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Summary:
This paper provides some observations on the likelihood of nuclear terrorist violence and on the technical feasibility of crude nuclear weapon production. It will be shown that the production obstacles may be lower than anticipated and that technical barriers should not be regarded sufficient to avoid future nuclear terrorism.

Preventing any extremist group from achieving their goals of large-scale nuclear violence can best be done by denying them access to highly enriched uranium or plutonium, the essential ingredients of any nuclear device. Adequate protection and control of such materials is thus vital. However, the gap between the threat and the international response seems to be widening.

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Nuclear Terrorism: Threats, Challenges and Responses

By Morten Bremer Mærli

Only weeks after the devastating terrorist attacks on September 11th, 2001, a secret intelligence alert went out to a small number of U.S. government agencies. According to the alert, terrorists were thought to have obtained a nuclear weapon from the Russian arsenal and planned to smuggle it into New York City. In response to the threat, FBI alerted a number of other federal agencies, including the Nuclear Emergency Search Team (NEST).

In the days after September 11th, doomsday scenarios like a terrorist nuclear attack suddenly seemed plausible. In the end, however, the investigators found nothing and concluded that the information was false. The yield of the alleged nuclear weapon could have been equivalent to ten kilotons of TNT, thousand times higher than the biggest conventional bomb ever exploded. Detonated in lower Manhattan, the effects would have been devastating.

No terrorist group have publicly known ever deployed or fielded a nuclear device. Nuclear terrorism remains a fiction and scholars argue about the *real* threat of nuclear terrorism. According to some, “the possibility that terrorists could acquire a nuclear weapon and explode it in a U.S. city is real”, and the absence of flickering TV-screens worldwide with gruesome pictures in the wash of nuclear terrorist activities, is merely due to a “lack of means, rather than a lack of motivations”.[1] Such views are of course funded upon a belief that the scenes from lower Manhattan September 11th, 2001, is only the beginning. This day, the spectacular attacks were all performed with conventional terrorist means. However, the magnitude, crudeness, and the efficacy with which these actions were carried out could point in the direction of future large-scale terrorist uses of weapons of mass effect (WMEs).[2] More people died in one day on September 11th than in 35 years of sub-state terrorism in Western Europe.[3]

According to other scholars, however, nuclear terrorism is “an overrated nightmare”,[4] and while “chemical, biological, or radiological is likely to occur, nuclear terrorism is unlikely to do so, as it is too difficult”.[5] Others dismiss the risk of large-scale nuclear terrorist violence in their country on the grounds of internal factors such as geography, politics and security policy.[6] And indeed, conventional means are likely to remain the weaponry of choice for most terrorists.[7] Conventional weaponry, as painfully evidenced September 11th could still more than effectively serve their goals.

There will be practical, strategic, and perhaps even moral constraints against uses of WMEs. Unconventional means and methods of violence with new technical requirements and unknown outcomes – and thus an increased risk of failure – could be less appealing to sub-national groups. Any unsuccessful, failed, or uncontrolled action may waste resources, kill members of the terrorist groups, increase the risk of revelation and retaliation, embarrass the terrorist organization and reduce support amongst followers – all putting the very existence of the group at stake.

The use of weapons of mass destruction could stigmatize the terrorist group and render any political aspirations harder to accomplish. The constraints against the use of weapons of mass destruction are particularly severe for terrorists who are concerned with their constituents (like social revolutionary and national separatist terrorists).[8] Therefore, there has always been a huge gap between the potential of a weapon and the abilities and/or the will to employ it by terrorists.[9]

However, as the world will experience new acts of terror, provable and strong interest amongst some high-profile terrorist groups in acquiring nuclear weapon capabilities does not allow us to ignore the risk of nuclear terrorism.[10] The risk may still be low, but the possible level of physical destruction, fatality and injury is so great in and of itself that the potential for terrorist acquisition and use of nuclear devices warrants serious considerations.

While only a thorough and interdisciplinary analysis will have the chance of providing decisive answers to the question of the future threat of nuclear terrorism, this paper provides some observations on the likelihood of nuclear terrorist violence and on the technical feasibility of crude nuclear weapon production. It will be shown that the technical obstacles may be lower than anticipated and that technical barriers should not be regarded sufficient to avoid future nuclear terrorism. The primary barriers against large-scale nuclear terrorist violence are likely to be access to highly enriched uranium and plutonium, the essential component of any nuclear device. Protection and control of the materials is thus essential.

