All Stocks of Weapons-Usable Nuclear Materials Worldwide Must be Protected Against Global Terrorist Threats

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"We must ensure that terrorists never acquire a nuclear weapon. This is the most immediate and extreme threat to global security. One terrorist with one nuclear weapon could unleash massive destruction…. So today I am announcing a new international effort to secure all vulnerable nuclear material around the world within four years."
-- U.S. President Barack Obama, Prague, 5 April 2009

"We have firm knowledge, which is based on evidence and facts, of steady interest and tasks assigned to terrorists to acquire in any form what is called nuclear weapons, nuclear components."
-- Anatoly Safonov, Special Representative of the Russian President for International Cooperation in the Fight Against Terrorism and Transnational Organized Crime, *Interfax*, 27 September 2007 (translation by Simon Saradzhyan)

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The possibility that terrorists could get and detonate a nuclear bomb poses a real and urgent risk to international security.[2] No one knows the real probability of such an attack. But the evidence of terrorist efforts to get the nuclear materials and expertise needed to make a crude nuclear explosive is sufficiently troubling, and the consequences of such an event sufficiently grave, to justify urgent action to reduce the risk.

Nuclear Terrorism is a Genuine Danger

Several unfortunate facts shape the risk the world faces. First, some terrorists are actively seeking to acquire nuclear weapons, and the plutonium or HEU needed to make them. Osama bin Laden has called the acquisition of nuclear weapons or other weapons of mass destruction a "religious duty", and al-Qaeda operatives have attempted to buy nuclear material and recruit nuclear expertise. Two senior Pakistani nuclear weapon scientists associated with Ummah Tameer e-Nau (UTN) network, for example, personally met with bin Laden and Zawahiri to discuss nuclear weapons. In the 1990s, the Japanese

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[2] See Bunn, *Securing the Bomb 2008.* A substantial literature on the danger of nuclear terrorism is available. For one comprehensive (and alarming) look, see Graham T. Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe* (New York: Times Books/Henry Holt, 2004). For a less alarming analysis, see Michael Levi, *On Nuclear Terrorism* (Cambridge, Mass.: Harvard University Press, 2007).

terror cult Aum Shinrikyo, which launched the nerve gas attack in the Tokyo subway in 1995, also sought nuclear weapons. There is clear evidence that Chechen terrorists have pursued radiological "dirty bombs," and at least suggestive indications of their interest in actual nuclear bombs as well – and there are deep links between some Chechen terrorist factions and al Qaeda.[3] With at least two terrorist groups having pursued nuclear weapons in the last two decades, the world should not expect that they will be the last.

Second, repeated assessments by the U.S. government and other governments have concluded that it is plausible that a sophisticated terrorist group could make a crude nuclear explosive – capable of destroying the heart of a major city – if they got enough plutonium or HEU.[4] A "gun-type" bomb made from HEU, in particular, is basically a matter of slamming two pieces of HEU together at high speed.

One study by the now-defunct congressional Office of Technology Assessment summarized the technical reality: "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 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-Qa'ida's capabilities, if it could obtain fissile material."[6]

The hardest part of making a nuclear bomb is producing the needed plutonium or HEU – a task that took up more than 90% of the effort in the U.S. Manhattan Project. Making their own nuclear material is almost certainly beyond terrorist nuclear capabilities – so if the stocks controlled by states can be appropriately secured and kept out of terrorist hands, nuclear terrorism can be prevented.

It is important to understand that making a crude, unsafe, unreliable bomb of uncertain yield that might be carried in the back of a large van is a dramatically simpler task than designing and building a safe, secure, reliable, and efficient weapon deliverable by a ballistic missile, which a state might want to incorporate into its arsenal. Terrorists are highly unlikely to ever be able to make a sophisticated and efficient weapon, a task that requires a substantial nuclear weapons enterprise – but they may well be able to

[3] For a summary of the publicly available evidence, see Matthew Bunn and Anthony Wier, with Joshua Friedman, "The Demand for Black Market Fissile Material," in *Nuclear Threat Initiative Research Library: Securing the Bomb* (Cambridge, MA., 2005), available at www.nti.org/e_research/cnwm/threat/demand.asp (accessed 30 October 2009). See also the alarming account of al Qaeda's nuclear weapons efforts, extending well beyond the collapse of the Taliban regime in Afghanistan in late 2001, in George Tenet, *At the Center of the Storm: My Years at the CIA* (New York: HarperCollins, 2007), pp. 259–80. While Tenet's credibility has inevitably been undermined by the faulty intelligence on Iraq, none of the assertions in his chapter on Al Qaeda and nuclear weapons has been publicly challenged.

