
The threat of nuclear terrorism: What's new? What's true?

Matthew Bunn

Harvard Kennedy School

Seoul, South Korea, 3-5 November 2011

<http://www.managingtheatom.org>

Sponsored by the US-Korea Institute at SAIS

Nuclear terrorism remains a real danger

- ◆ Some terrorists are seeking nuclear weapons and materials – and could plausibly make a crude nuclear bomb if they got the needed nuclear material
- ◆ Some terrorists have considered sabotage of nuclear facilities
- ◆ Some terrorists have worked to disperse radioactive material in a “dirty bomb”
- ◆ International cooperation needed to secure nuclear and radioactive material and facilities, stop nuclear smuggling, counter terrorist with nuclear ambitions



Source: Block/AP

3 types of nuclear terrorism

◆ *Nuclear explosives*

- Incredibly catastrophic
- Difficult for terrorists to accomplish (though not as implausible as some believe)

◆ *Nuclear sabotage*

- Very catastrophic *if* highly successful (very limited if not)
- Also difficult to accomplish

◆ *“Dirty Bomb”*

- “Weapons of mass disruption” – potentially \$10s billions of disruption, cleanup costs
- Far easier to accomplish

Talk will address each of these risks in turn, starting with nuclear explosives

Nagasaki – a city laid waste



Source: Time-Life

The scale of the catastrophe

- ◆ Tens of thousands killed; tens of thousands more burned, injured, irradiated
 - Radioactive fallout would require large-scale evacuation
- ◆ Terrorists would likely claim they had more bombs hidden in cities, threaten to detonate them unless their demands were met
 - Potential for widespread panic, economic and social chaos
- ◆ Huge pressure on leaders of attacked state to take any action necessary to prevent further attacks – and to retaliate
 - Effects on international affairs likely far larger than 9/11

Notions of sovereignty and civil liberties may be radically altered – every state's behavior affects every other

Nuclear terrorism anywhere would be a global catastrophe

- ◆ Not just a risk to the United States
- ◆ Economic, political, military consequences would reverberate worldwide
 - Likely shut-down of much of world trade, for a period

“Were such an attack to occur, it would not only cause widespread death and destruction, but would stagger the world economy and thrust tens of millions of people into dire poverty.... [A]ny nuclear terrorist attack would have a second death toll throughout the developing world.”

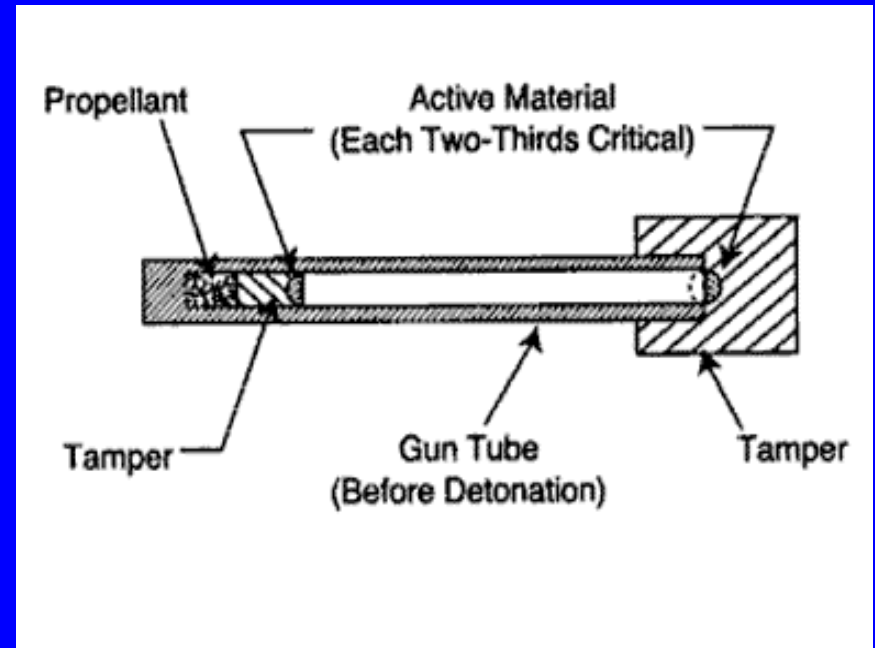
– Kofi Annan, “A Global Strategy for Fighting Terrorism,” March 10, 2005

- ◆ Political consequences would doom prospects for large-scale nuclear growth, putting nuclear industry at risk

Insecure nuclear material anywhere is a threat to everyone, everywhere

With nuclear material, terrorists may be able to make crude nuclear bombs

- ◆ With HEU, gun-type bomb – as obliterated Hiroshima – very plausibly within capabilities of sophisticated terrorist group
- ◆ Implosion bomb (required for Pu) more difficult, still conceivable (especially if they got help)
 - Doesn't need to be as complex as Nagasaki bomb



Source: NATO

Immense difference between difficulty of making safe, reliable weapons for use in a missile or combat aircraft and making crude, unsafe, unreliable weapons for delivery by truck

With nuclear material, terrorists may be able to make a crude nuclear bomb

- ◆ Government studies – in the United States and elsewhere – have repeatedly concluded that a sophisticated terrorist group could plausibly make a nuclear bomb.

“A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device... Only modest machine-shop facilities that could be contracted for without arousing suspicion would be required.”

– *U.S. Office of Technology Assessment, 1977*

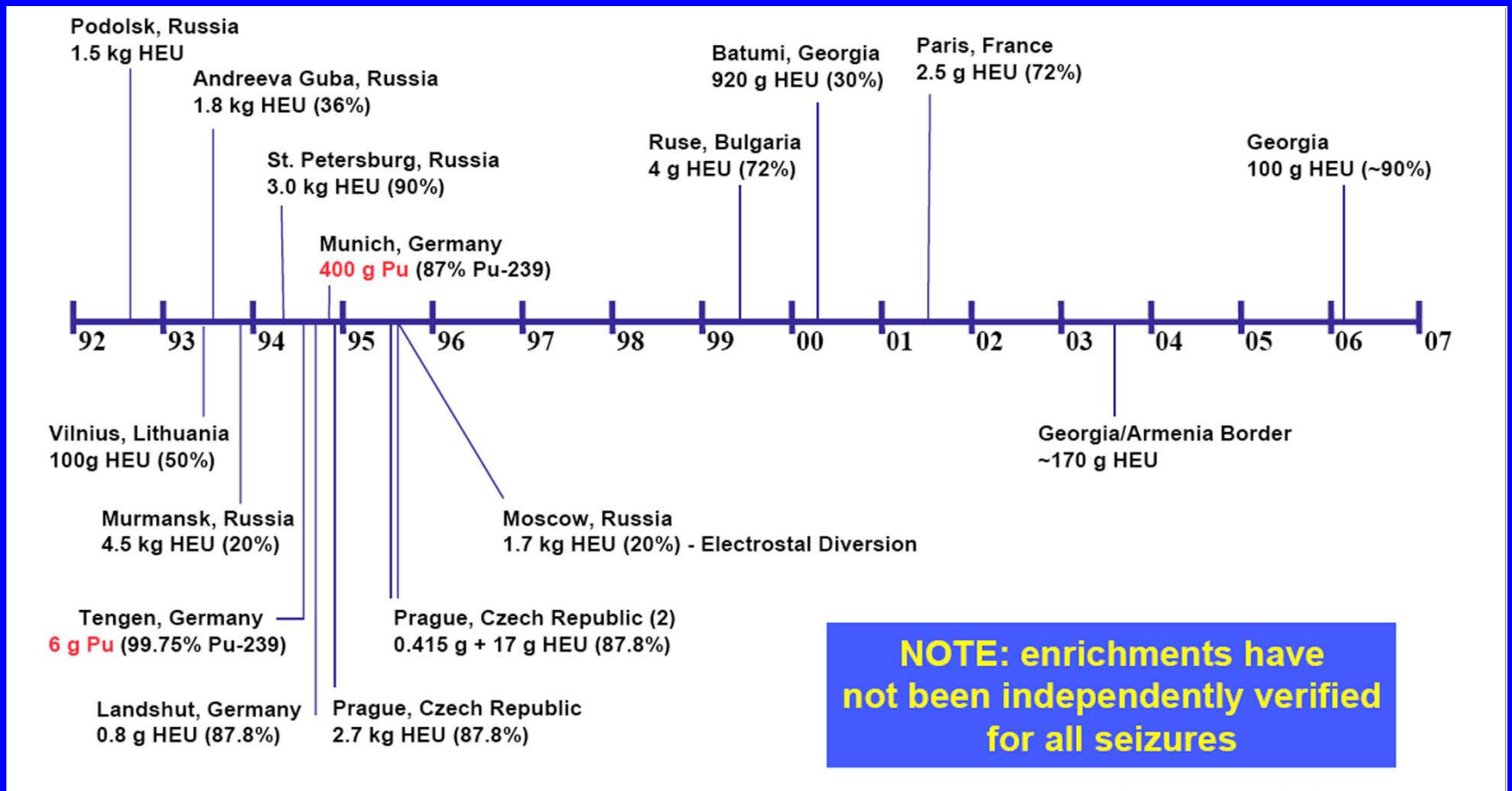
Terrorists might be able to get plutonium or HEU