The paper concludes with some policy recommendations in urgent need for implementation, as the gap between the threat and the international response seems to be widening.[11]

THE THREATS: TERRORISTS WITH NUCLEAR CAPABILITIES

There are four varieties of "nuclear terrorism". The ones with potentially the gravest consequences involve scenarios with nuclear weapons where 1) a complete nuclear weapon be taken over by rouge elements – often a preferred setting for Hollywood thrillers – or 2) nuclear materials get stolen for the subsequent fashioning a nuclear explosive device. Any nuclear detonation will result in huge physical *and* psychological damages.

Nuclear power plants or spent fuel storage sites may further be attacked, primarily to cause radioactive releases and societal disturbances. Terrorist could accomplish a similar outcome by combining highly radioactive nuclear material with conventional explosives to create radiological dispersal devices – so called "dirty bombs." No such bombs, nor commercial nuclear power plants, may ever become nuclear explosive devices or produce kiloton yields. However, the associated psychological impact may be strong. A taste of the likely media hullabaloo and public reaction was recently given when an American citizen with alleged ties to the Al- Qa'ida terror network was arrested on suspicion of plotting to build and detonate a radioactive "dirty bomb" in the United States.[12]

While all of these terrorist threats merit the attention of both national governments and the international community, emphasis in this paper is given to possible terrorist uses of crude nuclear devices, as opposed to potential radiological terrorism or deliberate attacks on nuclear power plants. Though related and lately discussed with increasing frequency and intensity, such types of "nuclear terrorism" would not result in the possibly hundreds of thousands of immediate fatalities that could be caused by a crude nuclear weapon.[13] A particular focus will be given to gun-type HEU devices, the simplest and possibly the most reliable crude nuclear device ever assembled. If any, such weapons could be the most likely choice for aspiring nuclear terrorists.

Changing motivations and opportunities

Terrorism may be regarded as a way of communicating. As clearly evidenced on Manhattan, terrorist incidents are often high-profile events. The news media tend to focus on spectacular and negative events.[14] To get attention, most terrorists traditionally want showy attacks that produce a great deal of noise. The immense destructive power and the definitive "shock value" of nuclear weapons will immediately create a manifest confirmation of an attack, and, of course, wide-spread and direct attention. Moreover, the detonation of a nuclear device could set a terrorist organization apart from any other group and could compel governments to take them seriously.[15]

The public has greater fear of events and consequences that e.g. are uncontrollable, dreadful, widely publicized, irreversible, and not well understood.[16] The psychological impact of nuclear detonations is therefore likely to be strong, with a radius of psychological damage far exceeding that of injury and death. Past nuclear explosions and nuclear accidents, limited public understanding and knowledge of radiation, and the human inability to sense potential exposures may have cultivated (disproportionate) negative perceptions of radiation. Terrorists who capitalize on these factors are likely to have a strong impact.

While the majority of terrorist groups are likely to stick to traditional terrorist means, some groups may be ready to take the step up to a new level of weaponry. Weapons of mass effect may thus again come to be used outside the sphere of state military activities, as seen in the Tokyo metro sarin nerve agent attack in 1995. This was the first widely publicized large-scale attempt at using weapons of mass effect for terrorism.[17] Similar or related actions cannot be ruled out in the future, as several interrelated developments have increased the risk that terrorists will use WMEs.

First of all, terrorists' motivations are changing. A new breed of terrorists appears more inclined than terrorists of the past to commit acts of extreme violence.[18] The set of new terrorists may include everything from ad hoc groups motivated by religious conviction or revenge, violent right-wing extremists, and apocalyptical cults. Secondly, weapons of mass effect could be especially valuable to terrorists without traditional political goals, but rather seeking divine retribution, to display prowess, or just to perform large-scale killing.[19] Thirdly, terrorists will generally choose their technology to exploit the vulnerabilities of a particular society. Modern societies are particularly susceptible to weapons that are capable of killing many people at one time. Moreover, as governments implement more sophisticated security measure against terrorist attacks, terrorists may find weapons of mass effect appealing, as a way to overcome such countermeasures.[20]

