

Nuclear security: What is required?

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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 focus on steps to secure material for nuclear explosives – likely highest overall risk (multiplying probability times consequences)

What nuclear security measures should countries put in place?

- ◆ Many elements are universal, but specifics will vary
 - Different countries face different threats (though important parts of the terrorist threat are global)
 - In some countries, technology is cheap; in others, people are cheap
 - Different countries have different cultures and approaches
- ◆ All significant stocks of HEU and plutonium worldwide should have effective and lasting protection against all plausible adversary threats:
 - Insiders and outsiders
 - Potentially well-armed and well-trained
 - Wide range of tactics – stealth, deception...
- ◆ Most significant single step is to instill a strong security culture
 - With a strong culture, staff will continuously find further ways to improve security

No country is so safe that nuclear security should not be a priority

- ◆ Terrorists will steal nuclear material wherever they think it would be easiest for them to get
 - Embassies in Kenya and Tanzania destroyed not because terrorists had any quarrel with those countries – but because vulnerable sites that could hurt the terrorists' real enemy
- ◆ Terrorists have shown global reach, with complex, well-planned attacks in:
 - New York to Beslan
 - London to Mumbai
 - South Korea faces risk of North Korean saboteurs
- ◆ Pelindaba 2007 (site with 100s of kilograms of HEU):
 - 2 teams of well-armed, well-trained adversaries
 - Apparent insider information on disabling detectors
 - Penetrated 10,000-volt fence with no alarm, shot worker in emergency control center, 45 minutes inside secure perimeter

Global nuclear security and accounting requirements

- ◆ CPPNM amendment, nuclear terrorism convention, have broad requirements, few specifics
 - IAEA recommendations somewhat more specific, voluntary
- ◆ UNSCR 1540 legally obligates *all* member states to put in place “appropriate effective”:
 - “measures to account for and secure” nuclear weapons and “related materials”
 - “physical protection measures” for nuclear weapons and materials
 - No definition of what must be included to be “appropriate effective”
 - Note that nuclear security and physical protection treated separately; securing these items effectively is a *broader* concept than just providing effective physical protection – would generally include police, intelligence...
- ◆ Radiological material, sabotage are not mentioned in the obligation

What is “appropriate effective” nuclear security?

- ◆ Plain language: If “appropriate effective” means anything, it should mean that security systems can “effectively” defeat the threats that terrorists and criminals can pose
 - ***Protection against all plausible adversary capabilities.*** Rules must require operators to provide effective protection against (a) capabilities terrorists and criminals have demonstrated in that country (or nearby), and (b) other capabilities the country’s intelligence agencies judge to be plausible threats
 - ***Global minimum protection for nuclear stocks.*** Facing terrorists of global reach, all such stocks anywhere should *at least* be protected against a modest group of well-trained, well-armed outsiders (capable of operating as more than one team), one well-placed insider, or both together – using broad range of possible tactics

Adversary capabilities may be substantial: demonstrated 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
- ◆ Significant covert attacks
 - e.g., multiple incidents of tunneling into bank vaults
- ◆ Deception attacks
 - e.g., arrive with military uniforms, forged IDs
- ◆ Use of unusual vehicles
 - e.g., helicopters used in many recent jail escapes
 - e.g., speedboat planned for use in \$200M Millennium Dome theft

Adversary capabilities may be substantial: demonstrated insider threats

- ◆ Multiple insiders working together
- ◆ Insiders providing information, assistance to outsiders
- ◆ Often including guards
 - Most documented thefts of valuable items from guarded facilities involve insiders – guards among the most common insiders
 - Goloskov: guards “the most dangerous internal adversaries”
- ◆ Motivations:
 - Desperation
 - Greed/bribery
 - Ideological persuasion
 - Blackmail