- ◆ ~20 documented cases of theft and smuggling of plutonium or HEU, some in kilogram quantities
 - Most recent seizures: Georgia 2010, Moldova 2011
- ◆ Major progress in improving nuclear security
 - Dozens of sites with major security upgrades
 - Dozens of sites all material removed
- ◆ But many weaknesses remain, in many countries
 - Protection against only modest threats
 - Lack of on-site armed guards
 - Limited insider protection



Source: Reuters, from Georgian Interior Ministry

Documented seizures, 1992-2006 (more seizures in 2010, 2011)



Source: Los Alamos National Laboratory, Tom Bielefeld

Terrorists might be able to get material: the 2011 Moldovan HEU case

- ◆ 27 June, 2011: Moldovan officials arrest 6 people for nuclear smuggling
 - 4.4 grams weapon-grade HEU seized
 - Smugglers claim to have access to 9 kilograms of HEU, willing to sell for \$31 million
 - Smugglers also claim to have access to plutonium
 - Smuggling through highly corrupt breakaway region of Transnistria
 - Russian leader of group, African buyer, still at large (appears to be first case in some time with serious buyer involved)
 - Moldovan officials report that “members of the ring, who have not yet been detained, have one kilogram of uranium”
 - Little is publicly known about specific characteristics or origins of the material, capabilities of the smugglers, identity of the buyer...

Attack at Pelindaba, Nov. 8, 2007

- ◆ Site with 100s of kgs of highly enriched uranium (HEU)
- ◆ Attack by 2 teams of armed, well-trained men, from opposite sides
- ◆ One team:
 - Penetrated 10,000-volt security fence
 - Disabled intrusion detectors
 - Went to emergency control center, shot a worker there, who raised first alarm
 - Spent 45 minutes inside guarded perimeter – never engaged by site security forces
 - Left through same spot in fence – never caught or identified
- ◆ South Africa has since undertaken major nuclear security upgrades, establishing regulatory design basis threat

Terrorists might be able to get material: Widely varying nuclear security

- ◆ No binding global standards for how secure nuclear weapons or nuclear materials should be
- ◆ Russia:
 - *Dramatically* improved security compared to 15 years ago
 - Cooperative upgrades nearly complete
 - *But*, world's largest stockpiles in world's largest # of buildings and bunkers, underinvesting in sustainability, security culture still weak, regulations weak, massive insider corruption
- ◆ Pakistan:
 - Small, heavily guarded stockpile
 - But immense threats – potentially huge outsider attacks, corrupt insiders, some with jihadist sympathies
- ◆ HEU-fueled research reactors
 - ~120 in > 30 countries, some only night watchman, chainlink fence

What is the evidence that current nuclear security is inadequate?

- ◆ Continuing seizures of weapons-usable material
 - ~20 real cases involving HEU or Pu since 1992
- ◆ “Red team” tests indicate security systems can be defeated by intelligent adversaries looking for weak points
 - Repeated cases in U.S. tests – though U.S. has more stringent security requirements than virtually any other country
 - Most other countries do not carry out such tests
- ◆ Successful thefts and attacks at well-secured non-nuclear facilities – demonstrating adversary capabilities
 - Repeated cases of use of insiders, covert outsider attacks, unusual tactics, succeeding in stealing from/attacking heavily guarded sites
 - Existing nuclear security measures in many countries demonstrably insufficient to protect against such adversary capabilities

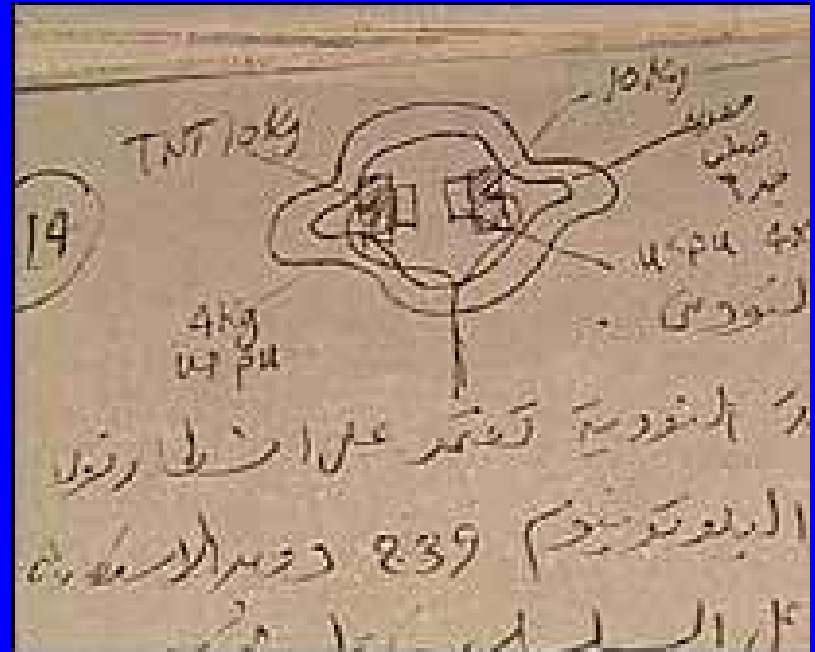
Nuclear material is not hard to smuggle – plutonium box for first-ever bomb



