* This value does not include about 4-5 tonnes of US unirradiated plutonium that was originally produced in civil power reactors. As of January 1, 1994 this plutonium was part of the US military program and later part of the 52.5 tonnes the United States declared excess. For more information about unirradiated plutonium produced in civil power reactor programs, see 'Separated Civil Plutonium Inventories: Current Status and Future Directions,' April 1, 2004.

Adapted from: Institute for Science and International Security (ISIS). Accessed at [http://www.isis-online.org/global\\_stocks/summary\\_tables.html](http://www.isis-online.org/global_stocks/summary_tables.html)

In the 1950s, Eisenhower's "Atoms for Peace" program, which gave nuclear power to many developing nations, has greatly increased the risk by placing nuclear materials that could be used in a weapon of mass destruction in the hands of struggling countries without adequate resources to secure their facilities. It has been noted by many reports that this technology has aided the production of advanced weapons in some nations, effectively speeding up the proliferation of arms.<sup>18</sup>

Whether or not fissile materials are properly secured from theft and smuggling remains the most important point of controversy regarding the terrorist nuclear threat. The acquisition of adequate nuclear materials would be the ultimate shortcut in nuclear capability, and most agree that capable groups could build at least an improvised low-tech nuclear weapon.<sup>19</sup>

## **The Nuclear Black Market**

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<sup>18</sup> Peter R. Lavoy, Arms Control Association. "The Enduring Effects of Atoms for Peace". Arms Control Today. December, 2003.

<sup>19</sup> Steve Bowman and Helit Barel. CRS Report for Congress. "Weapons of Mass Destruction – The Terrorist Threat". December 8, 1999

The recent discovery of A. Q. Khan's nuclear black market has shed light on a great number of proliferation profiteers and suppliers. Nicknamed the "father of Pakistan's nuclear program," Dr. Khan revealed classified information and nuclear weapon designs to other countries. Countries which received information include Pakistan, North Korea, Libya, and Iran, with the possibility of many more. Khan's illegal ring provided buyers with plans for centrifuge systems to enrich uranium, nuclear bomb designs, and other components.<sup>20</sup> His black market radically differed from previous proliferators because he offered all of the necessary information and equipment needed to produce a nuclear weapon, including technical expertise and consulting. He also utilized a complex clandestine shipping network that involved the transfer of one shipment through multiple middle-men to mask their final location and intent.<sup>21</sup>

Khan was arrested when one of his shipments of 1,000 centrifuges was seized by Italian officials on a German boat headed for Libya. The centrifuges were precision engineered to exact specifications for the high-velocity rotation that is needed to enrich uranium. Dr. Khan received a pardon from President Pervez Musharraf for confessing and revealing a wealth of information that severely damaged the nuclear black market.<sup>22</sup> New details from the ongoing investigation revealed that enriched uranium particles have been found in Iran and are being sampled to determine the location of enrichment. In addition, the

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<sup>20</sup> David Albright and Corey Hinderstein, "Uncovering the Nuclear Black Market: Working Toward Closing Gaps in the International Nonproliferation Regime." Institute for Science and International Security (ISIS) Accessed at [http://www.isis-online.org/publications/southasia/nuclear\\_black\\_market.html](http://www.isis-online.org/publications/southasia/nuclear_black_market.html)

<sup>21</sup> Council on Foreign Relations. "Nonproliferation: The Pakistan Network". Updated February 12, 2004. Accessed at <http://www.cfr.org/publication.php?id=7751>

<sup>22</sup> Ibid.



US recently announced that North Korea was the supplier of uranium hexafluoride to Libya via the Khan network.<sup>23</sup>

An examination of the A. Q. Khan case study shows that the reliability and capability of the nuclear black market is an important variable in the acquisition of nuclear weapons by terrorists. If, as some reports argue, the nuclear black market has simply gone further underground, secondary proliferators who may have received critical information and materials from Khan could sell their wares at a premium price to buyers. However, extensive sting operations would appear to deter profiteers from making a hasty sale. An example of this was Operation Gamma, in which undercover agents posed as Middle Eastern buyers looking for nuclear materials. The agents were contacted by smugglers who agreed to a price of \$12.6 million. Italian authorities arrested the smugglers and seized the fuel rod which had been stolen from the Kinshasa research reactor in the Democratic Republic of Congo. Even though the fuel rod turned out to be low enriched uranium, it was still a threat because it could have been used in a nuclear weapon.<sup>24</sup>

Scams such as this one appear to be common in the nuclear black market, since profiteers obviously cannot turn to authorities when they are ripped off in an illegal nuclear materials transaction. In fact, there have been reports that Al Qaeda was scammed in the 1990s when smugglers sold them radiological waste which they believed to be weapons-grade nuclear material. In addition, finding a

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<sup>23</sup> Paul Kerr, Arms Control Association. "New Details Emerge on Pakistani Networks," Arms Control Today, May 2005.