Fourthly, with the brake-up of the Soviet Union, black markets may now offer unprecedented access to weapons, components and know-how. Fifthly, copy-cat efforts, where, other groups both find inspiration and ideas from previous attempts at large-scale terrorist violence, may spur additional terrorist attacks, and maybe even some level of "competition" among terrorist groups. Ever since the Tokyo subway attack, incidents involving chemical and biological weapons have been on the rise. Before the attack, the FBI typically encountered a dozen cases a year involving threats or actual attempts to acquire or use chemical, biological, radiological, or nuclear materials. In 1997, 71 cases were investigated and in 1999 the number had increased to 143, most of these hoaxes.[21] Finally, advances in technology may have made terrorism with weapons of mass effect easier to carry out. Looking at the technical history of nuclear devices, this becomes particularly evident. The first nuclear weapons, produced more than half a century ago, then represented state of the art technology and science. Today, the first generation nuclear weapons are not only old, they are also regarded primitive with well-known designs presented in the scientific literature and physics textbooks.

A high-profiled terrorist group with obvious nuclear intentions is indeed the Al- Qa'ida, the organization of bin Laden who formally has been linked to the terrorist attacks by U.S. intelligence.[22] According to R. James Woolsey, former director of the Central Intelligence Agency, bin Laden has been trying to get his hands on enriched uranium for seven or eight years.[23] The trail for the bombings of the U.S. embassies in Nairobi, Kenya and Dar al-Salaam, Tanzania, August 1998, shed new lights on bin Laden's and Al- Qa'ida's nuclear weapon intentions.[24] Dating back to 1993, the group tried on several occasions to acquire nuclear material. In 1998 a key aide of bin Laden was arrested in Germany and charged with trying to obtain nuclear material. Moreover, an ex-bin Laden associate who testified for the U.S. government in the trial of the 1993 World Trade Center bombing, admitted that he had been trying to obtain highly enriched uranium for bin Laden.

The biological and chemical programs of the Japanese Aum Shinrikyo cult that culminated in the previously mentioned Tokyo metro attack have been highly publicized. Less well known is the nuclear weapon program of that group. Natural uranium was acquired from the sect's properties in Australia and markets were explored to purchase nuclear technology via front trading companies.[25] Apparently, this fissile material production path, normally chosen by states with vast resources and well-developed nuclear infrastructure (see below), turned out to be less than fruitful for Aum Shinrikyo. Why this arduous (state) approach was chosen remains unclear.[26]

Steps towards nuclear weaponization

To create a nuclear weapon a number of steps must be carried out. Any nuclear aspirant must:[27] 1) develop a design for its nuclear device or obtain such a design from a nuclear weapon state, 2) produce the fissile material for the core of the device or obtain it from an external source and then shape the fissile material into appropriate nuclear parts, 3) fabricate, or obtain from outside, the non-nuclear parts of the device, including the high-explosive elements and triggering components that will detonate the nuclear core, 4) verify the reliability of these various elements individually and as a system, and, finally, assemble all of these elements into a deliverable nuclear armament, commonly referred to as "weaponization".

Each of these steps represents particular challenges. All demonstrably successful efforts by states to develop nuclear weapons have to date therefore been major enterprises, involving several years of work, with large design teams and resources devoted to the development of nuclear devises. Unsuccessful state nuclear weapon programs (e.g. the Iraqi one) are often taken as evidence of the impracticality of establishing nuclear weapon capabilities. But during their efforts, most of the resources have been put on the production of fissile materials.[28] Moreover, all the well-documented nuclear weaponization efforts since 1945 seem to have been created as a step-stone to an eventually more sophisticated arsenal. Even the Iraqi nuclear weapon program was over-dimensioned from the point of view of simply producing a crude nuclear weapon. A modest program aiming simply at producing crude nuclear weapons may thus circumvent the need for extensive domestic know-how.