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

Essential elements of “appropriate effective” nuclear security

- ◆ To be “appropriate effective”, a nuclear security system should include:
 1. ***Effective rules based on a DBT.*** Clear and well-enforced rules requiring each facility or transporter with nuclear weapons or Cat. I nuclear materials to have security measures in place capable of defeating a specified set of threats. Regulator must have adequate authority, independence, competence, and resources.
 2. ***Strong security culture.*** A regular, effective process for assessing security culture and continually improving it.
 3. ***Defense in depth.*** Security systems should include a balance of multiple elements, and should still protect if any one element fails.
 4. ***Graded approach.*** An approach should be in place to focus the most security resources on the materials that would be easiest to use to make a nuclear bomb (but should not be “cliffed safeguards” where virtually all security removed past some arbitrary cutoff)

Essential elements of “appropriate effective” nuclear security (II)

- ◆ Additional essential elements:
 5. ***Vulnerability assessments.*** Requirements for regular in-depth vulnerability assessments, timely vulnerability fixes
 6. ***Security plans.*** Facility-level security plans for meeting the security rules, appropriately reviewed
 7. ***Effective guard forces.*** Well-armed, well-trained, and well-motivated guard forces
 8. ***Effective screening and monitoring of personnel.*** In-depth examinations of the background of all personnel given nuclear security-related responsibilities, with ongoing review, measures to limit access to authorized personnel.
 9. ***Effective measures to address insider threats.*** Keep material in vaults where possible; 2-person rule; continuous monitoring of material status; portal monitors to detect removal; effective accounting; etc. (More on this in accounting discussion.)

Essential elements of “appropriate effective” nuclear security (III)

- ◆ Additional essential elements:

10. ***Realistic testing of performance.*** Should include not only tests of subsystems and components – e.g., does the portal monitor detect HEU? – but “red team” exercises of the system’s ability to defeat outsiders trying to break in, insiders stealing material
11. ***Active efforts to minimize sites and transports.*** Should be a focused program to eliminate nuclear stocks from as many locations as possible.
12. ***Measures to stop the threat before an attack.*** Should be a focused police/intelligence effort to increase the chance of detecting, stopping nuclear plots before a theft attempt begins
13. ***An effective emergency response plan.*** Should be detailed plans in place – and exercised – for off-site response forces to aid on-site forces, and for search and recovery in the event of theft

What is “appropriate effective” nuclear material control and accounting?

- ◆ Plain language: to be “appropriate effective,” it must effectively address the key threats MC&A intended to cope with. It should provide high confidence of detecting (and ideally localizing)
 - Abrupt theft of significant quantity (ideally in time to respond, certainly in <1 month)
 - Protracted theft of significant quantity (ideally while theft is in progress and can still be stopped)
- ◆ Should also be accurate enough to provide high assurance that *no* removal of a significant quantity has occurred
- ◆ Ability to localize where theft occurred, who had access at that time and place, helps deter insiders

Essential elements of “appropriate effective” material control and accounting

- ◆ To be “appropriate effective”, a nuclear material control and accounting system should include:
 1. *No unmonitored access.* 2-person rule; security cameras monitoring access, handling
 2. *Minimum access of any kind.* Access to material by anyone only when absolutely necessary; material in vault when not in use
 3. *No exit without screening.* Effective portal monitors at all exits, no other ways to get nuclear material out
 4. *Effective use of tamper-indicating devices and alarms.* Material not in process should be in sealed containers with tamper-resistant uniquely identifiable seals; devices to set off an alarm in the event of any tampering should be used where practical
 5. *Regular measured inventories.* Measured inventories should be taken regularly.