Source: Los Alamos

Al Qaeda has actively sought to get nuclear bombs

- ◆ al Qaeda's efforts:
 - early 1990s: evidence of HEU purchase attempt in Sudan
 - mid-1990s: many reports (and Zawahiri claims) of nuclear shopping attempts in the former Soviet Union – credibility unclear
 - early 2000s: focused nuclear program reporting directly to Zawahiri – carried out crude explosives tests for nuclear bomb in Afghan desert
 - early 2000s: help from Pakistani UTN network – senior nuclear scientists met with bin Laden and Zawahiri, discussed crude bomb designs



Source: CNN

Al Qaeda has actively sought to get nuclear bombs (II)

- ◆ al Qaeda's efforts:
 - 2003: bin Laden seeks and receives *fatwa* from radical Saudi cleric authorizing use of nuclear weapons against U.S. civilians
 - 2003: “constant companion” of Saudi cleric negotiating to purchase 3 nuclear devices – al Qaeda leaders approve, *if* “Pakistani expert” confirms items are real
 - 2008: Zawahiri publishes extended elaboration on 2003 nuclear fatwa arguments



Source: Reuters

Chechen terrorists have pursued nuclear and radiological terrorism

◆ Multiple cases:

- 2 cases of teams carrying out reconnaissance at nuclear weapon storage sites – 2 more on nuclear weapon transport trains
- Repeated threats to attack nuclear reactors – terrorists who seized Moscow theater in 2002 considered seizing reactor at the Kurchatov Institute
- Repeated threats to use radiological “dirty bombs” – buried Cs-137 source in Moscow park
- Captured documents indicate plan to seize a Russian nuclear submarine (possibly with nuclear weapons on board)



Source: Public Broadcasting Service

Aum Shinrikyo sought nuclear weapons before its nerve gas attacks

◆ Aum's efforts

- Cult leader Shoko Asahara was obsessed with nuclear weapons
- Repeated shopping trips to former Soviet Union – acquired wide range of conventional weapons, recruited thousands of followers, sought to buy nuclear weapons and materials
- Purchased farm in Australia, stole enrichment documents – idea to mine, enrich its own uranium
- Turned to chemical and biological weapons when nuclear proved too slow
- No intelligence agency anywhere was aware of them until *after* nerve gas attacks



Source: Associated Press

What effect will bin Laden's death have?

- ◆ Could reduce the risk:
 - Likely some disruption as top leadership sorts itself out
 - Loss of charismatic leader will likely make recruitment of nuclear-related personnel, raising large sums of cash, more difficult
 - *If* coalition also eliminates Zawahiri, risk reduction could be larger
 - much of the nuclear drive appears to have come from these two
- ◆ *But*, risk will remain significant:
 - Al Qaeda's "nuclear CEO," other key participants in nuclear effort still at large
 - Other groups have pursued nuclear weapons as well – with 2-3 groups having gone the nuclear path in last 15 years, cannot expect they will be the last
 - The problem of nuclear terrorism and the need for nuclear security will be with us for decades – no room for complacency

North Korea and Iran are likely small parts of the nuclear terrorism problem

- ◆ Nuclear security:
 - North Korea has only a few bombs' worth of plutonium in a tightly controlled garrison state – theft very unlikely
 - Iran has not begun to produce weapons-usable material – has only a small amount of HEU research reactor fuel
- ◆ Conscious state transfer:
 - Regimes bent on maintaining power unlikely to take the immense risk of providing nuclear bomb material to terrorist groups who might use it in a way that would provoke overwhelming retaliation
 - Transfers to other *states* – who are likely to be deterred from using nuclear weapons – a very different act
- ◆ High-level “rogues” within states
 - If stocks of weapons-usable material grew, could an “A.Q. Kim” sell without detection?
- ◆ State collapse:
 - Could have worrisome “loose nukes” scenario

Spread of nuclear power need not increase terrorist nuclear bomb risks

- ◆ Most nuclear reactors do not use nuclear material that can readily be used in nuclear bombs:
 - Low-enriched uranium fuel cannot be used to make a nuclear bomb without technologically demanding further enrichment
 - Plutonium in spent fuel is 1% by weight in massive, intensely radioactive fuel assemblies
- ◆ Reprocessing (separating plutonium from spent fuel) could increase risks, requires intensive security and accounting
 - Poor economics, few additional countries pursuing – South Korea and China only countries currently considering shift
 - Reprocessing does not solve the nuclear waste problem – should not be seen as the “answer” to the U.S. Yucca Mountain problem
- ◆ Power reactors do pose potential targets for sabotage
 - Sabotage would mainly affect countries in region, global nuclear industry
 - As with nuclear theft, strong security measures can reduce the risk

Not just a U.S. view

- ◆ First ever U.S.-Russian joint threat assessment
- ◆ Concludes the danger is real, urgent action is needed to reduce it
- ◆ Endorsed by broad range of retired military, intelligence experts

<http://belfercenter.ksg.harvard.edu/publication/21087/>

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



BELFER CENTER
for Science and International Affairs



**INSTITUTE FOR U.S. AND
CANADIAN STUDIES**

MAY 2011

International assessments of the danger of nuclear terrorism

“Nuclear terrorism is one of the most serious threats of our time. Even one such attack could inflict mass casualties and create immense suffering and unwanted change in the world forever. This prospect should compel all of us to act to prevent such a catastrophe.”

- U.N. Secretary-General Ban-Ki Moon, 13 June 2007

“The gravest threat faced by the world is of an extremist group getting hold of nuclear weapons or materials.”

- then-IAEA Director-General Mohammed ElBaradei, 14 September 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, counter-terrorism representative of the Russian president, former head of the FSB, 27 September 2007

What's true? Reasons for skepticism

- ◆ States have had great difficulty getting nuclear weapons, surely it would be harder for terrorists
 - Hardest part for states is making the nuclear material – 90% of Manhattan Project
 - Making safe, reliable, that can be delivered by missile or aircraft *far* harder than making crude terrorist bomb
- ◆ Terrorist attacks are mostly not very sophisticated
 - But there is a spectrum – some terrorist groups *have* used sophisticated explosive designs
 - Significant numbers of well-trained engineers and scientists have worked with terrorist groups
- ◆ Greatly weakened al Qaeda could not organize a nuclear bomb effort
 - Killing, capture, disruption of much of top leadership *does* reduce the risk – but modest cell far from the drone strikes could still be pursuing a nuclear effort

What's true? Reasons for skepticism (II)

- ◆ U.S. intelligence has exaggerated terrorist threats – including in the lead-up to war in Iraq
 - Absolutely correct – skepticism justified. Notable that *both* George W. Bush and Barack Obama identify nuclear terrorism as greatest threat to U.S. national security
 - Wide range of other countries (both nuclear weapon states and non-nuclear-weapon states) have reached similar conclusions
- ◆ Terrorists could not plausibly get nuclear material
 - Ongoing seizures suggest danger still exists
 - For most seizures, material was never noticed to be missing --how many other thefts have *not* been detected?
- ◆ Terrorists not likely to get state support
 - Probably true – states unlikely to hand such power over to terrorist groups they cannot control
 - But state support helpful, not essential, to terrorist nuclear effort

What's new? How the threat is changing

- ◆ Factors leading to reduced risk:
 - Al Qaeda is weakened, disrupted – bin Laden dead
 - Widespread revulsion against the mass slaughter of innocents – including among Islamic extremists
 - Nuclear security is substantially improved at many sites
 - More international attention, resources focused on stopping nuclear smuggling, nuclear terrorist plots
- ◆ Factors leading to increased risk:
 - Continuing destabilization in Pakistan (and rapid growth of Pakistan's nuclear stockpile)
 - Possible increased al Qaeda desperation to achieve major blow
 - Some evidence of learning, increased sophistication, by nuclear smugglers and terrorists
 - North Korea now has nuclear weapons, may be producing HEU
 - Iran closer to the threshold of producing HEU