[4] Throughout this paper, references to plutonium and HEU, or to weapons-usable nuclear materials, refer to materials separated from the intensely radioactive fission products in spent fuel. In international parlance, the IAEA refers to these as "unirradiated direct use materials."

[5] U.S. Congress, Office of Technology Assessment, *Nuclear Proliferation and Safeguards* (Washington, D.C.: OTA, 1977) 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), http://www.gpoaccess.gov/wmd/index.html (accessed 30 October 2009), p. 276.

make a crude one. Their task would be easier if they managed to recruit knowledgeable help, which they have been actively attempting to do.

Third, there is a real risk that terrorists could get the plutonium or HEU needed to make a nuclear bomb. Important weaknesses in nuclear security arrangements still exist in many countries, creating weaknesses that outsider or insider thieves might exploit. HEU-fueled research reactors, for example, sometimes located on university campuses, often have only the most minimal security measures in place. One recent review of research reactors that had received U.S.-sponsored security upgrades identified research reactors that were wholly dependent on off-site response forces to respond to a theft attempt, but had never exercised the capabilities of those forces; a reactor that conducted no search of vehicles leaving the site for potential nuclear contraband; a reactor for which the national regulatory agency had not established any nuclear security requirements; and a reactor where no background checks were performed before allowing access to nuclear material.[7] In countries such as Pakistan, even substantial nuclear security systems are challenged by immense adversary threats, both from nuclear insiders – some with a demonstrated sympathy for Islamic extremists – and from outside attacks that might include scores or hundreds of armed attackers. In the end, all countries where these materials exist – including the United States and Russia – must regularly reassess whether the security they have in place is sufficient to meet the evolving threat.

As a result of such security weaknesses, there have been 18 incidents of theft or loss of HEU or separated plutonium confirmed to the IAEA by the states concerned.[8] Most recently, in February 2006, Russian citizen Oleg Khinsagov was arrested in Georgia (along with three Georgian accomplices) with 79.5 grams of 89% enriched HEU, claiming that he had kilograms more available for sale.[9] What we do not know, of course, is how many thefts may have occurred that were never detected; it is a sobering fact that nearly all of the stolen HEU and plutonium that has been seized over the years had never been missed before it was seized. There have also been alarming intrusions. In 2007, for example, at the Pelindaba nuclear facility in South Africa, where hundreds of kilograms of weapon-grade HEU are located, two teams of armed men attacked from opposite sides of the site: one of the teams got through a 10,000-volt security fence, disabled intrusion detectors without detection, proceeded to the emergency control center (where they shot

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[7] U.S. Congress, Government Accountability Office, *Nuclear Nonproliferation: National Nuclear Security Administration Has Improved the Security of Reactors in its Global Research Reactor Program, but Action is Needed to Address Remaining Concerns,* GAO-09-949 (Washington, D.C.: GAO, September 2009), http://www.gao.gov/new.items/d09949.pdf (accessed 30 October 2009).

[8] For the International Atomic Energy Agency's most recent list of incidents confirmed by the states concerned, see *IAEA Illicit Trafficking Database* (Vienna: IAEA, 2008) http://www.iaea.org/NewsCenter/Features/RadSources/PDF/fact_figures2007.pdf (accessed 28 October 2009). Perhaps the best available summary of what is known and what is not known about nuclear and radiological smuggling is "Illicit Trafficking in Radioactive Materials," in Mark Fitzpatrick, ed., *Nuclear Black Markets: Pakistan, A.Q. Khan, and the Rise of Proliferation Networks: A Net Assessment* (London: International Institute for Strategic Studies, 2007), pp. 119-138. (Lyudmila Zaitseva, principal author.)