<sup>24</sup> Nuclear Threat Initiative (NTI). "Sting Unravels Stunning Mafia Plot" NIS Nuclear Trafficking. Accessed at <http://www.nti.org/db/nistraff/1999/19990110.htm>

legitimate buyer has proven to be a difficult feat in the past. Some experts speculate that the person who stole the fuel rod from the Kinshasa reactor might have been searching for a buyer for twenty years.<sup>25</sup>

Transportation within the nuclear black market and international container security are important variables that affect the acquisition of nuclear materials. The implementation of radiological scanners and international container security efforts may prove to be a strong deterrent. Even the advanced clandestine shipping of A. Q. Khan's nuclear network was not sufficient, as his shipment of centrifuges bound for Libya was seized and ultimately led to the uncovering of the black market. If terrorists simply followed drug trafficking routes, they might be able to bypass any or all security checks and searches. This point is reinforced by the rising trend of terrorists linking up with organized crime groups to exchange weapons, training, and equipment. If this trend continues and more connections are made between the two types of groups, there could be an increased threat of nuclear materials entering the United States.

## **Expertise Needed to Construct a Nuclear Weapon**

If terrorists are indeed successful in obtaining an adequate amount of nuclear material, will they be able to construct at least an improvised nuclear device? Although some experts argue that the construction of a nuclear weapon is extremely difficult and requires immense expertise and capability, but the

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<sup>25</sup> Sara Daly, John Parachini, William Rosenau. "Aum Shinrikyo, Al Qaeda, and the Kinshasa Reactor: Implications from Three Case Studies for Combating Nuclear Terrorism. Rand Corporation. 2005

understanding is not generally reached that terrorists need only achieve an improvised low-yield nuclear device to realize catastrophic consequences.

There are two basic weapon design types that are widely accepted as the first-generation nuclear weapons that may be constructed using open-source literature with varying difficulty. The first is a “gun-type” weapon in which only highly enriched uranium may be used as nuclear materials. In this model, two subcritical masses of HEU will be fired into each other creating a devastating explosion. This is the least difficult weapon to create, and could easily be designed through information widely available on the internet and in other media.<sup>26</sup> In fact, a famous quote from Nobel laureate Luis Alvarez states, “With modern weapon-grade uranium, the background neutron rate is so low that terrorists, if they have such material, would have a good chance of setting off a high-yield explosion simply by dropping one half of the material onto the other half. Most people seem unaware that if separated, highly enriched uranium is at hand, it’s a trivial job to set off a nuclear explosion.”<sup>27</sup> The amount of HEU needed to construct a successful gun-type weapon has been estimated to be around 40-50 kilograms to ensure confidence in detonation. To be certain in overcoming any technical difficulties, a team with knowledge of explosives, metallurgy, draftsmanship, and chemical processing would be needed to

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<sup>26</sup> “Fission Weapon Designs”. The Nuclear Weapon Archive. Accessed at <http://nuclearweaponarchive.org/Nwfaq/Nfaq4-2.html>

<sup>27</sup> Luis W. Alvarez, “Adventures of a Physicist”. (New York,

confidently tackle this feat. A terrorist group like Al Qaeda would likely be able to recruit these experts with ease<sup>28</sup>

The other type of first generation nuclear weapon design is an implosion device. This type of weapon utilizes a plutonium sphere as its fission core, relying on a smooth implosion to create a supercritical state. In comparison with the gun-type design, this weapon is more complicated and would require more expertise to create. This design, however, can utilize either HEU or separated plutonium, and would only require about 25kg of weapons-grade HEU or 8kg of weapons-grade plutonium.<sup>29</sup> Although more technical, this design can certainly be created using only open-source literature. A famous U.S. experiment entitled “The Nth Country Experiment” has literally proven this to be possible. In this experiment commissioned by the US government, two young Ph. D. graduates with no prior knowledge of nuclear weapons successfully created an implosion device using only open-source information. The only help they received came from a few capable machinists and an explosives team, and they finished their design model in just three years.<sup>30</sup>

## **Resources and influence**

Building or purchasing the materials to create viable nuclear weapon would take a tremendous amount of resources. Many countries designate a large amount of funding to their nuclear weapons programs in order to maintain

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<sup>28</sup> Charles D. Ferguson and William C. Potter, “Improvised Nuclear Devices and Nuclear Terrorism.” The Weapons of Mass Destruction Commission (WMDC). <http://www.wmdcommission.org/>

<sup>29</sup> Ibid.

