



HARVARD Kennedy School

**BELFER CENTER**

FOR SCIENCE AND INTERNATIONAL AFFAIRS

# **THE THREAT OF NUCLEAR TERRORISM: WHAT'S NEW? WHAT'S TRUE?**

Matthew Bunn, Associate Professor of Public Policy

Harvard Kennedy School

Belfer Center for Science and International Affairs

Nuclear Security Summit March 2012

[www.nuclearsummit.org](http://www.nuclearsummit.org)

# 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 terrorists 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

*This briefing addresses 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 may claim they had more bombs hidden in cities, threaten to detonate them unless their demands were met
  - Potential for widespread panic, flight from major cities, resulting 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.”

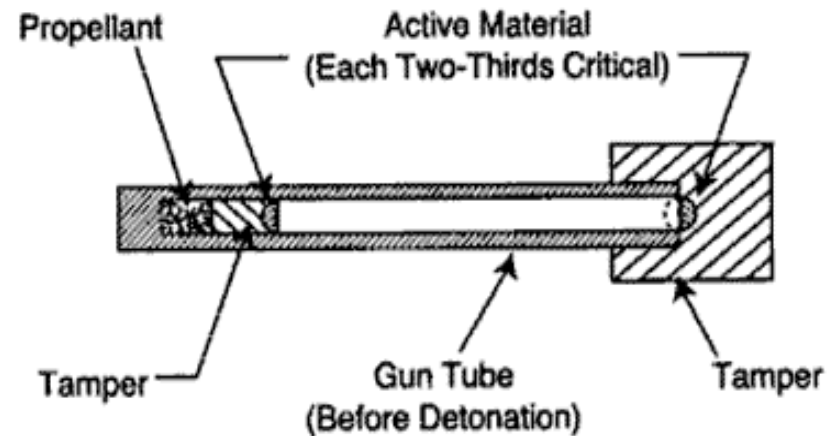
– Kofi Annan, “A Global Strategy for Fighting Terrorism,” March 10, 2005

- 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*



# Immense global stockpiles of nuclear weapons and weapons-usable materials

- ~19,000 assembled nuclear weapons still exist
  - All but ~1,000 in U.S. and Russian stockpiles
- Global stock of separated plutonium is nearly 500 tons
- Global stock of HEU is some 1,440 tons (+/- 125 tons)
- Nuclear weapons stored at >100 sites
- Weapons-usable nuclear material in hundreds of buildings in dozens of countries around the world