[9] For an especially useful account of this case, see Michael Bronner, "100 Grams (And Counting): Notes From the Nuclear Underworld" (Cambridge, Mass.: Project on Managing the Atom, Harvard University, June 2008). (The case involved roughly 100 grams of uranium oxide, of which 79.5 grams were uranium.)

one of the workers on duty), and spent 45 minutes inside the guarded perimeter without ever being engaged by site security forces.[10]

Fourth, it would be extremely difficult to stop terrorists from smuggling nuclear material or a crude nuclear weapon to its target. A nuclear bomb might be delivered, intact or in ready-to-assemble pieces, by boat or aircraft or truck. The length of national borders, the diversity of means of transport, the vast scale of legitimate traffic across borders, and the ease of shielding the radiation from plutonium or especially from HEU all operate in favor of the terrorists. Building the overall system of legal infrastructure, intelligence, law enforcement, border and customs forces, and radiation detectors needed to find and recover stolen nuclear weapons or materials, or to interdict these as they cross national borders, is an extraordinarily difficult challenge.[11]

Fifth, even a single terrorist nuclear bomb would be a catastrophe that would change history. The heart of a major city could be reduced to a smoldering radioactive ruin, leaving tens or hundreds of thousands of people dead. Terrorists – either those who committed the attack or others – would probably claim they had more bombs already hidden in other cities (whether they did nor not), and the fear that this might be true could lead to panicked evacuations, creating widespread havoc and economic disruption. Some countries may feel that nuclear terrorism is really only a concern for the countries most likely to be the targets, such as the United States. In reality, however, such an event would cause devastating economic aftershocks throughout the world – global effects that in 2005 then-UN Secretary-General, Kofi Annan warned would push “tens of millions of people into dire poverty,” creating “a second death toll throughout the developing world.”[12]

It is also important to emphasize that the nuclear industry itself has a huge interest in preventing nuclear terrorism. A terrorist nuclear bomb, or a major sabotage of a nuclear facility – a “security Chernobyl” – would doom any prospect for gaining the public, government, and utility support needed for large-scale growth of nuclear power, putting tens or hundreds of billions of dollars in future revenue at risk. In some countries, it might even lead to pressures to close major operating facilities.

The good news is that there is no convincing evidence that any terrorist group has yet gotten a nuclear weapon or the materials and expertise needed to make one. Moreover, making and delivering even a crude nuclear bomb would be among the most technically challenging and complex operations any terrorist group has ever carried out.

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[10] The team that entered the site left via the same point at the fence by which they arrived. Their familiarity with how to disable the intrusion detectors and with equipment at the emergency control center strongly suggests they had help from someone with insider knowledge. They have never been identified or captured. For a description of this event, see Bunn, *Securing the Bomb 2008,* pp. 3-4, and “60 Minutes: Assault on Pelindaba,” *CBS News,* 23 November 2008, http://www.cbsnews.com/stories/2008/11/20/60minutes/main4621623.shtml (accessed 30 October 2009)..

[11] For a useful discussion emphasizing the ease with which terrorists might follow different pathways to deliver their weapon, see Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe*. For a more optimistic view of the potential of these parts of a defensive system, see Levi, *On Nuclear Terrorism*.

[12] Kofi Annan, "A Global Strategy for Fighting Terrorism: Keynote Address to the Closing Plenary," in *The International Summit on Democracy, Terrorism and Security* (Madrid: Club de Madrid, 2005; available at http://english.safe-democracy.org/keynotes/a-global-strategy-for-fighting-terrorism.html as of 18 June 2008).

There would be many chances for the effort to fail. But given a history of terrorist efforts to get a nuclear bomb, and the dire consequences should they ever succeed, there can be no room for complacency. All countries must take action to reduce the risks of nuclear theft and terrorism to the lowest practicable level.

Nuclear Thieves Could Strike in Any Country

Unfortunately, international terrorists have demonstrated that they have global reach. Everyone recalls the attacks in the United States, in Moscow and Beslan, in London, and in Madrid. But it is important to recall that al Qaeda-linked conspiracies have been uncovered in some of the "safest" countries, from Canada to Belgium to the Netherlands. Japan has experienced homegrown terrorism with weapons of mass destruction from Aum Shinrikyo – and in the years to come, such groups could arise in other countries.

Al Qaeda bombed the U.S. embassies in Kenya and Tanzania not because they had any special quarrel with Kenya or Tanzania but because they were particularly vulnerable targets that would hurt the United States. Similarly, terrorists will seek nuclear material for a bomb wherever they think the combination of their strength and the security systems' weakness makes it easiest to get. They do not have to steal it in the country that is the ultimate target. No country should believe that because it has never been threatened by Islamic extremists it need not provide stringent security for its nuclear material. In a very real sense, vulnerable weapons-usable nuclear material anywhere is a threat to everyone, everywhere.