Nuclear terrorism: the good news

- ◆ No convincing evidence any terrorist group has yet gotten a nuclear weapon or the materials and evidence needed to make one
 - Despite many claims
- ◆ No evidence any state has helped terrorists with nuclear weapons
- ◆ Making a nuclear bomb is clearly not “easy”
 - Al Qaeda and Aum, both sophisticated, well-funded groups, appear to have faced major hurdles
- ◆ Overall, threat is probably lower than 10 years ago
 - Many nuclear sites have much better security, or all nuclear material removed
 - Al Qaeda substantially disrupted
 - *But what may be happening without being detected?*

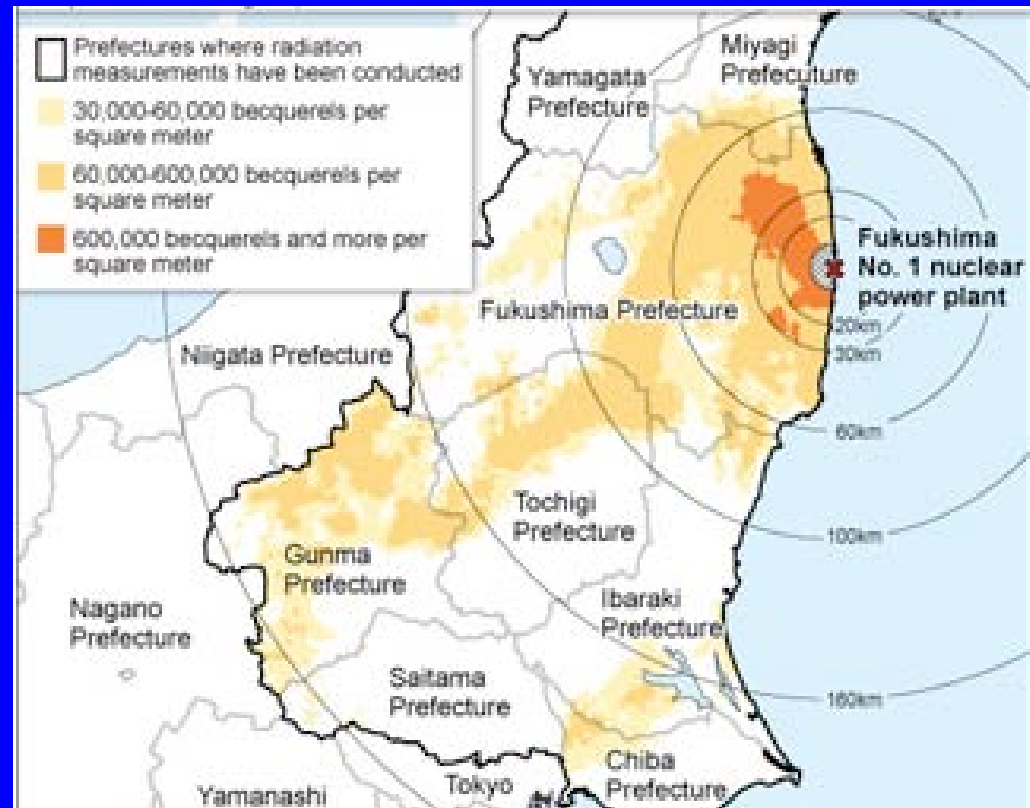
Summary: the nuclear terrorist threat

	Yes	No
◆ Do terrorists want nuclear weapons?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
◆ Is it conceivable terrorists could make a crude bomb if they got the material?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
◆ Is there material that might be vulnerable to theft and transfer to terrorists?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
◆ Is it likely that terrorists, if they had a crude device, could smuggle it to Moscow, London, Paris, Washington, New York, or Seoul?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

The probability may not be high – but no one would operate a nuclear reactor upwind of a city if it had a 1/100 chance each year of a catastrophic radiation release – risk of a terrorist nuclear bomb may well be higher

Terrorists have also considered sabotage of major nuclear facilities

- ◆ al Qaeda senior leadership has explored the possibility of sabotaging nuclear facilities
- ◆ Chechen terrorists have threatened and planned attacks on nuclear facilities
- ◆ Fukushima showed that destroying both main and backup cooling can lead to major release, create widespread fear



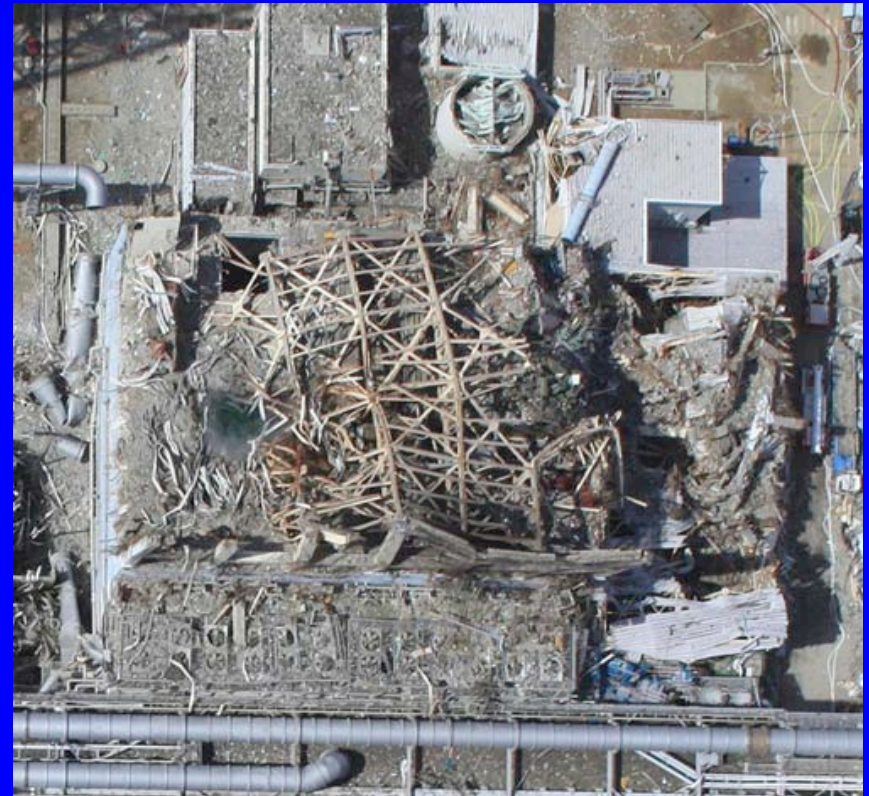
Source: Asahi Shimbun, from MEXT

The threat of nuclear sabotage

- ◆ Most nuclear power plants protected by security forces, containment vessels, and redundant safety systems
- ◆ *But*, levels of security vary widely:
 - Some reactors have no (or few) on-site armed guards
 - Few few civilian facilities designed to cope with 9/11 threat -- multiple, coordinated teams, suicidal, well-trained, from a group with substantial combat and explosives experience
 - Some reactors do not have Western-style containments, few redundant safety systems
- ◆ *If* attackers could successfully destroy multiple safety systems, reactor could melt down, breach containment, spread radioactive material – as at Fukushima
- ◆ Similarly, *if* attackers could successfully drain the water from a spent fuel pool, real risk that fuel could get hot enough to catch fire -- potential Chernobyl-scale disaster

Nuclear safety and security: Strengthening the regime after Fukushima

- ◆ Fukushima tragedy offers lessons for both safety and security
 - Took extraordinary natural disaster to take out both normal and emergency cooling
 - For terrorists, this may be part of the plan – changes probabilities
 - Odds of next major radioactive disaster coming purely by accident may be lower than odds of it happening from hostile action
 - All nations should request independent, international review of both safety and security



Source: Air Photo Service, Japan

Nuclear safety and security are closely linked – you can't be safe without being secure.