The rapid spread of technological knowledge can further boost terrorists' weaponization attempts. Relevant nuclear weapons production information can be found in the technical literature.[29] Within the information swamp on the Internet, potential nuclear weapon producers can find useful sites. While these are not likely to be "step-by-step" descriptions for nuclear weapon acquisition, parts of the openly available information are likely to assist and even guide potential bomb-makers in the process. Indeed, in a 1960s experiment conducted by the U.S. government, three newly graduated students were asked to develop a nuclear weapon design using only publicly available information. [30] The students performed their task successfully. In the years since, much more information has entered the public domain, probably making similar efforts today even simpler.

Simple, technical outlines of crude nuclear weapons have been made available to highlight the proliferation dangers and the potential for clandestine nuclear bomb production.[31] These weapons are allegedly capable of exploding with a yield equivalent to that of several hundred to a few thousand tons of TNT. Furthermore, for new bomb-makers there may be lessons to be learned from the now abandoned and dismantled South African nuclear weapon program. South Africa indigenously produced six nuclear devices based on the simple uranium gun-type weapon principle while under the constraints of an international embargo, and thus relying solely on its own domestic resources. Most probably, these weapons were readied without prior testing.

Moreover, the limited radiation emanating from the fresh fissile material could render shielding and advanced laboratory facilities superfluous during its handling. Under the right set of conditions, the required skills for making a simplified nuclear weapon could therefore be limited – especially if the technical requirements are low.

The differing nuclear weapon "standards"

It is considerably simpler to make a bomb using enriched uranium than to make one using plutonium, but the critical mass is larger.[32] The late Luis W. Alvarez, a Nobel Laureate in Physics and a prominent nuclear weapon scientist in the Manhattan Project, has emphasized the simplicity of constructing a nuclear explosive with highly enriched uranium (HEU):

> *With modern weapons-grade uranium, the background neutron rate is so low that terrorists, if they have such materials, would have a good chance of setting of a high-yield explosion simply by dropping one half of the material onto the other half. Most people seem unaware that if separated HEU is at hand it's a trivial job to set off a nuclear explosion... even a high- school kid could make a bomb in short order.*[33]

The Alvarez statement may also very well describe the fundamental differences between a terrorist and a state nuclear weapon. While potential nuclear terrorists probably would go for an undefined "high-yield explosion", military nuclear weapons must meet an array of requirements before fielded. The highly differing requirements for performance and delivery can make weapons designed to meet the "terrorist nuclear weapon standards" less technically challenging than traditional state nuclear weapons.

Firstly, as shown in Figure 1, a state would be at least as concerned with the nuclear device *not* going off during storage and transportation, as with optimizing the yield and detonation of the weapon. The "one-point safety" requirements of the U.S. to prevent accidental detonations of nuclear weapons are one example. This set of strict requirements is designed to ensure that a nuclear explosion will not result if any point on the conventional explosive that surrounds the fissile material were accidentally detonated. While safety is a must for states, such concerns could be given less consideration by terrorists, especially groups with strong affection to martyrdom.