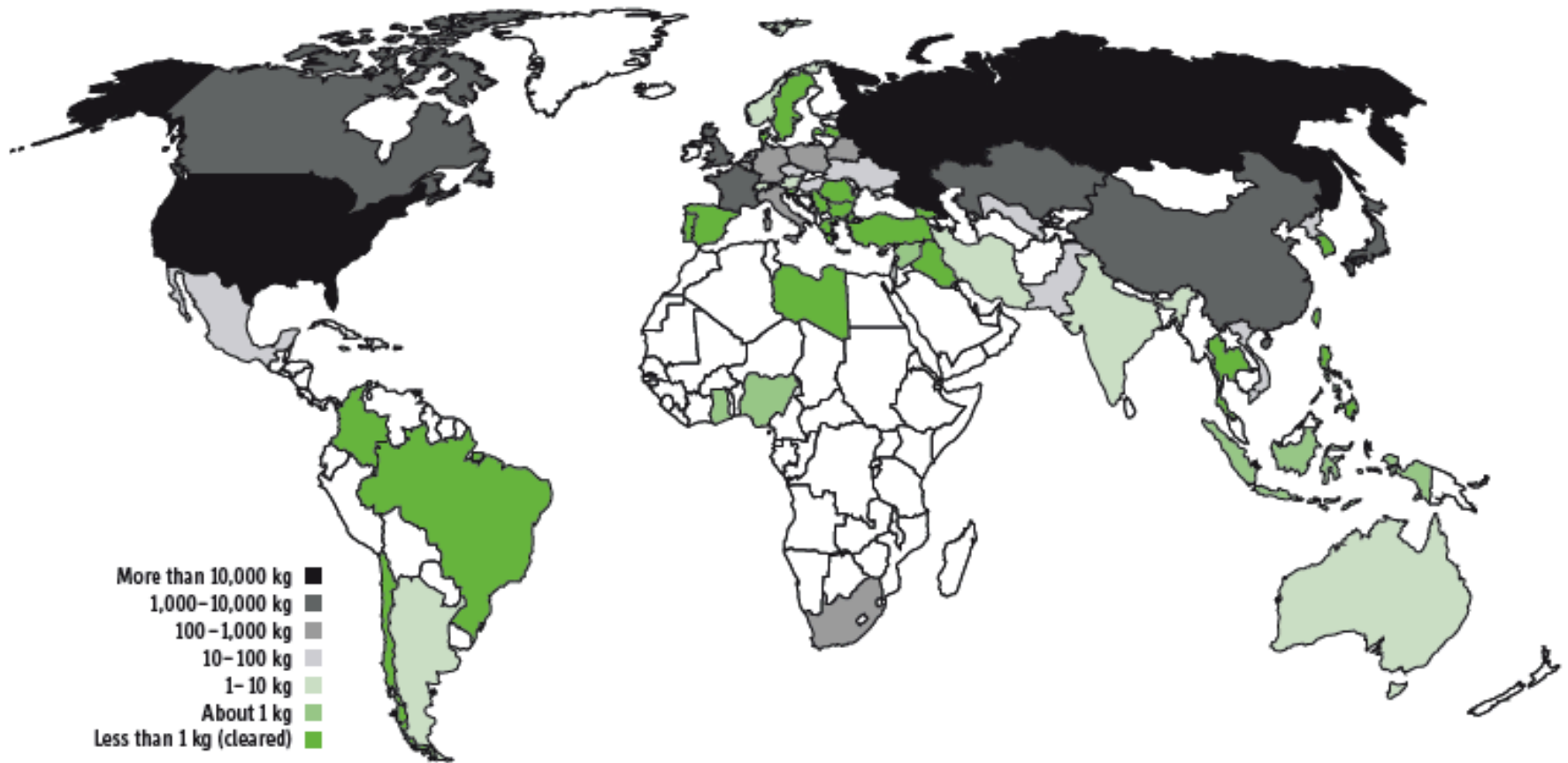


W-48 nuclear artillery shell, one of many thousands of tactical nuclear weapons that have been dismantled

Source: U.S. Department of Energy

*Theft of 0.01% of world stockpile could cause a global catastrophe*

# Widely distributed global stockpiles



Global Distribution of Civilian HEU Stockpiles

Source: International Panel on Fissile Materials, *Global Fissile Materials Report 2011*