All Nuclear Stockpiles Must be Protected Against Plausible Adversary Threats

Clearly, the capabilities of terrorists and thieves vary from one country to another. A nuclear security system sufficient to reduce the risk of nuclear theft or sabotage to a low level in Canada may not be sufficient in Pakistan. Each country with nuclear weapons, plutonium separated from spent fuel, or HEU must ensure that these stocks are effectively protected against the spectrum of outsider and insider capabilities that are most plausible in their country. These stocks should be protected against two sets of capabilities: first, capabilities that terrorists and criminals have shown they can bring together in that country (with whatever additional capabilities that country's intelligence agencies believe are most likely), and second, a set of capabilities that international terrorists might be able to bring to bear in any country. To accomplish this, countries controlling these stocks should establish and enforce rules that require that these stocks be protected against particular sets of adversary capabilities, known as the "design basis threat," (DBT), as described in IAEA recommendations and guidance.[13] Ideally, the threat assessment process should include experts who have access to all relevant threat

[13] International Atomic Energy Agency, *The Physical Protection of Nuclear Material and Nuclear Facilities*, INFCIRC/225/Rev.4 (Corrected) (Vienna: IAEA, 1999) http://www.iaea.or.at/Publications/Documents/Infcircs/1999/infcirc225r4c/rev4_content.html (accessed 30 October 2009), and International Atomic Energy Agency, *Development, Use, and Maintenance of the Design Basis Threat: Implementing Guide,* Nuclear Security Series No. 10 (Vienna: IAEA, 2009), http://www-pub.iaea.org/MTCD/publications/PDF/Pub1386_web.pdf (accessed 30 October 2009).

information available to the state, and who are independent of those operating the nuclear facilities. The DBT should be reviewed regularly to ensure that it reflects an up-to-date assessment of the evolving threat. Of course, a balance must be drawn between the costs of security and the threats the security system can protect against – and different participants in these discussions will often have different views as to where that balance should be drawn.

As just noted, facing terrorists with global reach, there are adversary capabilities that *all* stocks of nuclear weapons, plutonium, or HEU must be protected against, no matter what country they are in. In our view, all such stocks should *at least* be protected against:

- A modest group of well-trained outside attackers, capable of operating as more than one team, with armaments that might include automatic weapons, rocket-propelled grenades,[14] and explosives;
- A well-placed insider, with knowledge of the security system, who might carry out a theft himself or herself, or might provide passive or active assistance to outsiders;
- Deception attacks, where thieves might, for example, have military uniforms and forged identification papers, or even forged documents authorizing material to be removed from a site for shipment;
- Bombs that could be carried on a person's body, or in a car or van; and
- Unusual vehicles or routes.

Several elements of this list are particularly important. First, it is essential that all countries with nuclear materials and facilities include the possibility of an insider in the DBT that facilities must be able to protect against. All of the real cases of theft of HEU or plutonium whose origins are documented were perpetrated by insiders or with the assistance of insiders. Hence, it is essential to maintain a strong personnel reliability program that conducts background checks before giving employees access to nuclear weapons, materials, or nuclear security information, and that also includes ongoing monitoring so that suspicious changes in behavior may set off warnings. But even where effective personnel reliability programs are in place, it is still essential to protect against insider theft. Some managers may believe that their employees are trustworthy and they could never have an insider problem at their facility. In some countries (including the United States) operators are allowed to assume that employees participating in the full personnel reliability program would not *actively* participate in a theft attempt (though they might provide information to outsiders, or disable an alarm). But it should be remembered that even trustworthy insiders could be coerced. In one case in Northern Ireland, for example, a bank had a security system that required two senior officers of the bank to work together to open the vault – but a gang kidnapped the families of two of the

[14] Unfortunately, rocket-propelled grenades are widely available to terrorist groups, and have been used extensively in Lebanon, in Iraq, in Afghanistan, and elsewhere. Fortunately, in the case of defending fixed sites such as nuclear facilities, simple and cheap defenses – such as strong wire mesh in front of a wall to be protected – can cause the grenade to detonate harmlessly away from the wall. See "Systems Under Fire," (video), U.S. Department of Energy, Office of Independent Oversight and Performance Assurance, 2003.

senior officers of the bank, and sure enough, they opened the vault.[15] Where practical, it may even be desirable to require operators to at least explore options that would make theft attempts involving more than one insider more difficult and risky.