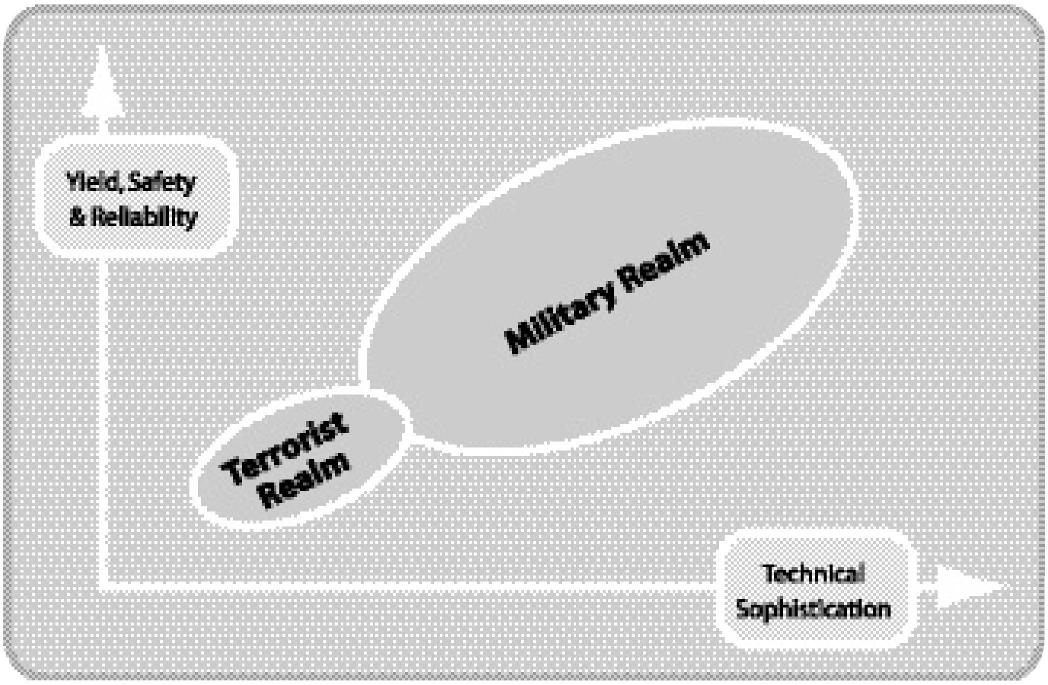

Figure 1. Terrorist and state military weapons compared

Secondly, the reliability concerns may be equivalently low amongst terrorists. While an ignition failure or a fizzle yield would be unfortunate from the viewpoint of terrorists, it could, potentially, have profound impact on the security of a state, e.g. in a nuclear offensive mode. For terrorists, however, any explosion in the lower kiloton range represents an unprecedented yield (and failed plutonium weapons may also serve as radiological dispersion devices). States, on the other hand, want fairly accurate and known yields to predict damages and the number of weapons needed.

Thirdly, weapons for military uses are normally required in fairly large numbers, and they must be delivered by conventional military means (missiles, mortars etc.). The most important constraining factors for state nuclear weapons are often the weight capacity of the delivery vehicle and the space available to carry the weapon (e.g., the diameter and length of a nosecone or the length and width of a bomb bay). Developing reliable delivery systems and slender nuclear explosives is technically challenging and expensive. Crude terrorist nuclear devices, however, will easily fit into a van, or even automobiles, for the subsequent detonation, possibly in densely populated areas. Other non-military means of delivery could involve trucks, hot-air balloons, ships, or simply a complete assembling of the nuclear device inside a garage or an out-of-the-way residence.

CHALLENGES: DENYING TERRORISTS ACCESS TO FISSILE MATERIAL

The primary technical barrier against nuclear terrorism is likely to be access to highly enriched uranium (HEU) or plutonium, the essential components of any nuclear weapon.[34] As mentioned, state nuclear weapon programs will usually be supported by large and costly infrastructure for enrichment and/or reprocessing of fissile weapons material. Sub-national groups, however, are more prone to rely on externally acquired weapons-usable materials. The primary objective of the international community should therefore be to deny terrorists access to highly enriched uranium and plutonium, the essential ingredients of any nuclear device.

Estimates of the quantities of fissile material needed for weapon production vary, depending on expected yield performance and technical sophistication. While the International Atomic Energy Agency's (IAEA's) "Significant Quantities" (SQ) are 25 kilo of HEU and eight kilo of plutonium, respectively, as low as one kilo of plutonium and 2.5 kilo of HEU has been suggested as sufficient with highly sophisticated weapon designs.[35]

The vast production of fissile materials during the Cold War has today left the world with a staggering legacy of three million kilos of weapons-usable material. 2/3 of these materials are produced for military purposes,[36] and more than half of the quantities are in excess to national security needs.[37] The huge quantities of fissile materials and the reports of lax security and accountancy of nuclear materials raise concerns about the possibility of a successful diversion of significant quantities of weapons-usable materials, particularly in the former Soviet Union. While the potential proliferation threats and the consequences of such chilling scenarios are fairly easy to understand, the problems of fissile weapons-usable material management have proven anything but simple to solve.[38]

According to the United State Department of Energy (DOE), 603 metric tons of highly enriched uranium and plutonium "enough to produce almost 40,000 nuclear bombs" are at risk of nuclear material theft in Russia.[39] This material can be used directly in a nuclear weapon without further enrichment or reprocessing. The material is considered to be highly attractive to theft because it (1) is not very radioactive and therefore relatively safe to handle and (2) can easily be carried by one or two people in portable containers or as components from dismantled weapons. Today, only some 40 percent of the facilities housing nuclear materials in Russia have received security improvements through U.S. assistance. Estimates indicate that if current rates are not accelerated, Russia's nuclear material will not be completely secure until 2029.[40]