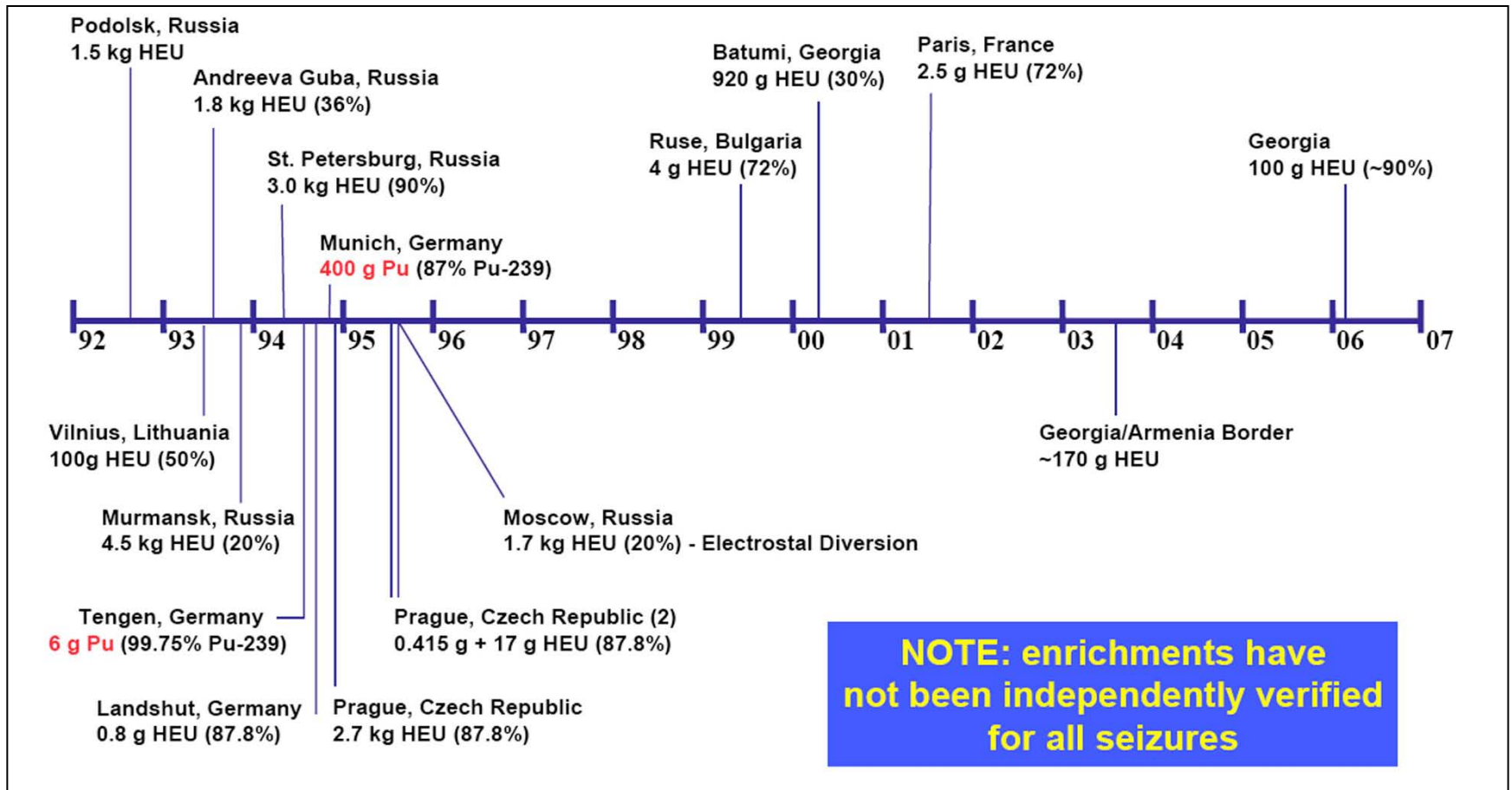
# Terrorists might be able to get plutonium or HEU

- ~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 and African buyer are 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 number of buildings and bunkers; underinvestment in sustainability; security culture still weak; regulations weak; widespread 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 (e.g., banks, military bases, diamond centers...)
  - Existing nuclear security measures in many countries demonstrably insufficient to protect against such adversary capabilities



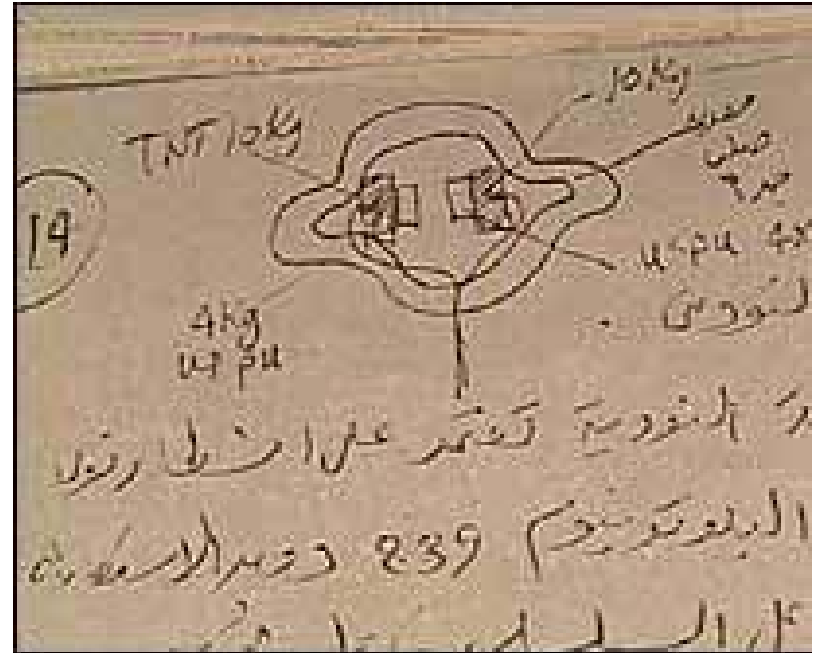
# Nuclear material is not hard to smuggle – plutonium box for first-ever bomb