The threat of “dirty bombs”

- ◆ Dirty bomb could be very simple -- dynamite and radioactive material together in a box
 - Other simple means to disperse radioactive material more effective
- ◆ Dangerous radioactive sources in use for valuable civilian purposes in hospitals, industry, agriculture
 - Even large sources often have minimal security
- ◆ “Weapons of mass disruption” – not mass destruction
 - Would cause zero to a few near-term radiation deaths, potentially a few hundred to a few thousand long-term cancer deaths (undetectable against cancer background)
 - *But*, fear of anything “radioactive” could create panic
 - Expensive, disruptive – potentially many blocks would have to be evacuated, cleaned up (possibly 10s of billions in costs)

Americium dispersal in Manhattan

- ◆ Inner Ring: One cancer death per 100 people due to remaining radiation (IF everyone stays, and no cleanup)
- ◆ Middle Ring: One cancer death per 1,000 people
- ◆ Outer Ring: One cancer death per 10,000 people; EPA recommends decontamination or destruction



Map source: Testimony by Henry Kelly, Federation of American Scientists, 2002

Dealing with the “dirty bomb” threat

- ◆ Better control, accounting, security for radioactive sources:
 - All high-priority sources worldwide should be accounted for, regulated, and have basic security measures (strong locks, alarms, etc.) throughout their life-cycle – IAEA “Code of Conduct”
 - Improved transport security especially needed
 - Retrieve, safely dispose of disused sources
 - >100 countries worldwide have inadequate controls
- ◆ Radiation detection at ports, borders
- ◆ Improved capacity to detect, assess, respond to attack
- ◆ Develop improved urban decontamination technologies
- ◆ Most important: communication strategy to limit panic, tell public how to respond – complicated by past gov’t lies

What must South Korea protect?

- ◆ No significant separated plutonium or HEU
 - For now – possibly pyroprocessed material in the future
- ◆ 21 nuclear power reactors, four sites
 - Also associated spent fuel
 - Some R&D facilities
- ◆ Wide range of radiological sources, with many beneficial uses
- ◆ Must protect against both terrorists with global reach, and local threats (such as North Korean sabotage teams)
 - Both insiders and outsiders
- ◆ In many cases, simple, cost-effective steps can reduce risks

The pyroprocessing dilemma

- ◆ South Korea has major political problems providing adequate spent fuel storage for nuclear reactors
 - Pyroprocessing not a short-term solution – plants cannot be built until after spent fuel pools would already be full
 - May be part of a long-term strategy – but likely very expensive
- ◆ Pyroprocessing separates plutonium from most of the fission products in spent fuel, raises security risks
 - Much easier for terrorists to get pure plutonium from
 - Not radioactive enough to prevent theft – though use taking place behind thick radiation shielding would make theft more difficult
- ◆ South Korean pyroprocessing may encourage other countries to process spent fuel – increase risks of proliferation

Why is nuclear security central to South Korea's national interests?

- ◆ South Korea could be target (e.g., North Korean sabotage)
- ◆ A terrorist nuclear attack – even if it occurred far away, in the United States or Britain or Russia – would be a major blow to South Korea's interests
 - Devastating economic reverberations around the world
 - Likely shut-down of much of world trade until confidence could be established this route could not be used to deliver another bomb
 - More extreme U.S. reaction than after 9/11 – America and the world would be transformed forever, and not for the better
- ◆ Hosting summit is a key symbol of ROK nuclear leadership
- ◆ After Fukushima, visible steps to strengthen safety and security needed to rebuild confidence – enable nuclear growth, ROK nuclear exports, nuclear component of climate response

What should South Korea do?

- ◆ Lead by example
 - Ensure effective security for its nuclear facilities against all plausible outsider and insider threats
 - Ensure radioactive sources are secure and accounted for – and less dangerous technology substitute where practicable
 - Help recipients of ROK nuclear exports achieve high security
- ◆ Lead a nuclear security summit that results in major progress on the ground at sites around the world
 - Should go beyond simply reaffirming past commitments
 - Individual countries' commitments are particularly important -- need bilateral diplomacy in capitals to convince countries to pledge to provide effective security for all nuclear material, eliminate and consolidate stocks wherever practicable
- ◆ Support major multilateral initiatives
 - Contribute to Global Partnership, IAEA, UNSC 1540 Implementation Fund, Global Initiative...

What would nuclear security success look like?

- ◆ Number of sites with nuclear weapons, HEU, or separated plutonium greatly reduced
- ◆ All countries with HEU, Pu, or major nuclear facilities put in place *at least* a “baseline” level of nuclear security
 - Protection against a well-placed insider, a modest group of well-trained and well-armed outsiders (able to operate as more than one team), or both outsiders and an insider together
 - Countries facing higher adversary threats put higher levels of security in place
- ◆ Strong security cultures in place, focused on continual improvement, search for sustainable excellence
- ◆ Measures in place to confirm strong security performance
 - Effective regulation, inspection, enforcement
 - Regular, realistic performance tests – including “red teams”
 - Independent, international review – becoming the norm

Essential elements of an “appropriate effective” physical protection system

- ◆ A *design basis threat* reflecting today’s threats
- ◆ Effective *regulation* requiring all facilities with potential bomb material or posing a catastrophic sabotage risk to have security capable of defeating the DBT
 - Backed up by inspections, and enforcement
 - Ideally including *realistic tests* of the system’s ability to defeat outsider and insider threats
 - Effective *control and accounting* of nuclear material
- ◆ A strong *security culture*, to ensure that all relevant staff understand the threat and the importance of security
- ◆ *Police and intelligence* efforts focused on ensuring that nuclear conspiracies will be detected
- ◆ *Regular review and adaptation* to ensure the system adapts to changing threats and opportunities

How could the Seoul nuclear security summit contribute to success?