The possibility of more than one team is also important. Unless the defenders are appropriately prepared for such possibilities, one team might create a major diversion to draw the defenders away while the other carried out the theft. Or one team might be assigned to prevent the response force from arriving in a timely way (for example by mining a road and then sniping at those trying to clear the obstacles). Imagine, for example, if the site relied on an external police response and there were to be another attack in a local town that preceded the facility attack.

With respect to vehicles and routes, much depends on the specifics of the particular site. Sites on the coast should be protected against attacks arriving from the sea (as in the recent attack in Mumbai). Sites in urban areas with buildings close by that are not controlled by the operator should consider whether tunneling into the facility is a realistic possibility; there have been repeated cases of that tactic being used to steal millions of dollars from otherwise well-guarded banks. Sites that rely heavily on layers of barriers for delay should consider whether they have adequate protection in the event that thieves arrive or depart with a helicopter, bypassing the barriers – a tactic that criminals have used in jailbreaks in several countries, though also one that introduces another step that the attack force has to take, with additional risks of its own.

Each of these types of adversary capability has been repeatedly demonstrated in terrorist attacks and thefts from guarded non-nuclear facilities around the world. Indeed, the Pelindaba incident described above – two teams attacking from opposite sides, apparently with insider knowledge of how to defeat the intrusion detectors – makes clear that this is a realistic level of threat against which stockpiles of nuclear weapons, plutonium, or HEU worldwide must be protected.[16]

Providing effective protection against at least this spectrum of potential adversary capabilities should be considered a "best practice" in implementing DBT methodology that should be adopted by all. Countries and operators who do *not* believe their stocks of weapons-usable nuclear materials need to be protected against such threats need to ask themselves what makes them so confident that thieves could not apply such capabilities in attempts to steal their nuclear stocks – and whether it is justified for them to endanger other countries and the nuclear industry as a whole by providing less security than other operators do.

Countries and operators should not use a DBT that represents a single point estimate of the threat, but rather should protect against a spectrum of possibilities. A theft attempt involving a small number of people with convincing official uniforms and

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[15] For a good introduction to the Northern Bank case, see Chris Moore, "Anatomy of a £26.5 Million Heist," *Sunday Life*, 21 May 2006. The thieves also used deception in this case, appearing at the bank managers' homes dressed as policemen. One of these managers, however, was later charged with participating voluntarily in the crime; he denied the charge.

[16] For a description, see Bunn, *Securing the Bomb 2008,* pp. 3-4, and "60 Minutes: Assault on Pelindaba," *CBS News,* 23 November 2008, http://www.cbsnews.com/stories/2008/11/20/60minutes/main4621623.shtml (accessed 30 October 2009).

paperwork is not a *lesser* attack than a dozen attackers arriving with guns blazing, it is a *different* attack, requiring different types of defensive procedures.

Of course, establishing a requirement that operators be able to protect against such a DBT is only the first step. Operators must then develop and implement security designs, plans, and procedures capable of protecting against the full spectrum of possibilities included in the DBT. Regulators must review these arrangements to confirm that they really will provide effective protection against the DBT. Assessments of operators' security arrangements should include a range of testing, including not only component tests – such as tests to ensure that detectors detect intrusions, or that response forces arrive in response to a call – but also exercises designed to test the full system's ability to defeat intelligent adversaries. In the United States, for example, "force on force" exercises testing sites' protection against outsider attacks – sometimes using laser-tag weapons to avoid anyone actually being shot in the exercise – have often revealed important weaknesses in security systems that looked good on paper. Exchanging approaches to getting the maximum value out of such exercises while maintaining appropriate safety for both facilities and personnel could be an important area for exchange of "best practices" between countries.

Facilities will inevitably vary in their abilities to maintain effective security against a spectrum of threats of this kind. Military organizations have long focused on security for their operations and are generally already protected against these kinds of threats – though the focus at both military and civilian facilities must always be on constant vigilance and continual improvement. For large commercial facilities, we believe that effective security can be achieved and maintained for a cost that represents a small fraction of total operating budgets. Companies must take responsibility for effective nuclear security as an essential part of corporate risk management, just as they already do in the case of nuclear safety. For small research reactors with little operating revenue, however, the costs of protecting against the kinds of threats outlined in this paper may seem prohibitive. We believe that governments, which generally already subsidize the operation of such reactors, should pay for their security, to the extent that governments believe their continued operation provides a benefit to society worth the cost. The costs of security will also provide an additional incentive to convert from the use of HEU to other fuels that do not require such stringent protection.