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

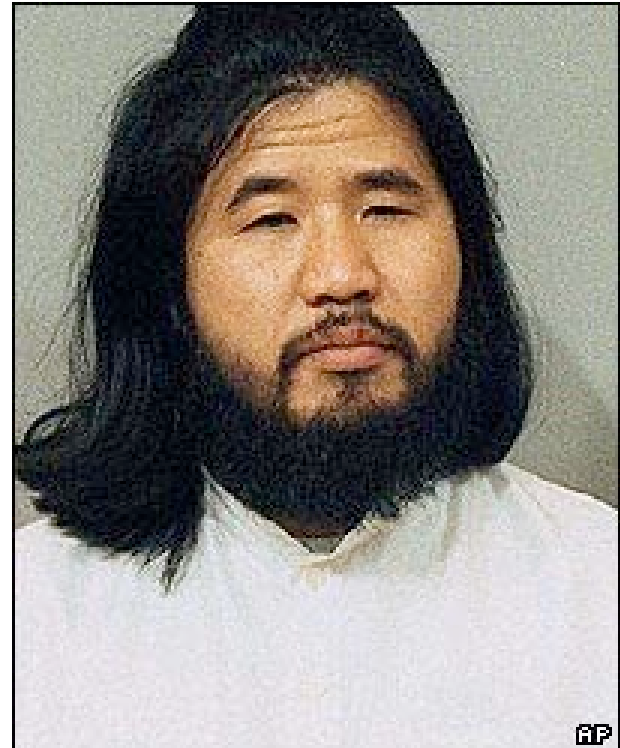
- Multiple cases:
  - 2 cases of teams carrying out reconnaissance at nuclear weapon storage sites – 2 more on nuclear weapon transport trains
  - Repeated threats to attack nuclear reactors – terrorists who seized Moscow theater in 2002 considered seizing reactor at the Kurchatov Institute
  - Repeated 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 was aware of their nuclear, biological, or chemical work 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