- ◆ Goal: commitments beyond first summit, which will lead to major nuclear security progress on the ground
- ◆ Commitment to lasting excellence in nuclear security
 - Taking every practical and cost effective step to reduce the risk
 - Protecting against every plausible terrorist threat
 - Assessing every site with HEU, Pu, or warheads to see if it can be consolidated with others – whether benefits justify costs, risks
- ◆ More focused approach to national commitments
 - Work with U.S., others, to develop set of commitments to suggest to each country
 - Get as many states as possible to commit to provide *at least* “baseline” level of nuclear security, eliminate HEU sites
 - Bilateral diplomacy in capitals going well beyond sherpa process
- ◆ Provide detailed information on nuclear terrorism threat to multiple levels of all participating governments

How could the Seoul nuclear security summit contribute to success? (II)

- ◆ Summit should keep the focus on making major progress over four years – but make clear that nuclear security must be maintained and improved far beyond that
 - Should agree on third summit (no need to decide on whether there will be more beyond that)
- ◆ After Fukushima, commit to steps that will strengthen *both* safety and security – such as better ability to restore cooling, refill spent fuel pools, in an emergency
- ◆ While keeping an intense focus on securing separated plutonium and HEU, also call for actions to protect nuclear facilities from sabotage, and to secure radiological sources
- ◆ Secure commitments to establish national police or intelligence teams focused on stopping nuclear smuggling
 - International police, intelligence cooperation essential

The later lines of defense

- ◆ Preventing weapons and materials from being stolen in the first place is 90% of the battle -- once stolen, extremely difficult to find and interdict
- ◆ *Intelligence and law enforcement cooperation.* Need drastically increased cooperation to detect, analyze, all key indicators of nuclear conspiracies
- ◆ *Smuggling interdiction.* All countries have UNSC 1540 legal obligation to put in place effective border controls, transshipment controls – including to stop nuclear and radiological materials. Vast amount of work to be done
- ◆ *Nuclear emergency response.* Need effective measures in place to respond to a nuclear emergency – evacuation, treatment, decontamination, public communication – but should focus first on prevention.

Belief in the threat – the key to success

- ◆ Effective and lasting nuclear security worldwide will not be achieved unless key policymakers and nuclear managers around the world come to believe nuclear terrorism is a real threat to *their* countries' security, worthy of investing their time and resources to address it
- ◆ Steps to convince states this is a real and urgent threat:
 - Intelligence-agency discussions – most states rely on their intelligence agencies to assess key security threats
 - Joint threat briefings – by their experts and our experts, together
 - Nuclear terrorism exercises and simulations
 - “Red team” tests of nuclear security effectiveness
 - Fast-paced nuclear security reviews – by teams trusted by the leadership of each country
 - Shared databases of real incidents related to nuclear security, capabilities and tactics thieves and terrorists have used, lessons learned

Security culture matters: Propped-open security door



Source: GAO, Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving, More Enhancements Needed (GAO, 2001)

For further reading...

- ◆ Full text of Managing the Atom publications at:
 - <http://www.managingtheatom.org>
- ◆ *Securing the Bomb 2010*:
 - <http://www.nti.org/securingthebomb>
- ◆ *For regular e-mail updates from Managing the Atom, write to atom@harvard.edu*

Backup slides if needed...

Seizing the opportunities from the Washington nuclear security summit

- ◆ Summit raised the issue to presidents and prime ministers in an unprecedented way
 - Major contribution to building the sense of urgency and commitment around the world
 - Agreement on securing all vulnerable material within four years
 - Many significant commitments (e.g., Ukraine's commitment to eliminate all HEU by the end of 2012)
 - Agreement to hold another summit in 2012, regular meetings between, helps hold countries' feet to the fire
- ◆ Challenge now is moving from words to deeds
 - Need intensive diplomacy to convince countries to toughen security rules, convert research reactors, eliminate stocks where possible
 - Unfortunate funding constraint: FY2010 < FY2009, FY2011 on year-long continuing resolution (major cut from request)
 - Huge obstacles: complacency, sovereignty, secrecy, bureaucracy, politics between states...

Preventing state transfers, smuggling

◆ *Prevent and deter state transfers*

- Strengthen the global effort to stem the spread of nuclear weapons and put together an international package of carrots and sticks to engage North Korea and Iran credible enough to convince these states it is in their interests to verifiably end their nuclear weapons efforts
- Put in place best practicable means for identifying the source of any nuclear attack: nuclear forensics, traditional intelligence, databases of material characteristics

◆ *Interdict nuclear smuggling*

- Intensify police and intelligence cooperation focused on stopping nuclear smuggling including more stings and incentives for informers
- Ensure countries have effectively enforced laws for real or attempted nuclear terrorism
- Focus on the development of integrated security systems that recognize the limitations of radiation detectors and place as many barriers as possible in the path of intelligent adversaries

Strong security culture is critical

- ◆ Officials, managers, will not assign needed priority, resources to security unless they believe in the threat; staff will not take security seriously, and will cut corners on burdensome security rules, unless they believe in the threat
- ◆ All relevant staff must understand *what* the security rules are and *why* they are important
- ◆ Can build security culture with:
 - Threat briefings, videos, and other training
 - Nuclear terrorism exercises
 - Incentives for strong security performance
 - IAEA guidance in preparation
- ◆ *Probability of major radioactive release from terrorism is higher than from accidents – security requires same level of care and scrutiny as safety – major culture shift*

Why does complacency matter?

- ◆ No one will make it a priority to invest time and resources to reduce a danger they don't believe is real
 - The key to security culture is “never forgetting to be afraid”
- ◆ Sources of complacency (a partial list):
 - “We’ ll never have an attack or a theft attempt here”
 - “We’ ve been doing it this way for 30 years without a problem, why should we change?”
 - “Fixing that would cost money”
 - “I’ ve got more urgent things to do than to deal with protecting against something that will probably never happen”
 - “I don’ t believe terrorists could make a bomb, or sabotage a plant in a way that would cause a major radioactive release”
 - “Terrorists don’ t want to attack my country anyway – this is the Americans’ problem if it’ s a problem at all”
 - “Nuclear security in our country is already good enough”
 - “The nail that sticks up gets pounded down”

Reactor-grade plutonium is weapons-usable

- ◆ Higher neutron emission rate:
 - For Nagasaki-type design, even if neutron starts reaction at worst possible moment, “fizzle yield” is ~ 1kt – roughly 1/3 destruct radius of Hiroshima bomb – more neutrons won’t reduce this
 - Some advanced designs are “pre-initiation proof”
- ◆ Higher heat emission:
 - Various ways to deal with – for example, plutonium component can be inserted into weapon just before use (as in early U.S. designs)
- ◆ Higher radiation:
 - Can be addressed with greater shielding for fabrication facility
 - Last-minute insertion of plutonium component again
- ◆ *Reactor-grade plutonium is not the preferred material for weapons, but any state or group that can make a bomb from weapon-grade plutonium can make one from reactor-grade*

Did you know? Real incidents related to nuclear terrorism

- ◆ Events that have genuinely occurred:
 - A large-scale terrorist attack on a U.S. nuclear weapons base
 - Terrorist teams carrying out reconnaissance at Russian nuclear weapons storage facilities
 - An attack on the Pelindaba site in S. Africa (100s of kgs of HEU) by two armed teams
 - » One team penetrated 10,000-volt security fence, disabled intrusion detectors, went to emergency control center, shot worker there
 - » 45 minutes inside guarded perimeter, never engaged by site security forces
 - A terrorist attack on a nuclear facility (not yet operational) in which armed guard force was overwhelmed, terrorists were in control of facility for an extended period
 - More than a dozen real acts of sabotage at nuclear facilities
 - » None apparently intended to cause large radioactive release
 - » One involved firing a rocket-propelled grenade at a nuclear facility
 - Russian businessman offering \$750,000 for stolen weapon-grade plutonium, for sale to a foreign client

Did you know? Real incidents related to nuclear terrorism (II)