Specialists from Russian law enforcement bodies have identified poor physical protection as the primary causes of nuclear thefts, along with the acute shortage of funds allocated for nuclear material protection, control and accounting (MPC&A).[41] The ratio of prevented to successful thefts remains uncertain due to insufficient accounting of nuclear material at some facilities and the failure to carry out an overall national fissile material inventory exercise. A close call apparently took place in December 1998, when the Russian Federal Security Services intercepted an attempt to divert 18.5 kg of "radioactive materials that might have been used in the production of nuclear weapons".[42] Russian officials, stating that the perpetrators "could have done serious damage to the Russian state" later confirmed this attempt, making it the first confirmed case that apparently involved a conspiracy to steal enough materials for bomb at a single stroke.[43]

In February 2002, representatives of the U.S. intelligence community confirmed to Congress that "weapons-grade and weapons-usable nuclear materials have been stolen from some Russian institutes".[44] Law-enforcement representatives assessed that undetected smuggling has occurred, although they were unable to know the extent or magnitude of such thefts.

According to the IAEA's Illicit Trafficking Database,[45] about 600 illicit trafficking incidents have taken place since January 1st, 1993.[46] Of these, about 400 incidents are confirmed by states. A little less than half of the confirmed cases (175) involve nuclear material, including 18 cases with highly enriched uranium or plutonium. None of the quantities of seized nuclear material is enough to produce a workable nuclear explosive and no endpoint, or buyers, have been identified. Yet, one successful transfer of high-quality nuclear material could be one too many and the seizures produce a disturbing picture.

A closer look firstly reveals that the fraction of HEU and plutonium today represents a similar proportion of cases as in the early 1990s, indicating a remaining market, or at least a remaining interest in fissile materials. Secondly, successful transfers will never be registered and the dark figures of the smuggling remain unknown. An optimistic detection rate of 10% indicates for instance nearly 200 smuggling events involving plutonium or highly enriched uranium. Thirdly, some of the material seized travelled across wide distances and through several border crossings, clearly indicating the difficulties of detecting illicit unirradiated fissile material. Finally, the seized quantities may be test samples for larger amount of materials readily available for sale.

RESPONSES: MITIGATING THE THREAT OF NUCLEAR TERRORISM

In particular with U.S. assistance over the past decade, Russia has made some progress in securing dangerous weapons and material, but much more needs to be done.[47] In January 2001, Howard Baker and Lloyd Cutler, chaired a bipartisan panel mandated by the U.S. Secretary of Energy to assess the security of Russia's nuclear materials. Their conclusions were not encouraging:[48] "The most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons usable material in Russia could be stolen and sold to terrorists or hostile nation states and used against American troops abroad or citizens at home."

The Baker-Cutler report concludes that $3 billion per year would go a long way to address the problem of poorly guarded fissile materials in Russia. The additional resources that should be allocated could i.a. be used to double the size of the U.S. Department of Energy's $174 million Materials Protection, Control and Accounting program, which safeguards Russia's nuclear materials. Russia recently signed an agreement to open up many more nuclear sites to U.S. assistance, providing an opportunity to substantially increase the security of nuclear stockpiles.[49] So far, the recommendations have been given little attention.

Following a yearlong review in 2001, the Bush administration concluded that most of the U.S. non-proliferation assistance programs are cost-effective and beneficial to national security. But even after September 11th, when some of the proposed budget cuts were restored, these conclusions are not properly reflected in the administration's final budget proposal. The assistance to Russia remains a highly politicized issue, and while some programs receive small increases, others remain flat, and still others are targeted for spending cuts.

The international community is also trying to meet the new security challenges. In response to the threat of nuclear terrorism, the International Atomic Energy Agency (IAEA) in March 2002 approved an action plan designed to upgrade worldwide protection against acts of terrorism involving nuclear and other radioactive materials.[50] In approving the plan, the IAEA recognizes that the first line of defense against nuclear terrorism is the strong physical protection of nuclear facilities and materials.