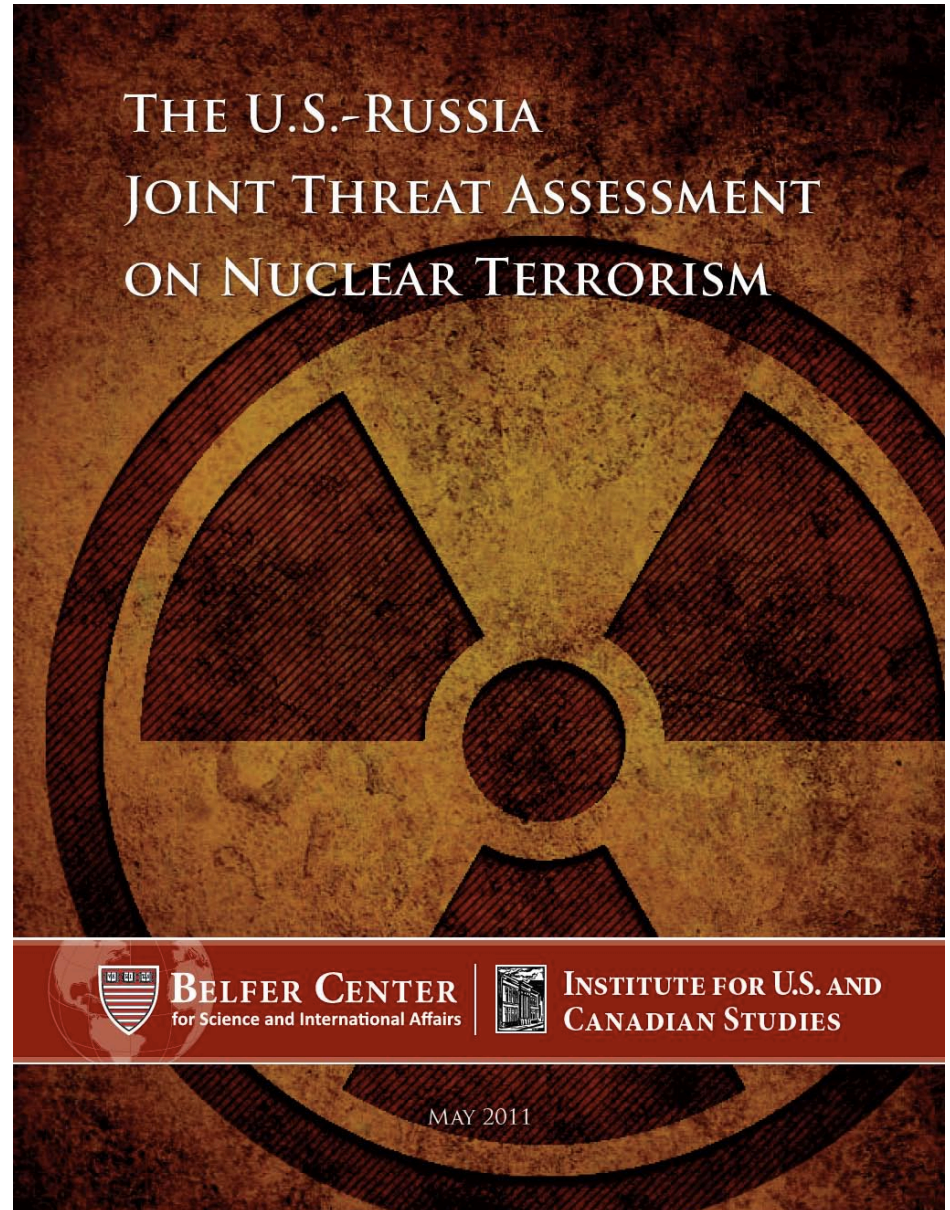
- Most nuclear reactors do not use nuclear material that can readily be used in nuclear bombs:
  - Low-enriched uranium fuel cannot be used to make a nuclear bomb without technologically demanding further enrichment
  - Plutonium in spent fuel is 1% by weight in massive, intensely radioactive fuel assemblies
- 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 – still need a nuclear waste repository
- 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/>



# 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 about the nuclear terrorism threat

- 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 weapons that can be delivered by missile or aircraft is *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 about the nuclear terrorism threat (II)

- U.S. intelligence has exaggerated terrorist threats – including in the lead-up to war in Iraq
  - Absolutely correct – skepticism justified. *But* 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 obtained a nuclear weapon or the materials and expertise 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?*