<sup>30</sup> Dan Stober, “No Experience Necessary.” Bulletin of the Atomic Scientists. March/April 2003. pp. 56-63 (vol. 59, no. 02)

this capability. If this is a challenge for a developed nation, it would be a considerable hurdle to a terrorist group. The cost alone severely limits the risk of nuclear terrorism to groups that can afford to utilize nuclear weapons. Table 4 illustrates sources of terrorist financing.

Unfortunately, some terrorists enjoy a great wealth of funding that has been obtained through extortion, kidnapping, charities, and drug trafficking. Sometimes there exists a mutually beneficial relationship between terrorism and drug traffickers. In many cases, terrorists offer protection to the drug smuggling operation, and receive a percent of the profit in return. In other cases, there are direct drugs-for-weapons trades between terrorists and organized crime. However, sometimes there is a conflict over who controls the drug trade between these two types of groups, and this can lead to deadly confrontations<sup>31</sup>.

**Table 4: Principal Sources of Terrorist Financing**

Domestic:	individual and corporate, voluntary contribution or coercive extortion
Diaspora-migrant communities:	voluntary contribution or coercive extortion
Co-ethnic and co-religious support	donations and contributions from people with religious or ethnic affinity
State-sponsorship:	patron states encouraging terrorist group to engage an inimical state
Public and private donors and individual financiers:	support for terrorist-controlled welfare, social and religious organizations
Low level crime and organized crime:	fraud, illegal production and smuggling of drugs, document forgery, smuggling, kidnapping for ransom, armed robbery, money-laundering, racketeering, smuggling of, and trafficking in, human beings

<sup>31</sup> Yvon Dandurand and Vivienne Chin, “Links between Terrorism and Other Forms of Crime.” International Centre for Criminal Law Reform and Criminal Justice Policy. Accessed at [http://www.icclr.law.ubc.ca/Publications/Reports/TNOC\\_LINKS\\_STUDY\\_REPORT.pdf](http://www.icclr.law.ubc.ca/Publications/Reports/TNOC_LINKS_STUDY_REPORT.pdf)

Investments and legitimate business: money earned (e.g. from publications) is used to acquire enterprises and engage in trade with profits being used to finance terrorism

Non-governmental organizations and community organizations: terrorist organizations set up front organizations, which receive funds from sister NGOs in other countries or infiltrate established community organizations, which receive grants.

Source: Adapted from Rohan Gunaratna “The Lifeblood of Terrorist Organizations: Evolving Terrorist Financing Strategies”, in: Alex P. Schmid (Ed.). *Countering Terrorism Through International Cooperation*. (Milan, ISPAC, 2001), pp. 182-185. Accessed at <http://english.safe-democracy.org/causes/links-between-terrorism-and-drug-trafficking-a-case-of-narcoterrorism.html>

## **Implications for Risk Analysis**

The most important variable affecting the acquisition of nuclear weapons capability by terrorist groups is the ability to obtain fissile materials. As has been previously documented, this is the ultimate short-cut in nuclear weapons production. With these materials, an improvised nuclear device may be constructed using only unclassified open-source information and with a very small team of experts. Since it is likely that groups such as Al Qaeda have the capability to recruit the necessary experts with ease, the main barrier to nuclear capability is obtaining these fissile materials. Issues affecting fissile material security must be looked at with renewed determination, and other areas such as the accounting systems for stockpiles should be re-evaluated. Perhaps an international standard for fissile material security should be created based on the risk analysis of each facility and nuclear inventory.

Another important variable is the reliability and capability of the nuclear black market. If, as press reports indicate, there are indeed weapons-grade fissile materials on the black market, there is a high risk that terrorists will seek and acquire these materials. To complicate the matter, countries such as Russia

and the NIS rarely reveal the findings of internal investigations, and so these claims may never be confirmed nor denied as threats to national security. A collaborative international intelligence effort to further reveal the nuclear black market and to evaluate these claims might clarify the risk.

Upon reviewing recent literature, it appears that a great deal of attention has been focused on the physical aspects of fissile material security in Russia and the NIS. These issues include barriers, walls, radiation portals, and other measures that may or may not be implemented to physically prevent theft or misuse of nuclear materials. Although these aspects are important, perhaps a more robust focus on insider threats and unconventional methods of attack would provide further insight.

Conceivably, a “creative” attack such as the disruption of spent fuel pools at reactors on U.S. soil would have a catastrophic effect both physically and psychologically. Some experts estimate that an attack on these nuclear waste storage structures would do more damage than a nuclear reactor meltdown, and that they are contained in more vulnerable facilities.<sup>32</sup> The majority of recent academic literature does not focus on unconventional methods such as these types of attacks. A more comprehensive risk analysis of nuclear/radiological attacks would include such possibilities and incorporate them into existing risk analysis models.

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<sup>32</sup> Robert Alvarez, “What about the Spent Fuel”. Bulletin of the Atomic Scientists. January/February 2002. pp 45-47 (vol 58, no. 01)