The plan covers eight areas: physical protection of nuclear material and nuclear facilities; detection of malicious activities (such as illicit trafficking) involving nuclear and other radioactive materials; strengthening of national state systems for nuclear material accountancy and control; security of radioactive sources; the assessment of safety and security related vulnerabilities at nuclear facilities; response to malicious acts or threats thereof; the adherence to international agreements and guidelines; and enhancement of program co-ordination and information management for nuclear security related matters.

Conclusion

Conventional weaponry will remain the weapon of choice for most terrorists. However, if allowed the opportunity some groups may stand ready to use weapons of mass effect, hereunder nuclear weapons. Dismissing the risk of nuclear terrorism may be an overly simplified – and possibly dangerous – approach for understanding the threat. Technical barriers to crude nuclear weapon production may be lower than perceived. Denying terrorists access to highly enriched uranium or plutonium, the essential components of any nuclear device, is therefore of indispensable importance.

Acquisition of fissile material of sufficient qualities and quantities remains the most formidable obstacle to (crude) nuclear terrorist capabilities. It is therefore imperative that preventing terrorists from gaining access to fissile materials be a high priority in the new global battle against terrorism. This can only be done by establishing stringent domestic and international standards of protection, control and accounting, and by supporting multinational non-proliferation activities.

In this regard, the following policy recommendations could be considered:

1) Continue and expand Material Protection Control and Accountability (MPC&A) activities in Russia.

2) Engage Europe in Cooperative Threat Reduction (CTR) activities.

3) Explore options for further purchases of Russian excess fissile material.

4) Make all nuclear arms reductions truly irreversible, with international control and/or irrevocable disposition of fissile material.

5) Limit the number of stored nuclear warheads, and initiate formalized and binding nuclear arms control on tactical nuclear weapons.

6) Commence negotiations on a fissile material cut-off treaty.

7) Reinvest politically in the non-proliferation regime, and in particular the 13 steps from the 2000 RevCon of the Non-Proliferation Treaty (NPT).

8) Implement the additional safeguards protocol in all relevant states.

9) Establish international standards of physical protection. Support the work for amending and widening the scope of the Convention on the Physical Protection of Nuclear Material.

10) Expedite international efforts to put material declared excess to national needs under international (IAEA) control.

11) Improve transparency and accountability. Stimulate nuclear weapon state declarations and data exchanges on national nuclear material stockpiles.

Each and one of the suggested steps may itself not prevent future nuclear terrorism.

However, put together they are likely to be self-enforcing and eventually sufficient to establish some of the norms and standards needed to avoid further proliferation of weapons of mass effect to states and sub-state actors. This, however, requires political leadership, not only to secure the financial resources urgently needed, but also to put forward a willingness to invest politically in the long-term sustainability of the international non-proliferation regime.

Deteriorating multinational norms against the spread of nuclear and other weapons of mass effect is possibly amongst the most paradoxical and worrisome features of an era where the "war on terrorism" is put on top of the international security agenda.

NOTES

[1] Opening sentence in Matthew Bunn, John P. Holdren, Anthony Wier, "Securing Nuclear Weapons and Materials: Seven Steps for Immediate Action", Report of the Project Managing the Atom, Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University.
http://ksgnotes1.harvard.edu/BCSIA/MTA.nsf/www/N-Terror

[2] Traditionally, biological, chemical, and nuclear weapons are collectively grouped in the "Weapons of Mass Destruction (WMDs)"category. However, the destructive powers of the weapons differ significantly and the term "Weapons of Mass Effect" may be more appropriate. Moreover, such a term may also better cover the likely psychological consequences of their uses.

[3] Paul Wilkinson, "Overview of the Terrorist Threat to International Security", Terrorism and Disarmament, DDA Occasional Papers, No. 5, October 2001, p.5.

[4] K.H. Kamp, "An Overrated Nightmare", The Bulletin of the Atomic Scientists, vol. 52, no. 4, July/August, 1996.

[5] Gavin Cameron, "Nuclear Terrorism Reconsidered", Current History, April, 2000.

[6] Bernard Anet, "Nuclear Terrorism: How Serious a Threat to Switzerland?", Fact Sheet, Spiez Laboratory, Defence Procurement Agency, http://www.vbs.admin.ch/acls/e/current/fact_sheet/nuklearterrorismus/pronto/

[7] David C. Rapoport, "Then and Now: What Have We Learned?", Terrorism and Political Violence", issue 13.3, p. xv.