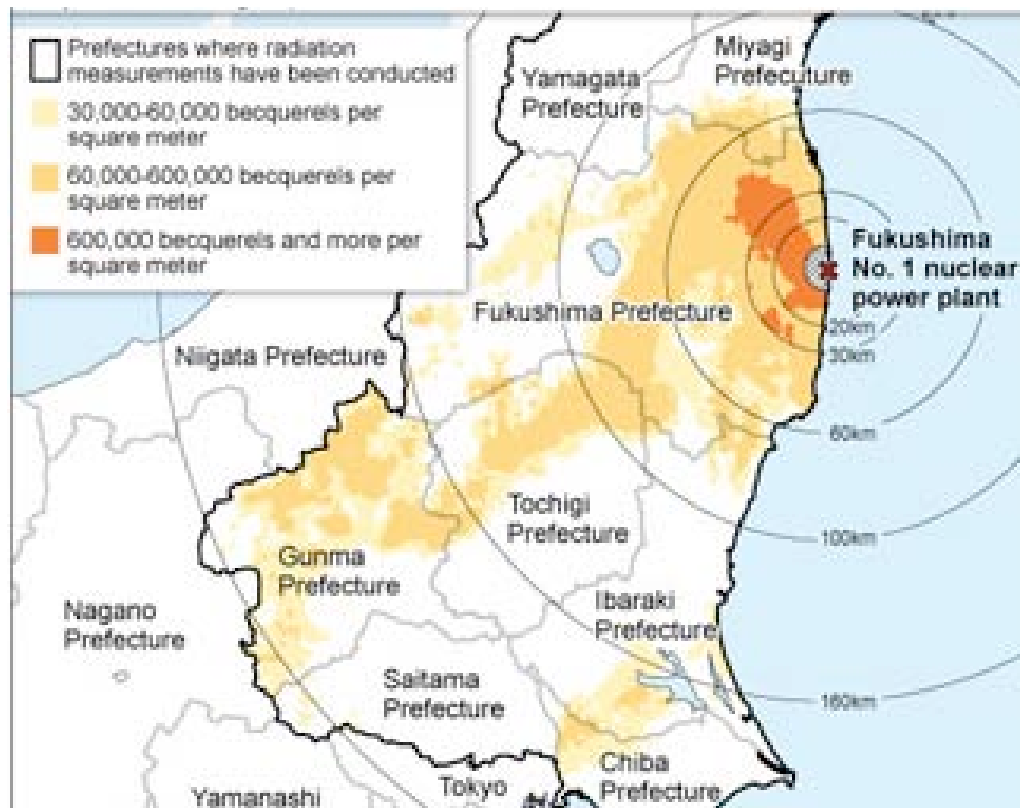
# Summary: the nuclear terrorist threat

- |  | 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

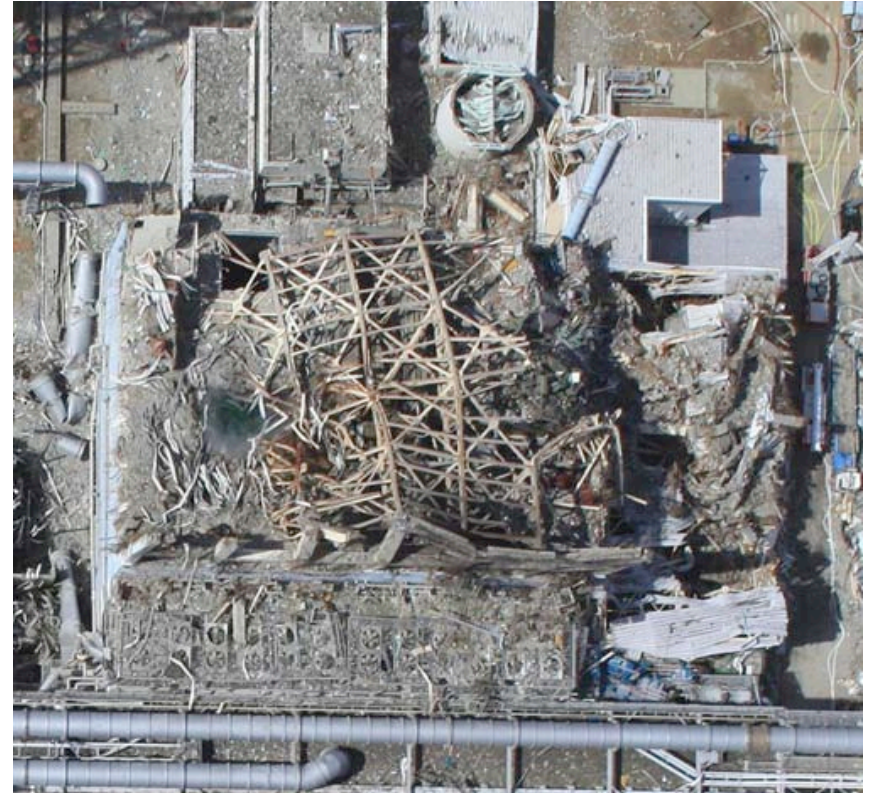


# The threat of nuclear sabotage

- 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 civilian facilities are 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”