- ◆ Events that have genuinely occurred:
 - Preliminary explosive tests in al Qaeda's nuclear program
 - Repeated al Qaeda efforts to get stolen nuclear material or nuclear weapons (most recently in 2003)
 - Repeated al Qaeda attempts to recruit nuclear expertise
 - » Including bin Laden and Zawahiri meeting with senior Pakistani scientists
 - al Qaeda seeking and receiving religious ruling authorizing nuclear attack on American civilians (2003)
 - Several incidents of al Qaeda considering (but not pursuing) attacks on nuclear power plants
- ◆ Good news on nuclear terrorism (*as far as we know*):
 - No convincing evidence terrorists have yet succeeded in getting either materials or expertise needed
 - Risk has likely declined, because of improved nuclear security, large disruptions to “al Qaeda central”
 - Both al Qaeda and Aum Shinrikyo found nuclear to be difficult

All states must protect HEU and Pu against a range of adversary capabilities

- ◆ All states should require all operators with Cat. I nuclear material to have security in place capable of defeating, with high confidence, a specified set of insider and outsider threats
- ◆ This design basis threat (DBT) should include both
 - Capabilities comparable to those terrorists and criminals have demonstrated in that country (or nearby)
 - Capabilities of terrorists with global reach
 - Even in the safest countries, HEU and Pu must be protected against a robust set of potential adversary capabilities
 - In high-threat countries, even more stringent security measures needed

Each nation has responsibility for protecting its nuclear materials – but all nations have an interest in seeing that other nations carry out that responsibility appropriately

Broad range of demonstrated adversary capabilities and tactics: outsider threats

- ◆ Large overt attack
 - e.g., Moscow theater, October 2002: ~ 40 well-trained, suicidal terrorists, automatic weapons, RPGs, explosives, no warning
- ◆ Multiple coordinated teams
 - e.g., 9/11/01 -- 4 teams, 4-5 participants each, well-trained, suicidal, from group with access to heavy weapons and explosives, >1 year intelligence collection and planning, striking without warning
- ◆ Use of deception
 - Uniforms, IDs, forged documents to get past checkpoints, barriers
- ◆ Significant covert attack
 - e.g., Pelindaba attackers disabling intrusion detectors
- ◆ Use of unusual vehicles or routes
 - e.g., arrival by sea or air
 - e.g., multiple cases of tunneling into bank vaults

Broad range of demonstrated adversary capabilities and tactics: insider threats

- ◆ Multiple insiders working together
 - Many cases of theft from guarded facilities worldwide
- ◆ Often including guards
 - Most documented thefts of valuable items from guarded facilities involve insiders – guards among the most common insiders
 - Goloskokov: guards “the most dangerous internal adversaries”
- ◆ Motivations:
 - Desperation
 - Greed/bribery/corruption
 - Ideological persuasion
 - Blackmail

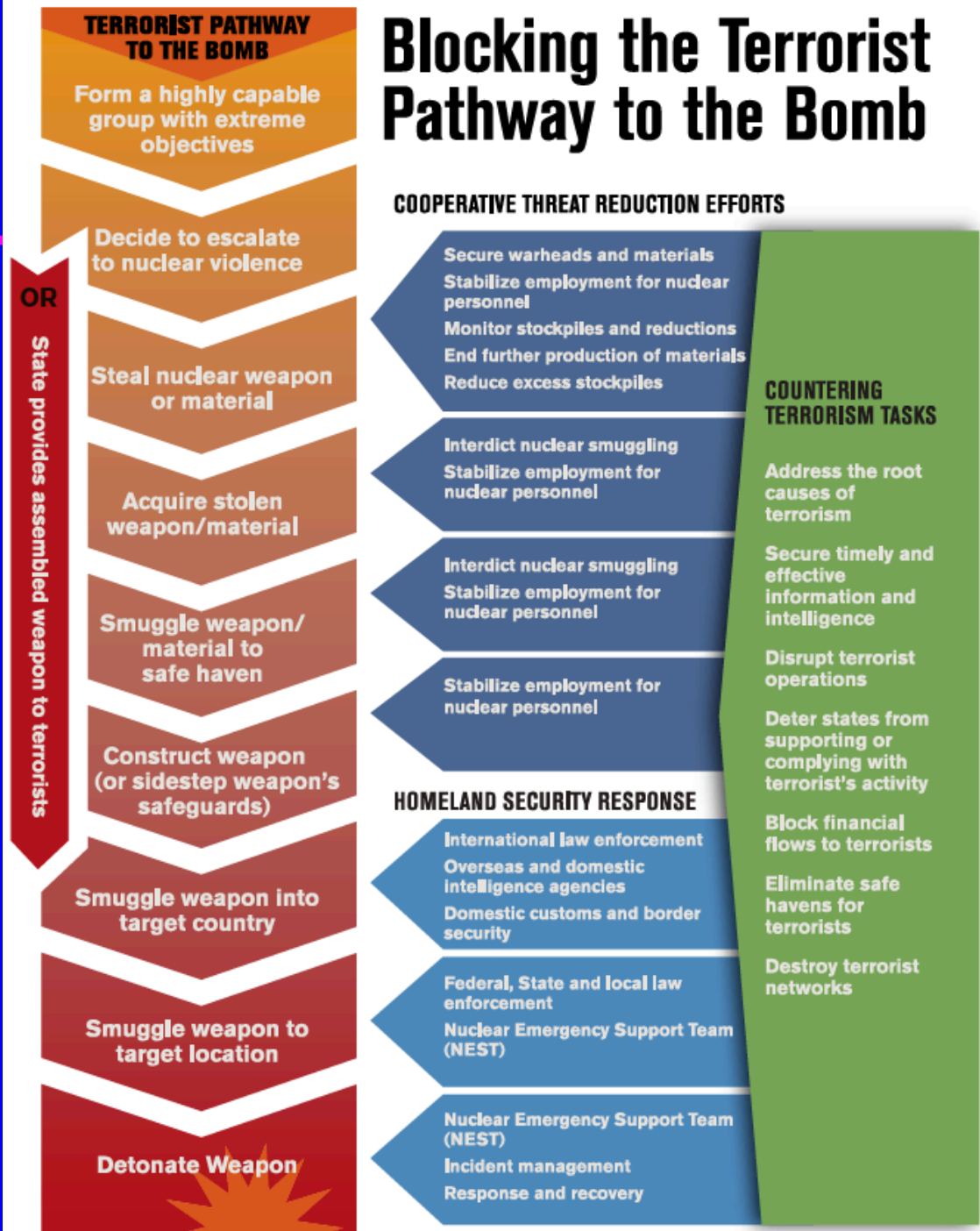
A trustworthy employee may not be trustworthy anymore if his family's lives are at risk