International Nuclear Security Cooperation and Agreements

Countries should work together, including providing technical and financial assistance where needed, to ensure that this minimum level of protection is in place for all nuclear weapons, plutonium, and HEU worldwide – and that countries facing more substantial adversary threats put even more capable security systems in place. Achieving that goal should be the centerpiece of the four-year international effort to secure nuclear stockpiles worldwide that President Obama envisioned, which has now been unanimously endorsed by the U.N. Security Council.[17] The cooperation between the United States and Russia, which has led to substantial improvements in physical

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[17] U.N. Security Council, Resolution 1887, 24 September 2009, http://daccess-ods.un.org/access.nsf/Get?Open&DS=S/RES/1887%20(2009)&Lang=E&Area=UNDOC (accessed 30 October 2009).

protection, material control, and material accounting at many sites, demonstrates what can be accomplished.

International agreements and recommendations should be modified to call for all nuclear weapons, plutonium, and HEU to have effective protection against such a minimum set of adversary capabilities. The current version of the IAEA physical protection recommendations, drafted in 1999, already calls on states to base their nuclear security approach on a DBT; we believe a new revision should recommend that all of the highest-value nuclear material (Category I material in IAEA parlance) should be protected against a DBT like that described in this paper. Similarly, nuclear exporters should consider requiring that plutonium or HEU they export, or produced from materials they export, be protected to at least the level described in this paper. Ultimately, effective nuclear security should be part of the "price of admission" for doing business in the international nuclear market.

A strong argument can be made that states are already legally obligated to provide something like this level of security. UN Security Council Resolution 1540 requires all states to provide "appropriate effective" security and accounting for any nuclear weapons or weapons-usable nuclear materials they may have – but no one has yet defined precisely what this requires. If the words "appropriate effective" mean anything, they should mean that nuclear security systems would effectively protect against the threats that terrorists and criminals have shown they can pose. Thus one possible definition would be that to meet its UNSCR 1540 physical protection obligation, every state with nuclear weapons or weapons-usable nuclear materials should have a well-enforced national rule requiring that every facility with a nuclear bomb or a significant quantity of nuclear material must have security in place capable of defeating a specified DBT including outsider and insider capabilities comparable to those terrorists and criminals have demonstrated in that country (or nearby).[18] Even in particularly safe countries, as argued above, the DBT should not be less than two modest teams of well-armed and well-trained outsiders, possibly in collaboration with one insider. This approach has the following advantages: the logic is simple, easy to explain, and difficult to argue against; the approach is general and flexible enough to allow countries to pursue their own specific approaches as long as they are effective enough to meet the threats; and at the same time, it is specific enough to be effective and to provide the basis for questioning, assessment, and review. If the leading nuclear states could agree on a common interpretation of what UNSCR 1540 requires – including a minimum design basis threat that all nuclear weapons or weapons-usable nuclear materials everywhere should be protected against – that would, in effect, create a binding global nuclear security requirement. The leading nations agreeing to such a requirement should then launch an

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[18] For an initial cut at defining the essential elements that must be included for nuclear security and accounting systems to meet the obligation to be "appropriate effective," see Matthew Bunn, "'Appropriate Effective' Nuclear Security and Accounting – What is It?" presentation to "'Appropriate Effective' Material Accounting and Physical Protection," Joint Global Initiative/UNSCR 1540 Workshop, Nashville, Tennessee, 18 July 2008, http://belfercenter.ksg.harvard.edu/files/bunn-1540-appropriate-effective50.pdf (accessed 30 October 2009).

intensive effort to persuade other states to bring their nuclear security arrangements up to the agreed level and help them to do so as needed.[19]

The danger of nuclear terrorism is real. Action to reduce the risk is essential. But no nation, however powerful, can prevent nuclear terrorism on its own. The task requires international cooperation, involving all those with stockpiles to secure and resources and expertise to help secure them. Ensuring that all stockpiles of nuclear weapons, plutonium, and HEU worldwide are effectively protected against the most plausible terrorist and criminal threats is the first and most important step, holding the potential to greatly reduce the risk the world faces, at a cost that is far smaller than the potential cost of failure to act.

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[19] For a more detailed discussion of possible routes toward effective global nuclear security requirements, see Bunn, *Securing the Bomb 2008,* pp. 147-157.