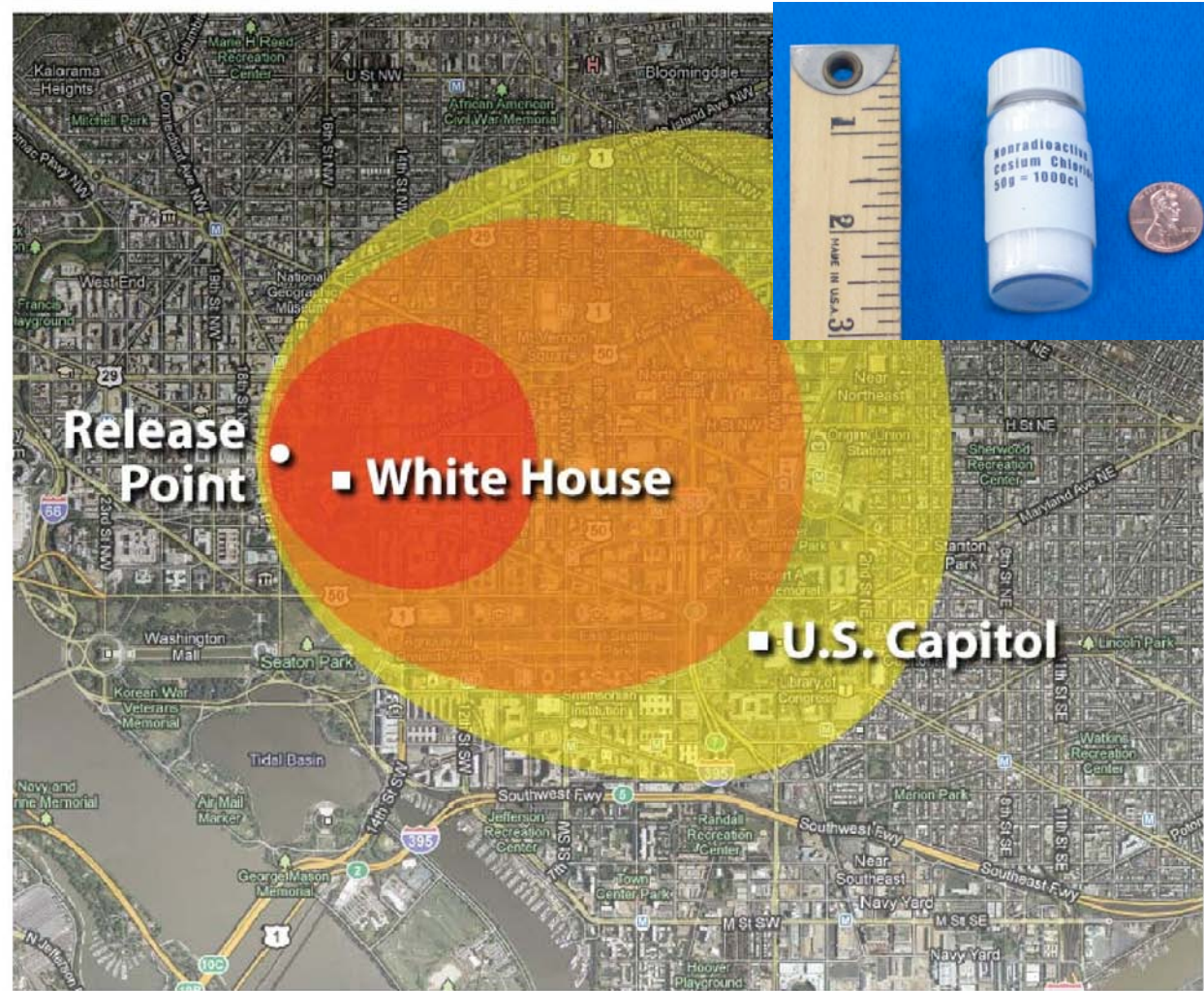
- Dirty bomb could be very simple -- dynamite and radioactive material together in a box
  - Other simple means to disperse radioactive material more effective
- Dangerous radioactive sources in use for valuable civilian purposes in hospitals, industry, agriculture
  - Even large sources often have minimal security
- “Weapons of mass disruption” – not mass destruction
  - Would cause zero to a few near-term radiation deaths, potentially a few hundred long-term cancer deaths (undetectable against natural 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)