What can be done in the four-year effort – and beyond

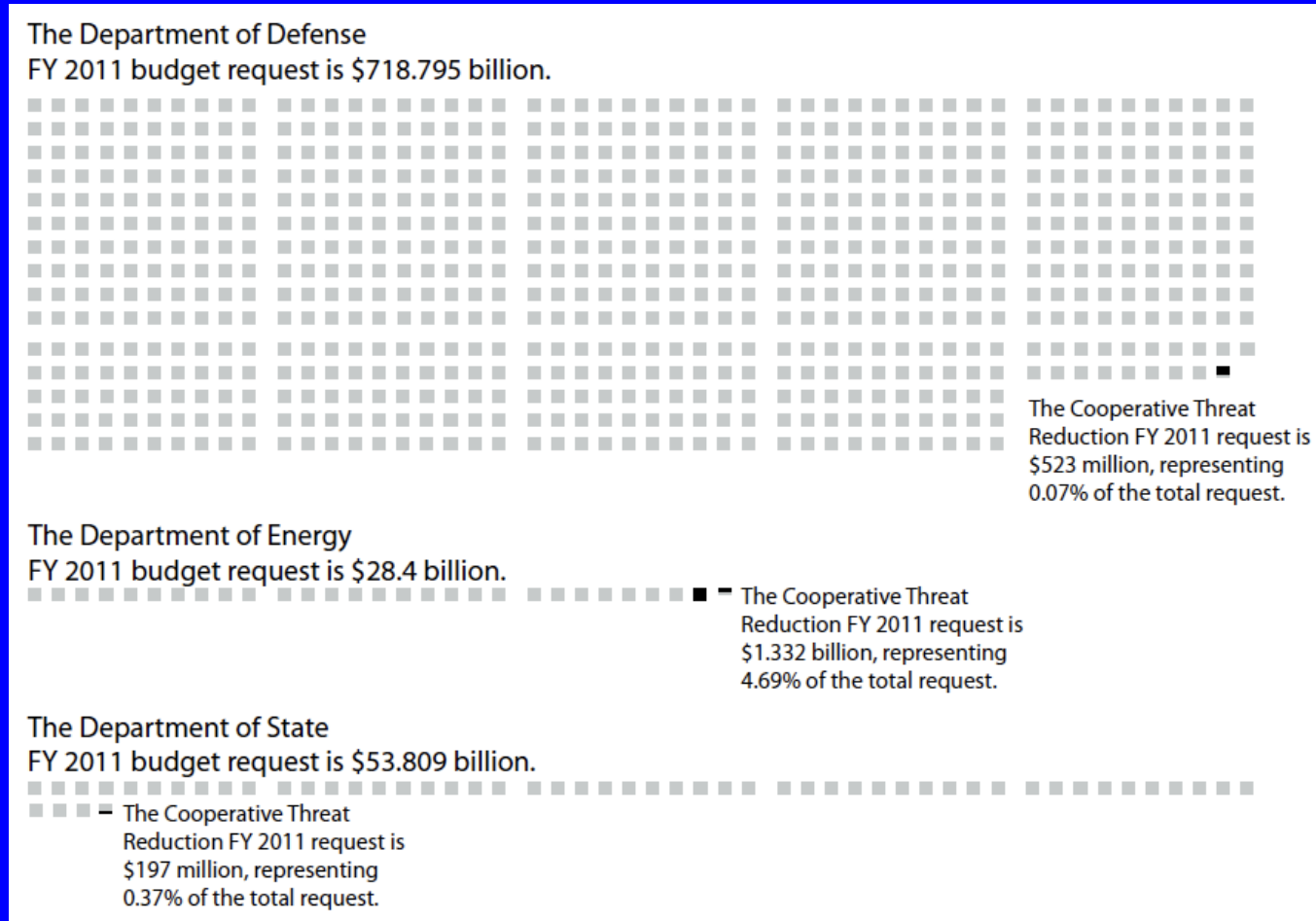
- ◆ By end of 2013 (ambitious targets)
 - Drastically reduce number of countries with weapons-usable nuclear material on their soil
 - » ~50% reduction may be possible
 - Reduce number of locations where weapons-usable nuclear material exists (~20-30% reduction may be possible)
 - Ensure all HEU and Pu worldwide has at least a “baseline” level of protection – e.g., secure against modest group of well-armed, well-trained outsiders (>1 team), and/or one well-placed insider
 - Ensure beyond-baseline security in a few countries with especially large threats (e.g., Pakistan)
 - Get countries to launch programs to strengthen security culture
- ◆ After end of 2013:
 - Forge common understanding on effective global nuclear security standards (e.g., as interpretation of UNSC 1540 obligation)
 - Phase-out of civilian HEU, end accumulation of separated Pu

Blocking the terrorist pathway to the bomb

Source: Bunn, Securing the Bomb 2010: Securing All Nuclear Materials in Four Years (2010)



Cooperative threat reduction is a tiny portion of overall spending



Source: Author's estimates, described in *Securing the Bomb 2010*

The international nuclear security framework is insufficient

◆ Binding agreements

- 1980 Physical Protection Convention and 2005 Amendment
 - » Parties must have a rule on nuclear security – but what should it say?
 - » 2005 Amendment not likely to enter into force for years to come
- 2005 Nuclear Terrorism Convention
 - » All parties to take “appropriate” nuclear security measures -- unspecified
- UNSC Resolution 1540
 - » All states must provide “appropriate effective” nuclear security -- unspecified

◆ International recommendations

- IAEA “Nuclear Security Series,” especially INFCIRC/225
 - » More specific, but still quite general – should have a fence with intrusion detectors, but how hard should they be to defeat?
 - » Compliance voluntary (though most countries do)

◆ Technical cooperation and funding

- Nunn-Lugar, comparable programs
- Global Partnership
 - » But no agreement yet on 10-year, \$10B extension

The international nuclear security framework is insufficient (II)

◆ Cooperative frameworks

- Global Initiative to Combat Nuclear Terrorism
 - » 82 nations participating
 - » Helps to convince countries of reality of threat
 - » Sharing of experience, best practices, capacity-building
 - » Modest focus on upgrading nuclear security
- Proliferation Security Initiative
 - » Unlikely to stop smuggling of suitcase-sized items
- Nuclear Security Summit
 - » Brought together leaders from 47 countries
 - » Commitment to secure all vulnerable nuclear material in four years

◆ The IAEA role

- Developing recommendations, peer reviews, assistance, data
 - » All voluntary, largely limited to non-nuclear-weapon states

Many tiles in the mosaic – but is it yet a beautiful picture? No common baseline of nuclear security for all Pu and HEU

Dealing with the sabotage threat

- ◆ Similar to preventing theft: 1st priority is high security at highest-risk sites
 - Need sabotage threats to be categorized by priority, as materials are
 - Need protection against outsider attack and insider conspiracy
 - Outsider attack could include:
 - » Groups of armed terrorists attacking by land, boat, or helicopter
 - » Truck bombs, boat bombs
 - » Large aircraft crashes
 - » Small aircraft packed with explosives
- ◆ For future systems, design for security:
 - Strengthens case for “inherently safe” systems
 - Designs must ensure against catastrophic release BOTH in the event of external attacks and internal sabotage (harder problem)
 - Terrorism risk will inevitably be a key factor publics, utilities, governments will consider in choosing energy sources

What should the mission be?

- ◆ Achieve effective and lasting security for all nuclear weapons and stocks of plutonium and HEU worldwide within four years – while consolidating to the minimum number of locations
 - Effective = provides high-confidence protection against demonstrated terrorist and criminal capabilities
 - » Not only installed systems but effective security culture
 - Lasting = countries can and will sustain effective security with their own resources (and have effectively enforced regulations in place that require the necessary measures to be maintained)
 - All = not just in Russia and the former Soviet Union, not just in developing countries, but in all countries – global problem, and wealthy developed countries also an issue
 - Consolidating = reducing number of weapons and materials sites wherever possible, especially removing material from the most vulnerable, difficult-to-defend sites (such as civilian research reactors)

The challenge

- ◆ Lugar Doctrine: war on terrorism will not be won until every nuclear bomb and cache of bomb material everywhere in the world is secure and accounted for to stringent and demonstrable standards

On the day after a nuclear terrorist attack, what would we wish we had done to prevent it?

Why aren't we doing it now?