[8] Jerrold M. Post, "Differentiating the Threat of Radiological/nuclear terrorism: Motivations and Constraints. Paper presented at the International Atomic Energy Agency (IAEA) Symposium on International Safeguards: Verification and Nuclear Material Security Vienna, Austria, 29 October - 1 November 2001.

[9] David Rapoport, "Terrorism and Weapons of the Apocalypse", National Security Studies Quarterly. Summer 1999, Volume V, Issue 3, 1999.

[10] Both the Aum Shinrikyo, the Japanese cult that released sarin on the Tokyo metro, and bin Laden's Al Qaeda have had provable nuclear ambitions.

[11] On this gap see e.g. the opening statements for the IAEA Symposium on International Safeguards: Verification and Nuclear Material Security Vienna, Austria, 29 October - 1 November 2001, with a special session on "Combating Nuclear Terrorism", http://www.iaea.org/worldatom/Press/Focus/Nuclear_Terrorism/, or The Russian American Nuclear Security Advisory Council (RANSAC), Letter to President Bush, President Putin, Dr. ElBaradei, and Delegates to the General Conference of the International Atomic Energy Agency, September 19, 2001.

[12] See e.g. Dan Eggen, ""Dirty bomb" plot uncovered in U.S., the Washington Post, June 11, 2002, http://www.iht.com/articles/60917.html

[13] Despite some common features, nuclear and radiological terrorism is in fact quite distinct and different types of terrorism. Nuclear terrorism involves the use of nuclear weapons, where large amounts of energy are released when highly enriched uranium or plutonium fissions. The consequences and the destructions may be devastating from even a crude nuclear weapon (like the Hiroshima type), due to the heat, pressure and radiation generated. Radiological dispersion devices expose people to radiation as, for in

stance, a "dirty bomb" in which radioactive laboratory waste or civilian nuclear fuel rods would be wrapped around a conventional explosive and detonated, spreading poison and contamination. While acute deaths may occur, the primary impact on health and life will be through long-term effects (like cancer development). A radiological device detonated by terrorists would require the evacuation and decontamination of the immediate area, disrupting the local economy. Given the relative simplicity of constructing a dirty bomb and the vast availability of radioactive materials, scenarios involving radioactive substances have been assumed to be more probable than acts of nuclear terrorism. The psychological impact of both types of terror may be severe. Hospitals would be overrun by injured and worried people in the affected area.

[14] Johan Galtung and Marie Holmboe Ruge, "The Structure of Foreign News", The Journal of International Peace Research, no.1, 1965.

[15] Gavin Cameron, "Nuclear Terrorism Reconsidered", Current History, April, 2000.

[16] Arnfinn Tønnessen, Psychological Reactions to Nuclear Threats: Information, Coping and the Uncertainties of Outcome at the Individual Level, Dissertation for the Degree of Dr.Philos, Faculty of Medicine, University of Oslo, 2002, p. 61.

[17] Sarin is an extremely toxic chemical warfare agent that is a powerful cholinesterase inhibitor also called GB. 12 people were killed and several thousand were inquired in the attack. Aum Shinrikyo's first large-scale attack using sarin, which went largely unnoticed internationally, occurred in Matsumoto, Japan, on June 24, 1994. Seven people were killed in the attack, and another 144 were seriously injured when cult-members used specially equipped vans to release sarin.

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[49]Another, and probably a more controversial suggestion, would be to reduce Russia's Soviet-era debt in return for Russian investment of the proceeds in non-proliferation programs. According to U.S. Senator Biden, debt swaps are a win-win proposition: Russia can avoid an expected payment crunch next year while bolstering security through protection of sensitive materials and technologies.

[50] See http://www.iaea.or.at/worldatom/Press/P_release/2002/prn0204.shtml.

The activities proposed are not a substitute for national measures, nor can they diminish the primary responsibility of nation states on all matters of security; rather the measures are designed to supplement and reinforce national efforts in areas where international co-operation is indispensable to the strengthening of nuclear security. These areas include, in addition to improved protection of nuclear material and other radioactive sources, better border controls, and enhanced national and international mechanisms for responding to radiological emergencies.

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