# Cs-137

## “dirty bomb”

- Under current guidelines, dirty bomb might require evacuating large area (1000 curies dispersed)
- 100s of long-term cancer deaths (*if everyone stays, no cleanup*)

Source: Congressional Research Service, modeling by Sandia National Laboratories, 2010



**Effects and Actions**

	Area km <sup>2</sup> mi	Equivalent Dose (rem)	Exceeds relocation PAG for which year:	Population	All Cancers	Fatal Cancers
	2.10 0.81	>2.00	First year only	38,000	233	159
	7.60 2.93	>0.500	Any subsequent year	94,700	278	189
	13.2 5.10	>5.00	50 years (cumulative)	125,000	461	314

Areas and counts are cumulative. RDD detonated at 38.9 N, 77.0 W. PAG: Protective Action Guide

# 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
  - Need training, regular exercises, for first responders
  - Develop improved urban decontamination technologies
- Most important: communication strategy to limit panic, tell public how to respond – complicated by past gov’t lies

# Nuclear security is the foundation for the three pillars of the NPT

- Nuclear security is the foundation of nonproliferation
  - Because insecure nuclear material could allow terrorists or proliferating states to get the material to make a nuclear bomb
- Nuclear security is the foundation for peaceful use
  - Because nuclear energy will not gain the government, public, and investor support it needs for large-scale growth unless people are confident that it is safe and secure
- Nuclear security is the foundation for disarmament
  - Because nuclear weapon states will not give up their nuclear weapons if insecure nuclear material could lead terrorists or hostile states to get nuclear weapons

*In all these areas, nuclear security is important to the security of all countries around the world*

# 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



# 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

# Security culture matters: Propped-open security door



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

# 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](mailto:atom@harvard.edu)
- The Belfer Center's Nuclear Security Summit Dossier:  
[www.nuclearsummit.org](http://www.nuclearsummit.org)

# Further Background Material

---

- The following slides provide additional data and context.

# 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  $\sim 1$ kt – 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*

# 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*



# Blocking the terrorist pathway to the bomb

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



# Blocking the Terrorist Pathway to the Bomb

## COOPERATIVE THREAT REDUCTION EFFORTS

- Secure warheads and materials
- Stabilize employment for nuclear personnel
- Monitor stockpiles and reductions
- End further production of materials
- Reduce excess stockpiles

- Interdict nuclear smuggling
- Stabilize employment for nuclear personnel

- Interdict nuclear smuggling
- Stabilize employment for nuclear personnel

- Stabilize employment for nuclear personnel

## HOMELAND SECURITY RESPONSE

- International law enforcement
- Overseas and domestic intelligence agencies
- Domestic customs and border security

- Federal, State and local law enforcement
- Nuclear Emergency Support Team (NEST)

- Nuclear Emergency Support Team (NEST)
- Incident management
- Response and recovery

## COUNTERING TERRORISM TASKS

- Address the root causes of terrorism
- Secure timely and effective information and intelligence
- Disrupt terrorist operations
- Deter states from supporting or complying with terrorist's activity

- Block financial flows to terrorists

- Eliminate safe havens for terrorists

- Destroy terrorist networks

# 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*

# 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?***