Essential elements of “appropriate effective” MC&A (II)

- ◆ Additional essential elements:
 5. *Rapid and effective resolution of anomalies.* Whenever accounting suggests missing material, the investigation should be swift and thorough.
 6. *Shipper-receiver reporting and resolution of differences.* Material must be measured and sealed before shipment, measured on receipt, and differences effectively resolved.
 7. *Accounting system structured to allow localization.* Where practicable, the material balance areas should be structured to keep measurement uncertainties in any one area small and to make it possible to localize problems to particular areas.
 8. *Measurement control program.* Must be a rigorous program to calibrate, control measurement systems – “without measurement control, may as well not measure”
 9. *Performance testing and assessment.* Performance goals should be established, and system performance must be regularly tested

Toward a global nuclear security standard

- ◆ A broadly accepted definition of what UNSC 1540's "appropriate effective" obligation requires would become, in effect, a binding global standard for nuclear security
- ◆ To succeed, such a definition of what's needed must:
 - Not be seen as unduly interfering with sovereignty (and secrecy) over nuclear security
 - Be simple enough to allow each state to pursue its own approaches – but specific enough to be effective, and to hold states accountable for complying with the obligation
 - Be pursued at a political level, bypassing expert-level talks where those focused mainly on costs traditionally object
 - For example, could be focus on protecting *at least* against a modest team of well-trained, well-armed outsiders, an insider, or both
 - Beijing and Washington should seek to get as many participants as possible to commit to such a "baseline" level of security in their national commitments for the Seoul nuclear security summit

Minimizing locations with HEU or Pu

- ◆ Can achieve higher nuclear security at lower cost by having fewer places to guard
- ◆ Each country with HEU or plutonium (or nuclear weapons) should review every site where these exist, and assess whether benefits are worth the costs and risks
 - Convert HEU-fueled research reactors where practicable
 - Shut down little-used HEU-fueled reactors, move research to other sites
 - Consolidate plutonium storage, warhead storage
 - Remove materials that are no longer needed
 - Ultimately phase out all civil use of HEU

Beijing and Washington should seek to get as many participants as possible to commit to such steps in their national commitments for the Seoul nuclear security summit

The importance of on-site armed guards

- ◆ Armed response is only one part of a broader nuclear security system – but it is an essential part
- ◆ Relying solely on off-site armed response forces not likely to be sufficient
 - In U.S. tests, sometimes 3 minutes from start of test to adversaries reaching vital area where they could sabotage plant
 - All sites and transports with HEU or plutonium, and all major nuclear facilities (such as power reactors) should have on-sited armed guards
 - South Korea needs armed guards to cope with a potential North Korean threat; to demonstrate South Korean nuclear security leadership; and to avoid critical stories from thousands of journalists who will attend nuclear security summit
 - Japan (for example) was able to deploy armed guards from national police quickly, faster than regulations could be changed

After defining what's required, assess what's needed, help put it in place

- ◆ Some countries may need assistance to put the measures described here in place
 - From extension of Global Partnership
 - From UNSCR 1540 Implementation Fund
 - From IAEA Nuclear Security Fund
- ◆ Assessment teams led by experts from the major donors – or by the IAEA's Office of Nuclear Security – could assess needs worldwide
- ◆ Given the substantial ongoing cost of ensuring effective physical protection – and the continuing risk of theft wherever weapons-usable nuclear materials exist – removing material entirely from all sites where it is not needed should be part of this effort
 - The costs of meeting effective nuclear security standards, if adopted, will give sites incentives to eliminate nuclear material

Security culture – the essential ingredient

- ◆ A strong security culture – in which all key staff give priority to security every day – is the key to good security
- ◆ Security culture is based on belief in the threat -- “never forgetting to be afraid”
- ◆ Top management must make security a priority and lead by example
 - Regular briefings on the threat, and the importance of security measures in addressing it
 - Regular, realistic security exercises and tests
 - Security performance as a key part of performance reviews, promotions, raises
 - Awards for identifying security problems and ways to fix them
 - Regular assessments of security culture, with targeted programs to address problem areas identified

Security culture matters: Propped-open security door



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

Strengthening the IAEA role

- ◆ In many countries, definitions of “appropriate effective” approaches; assessments of needs; and assistance in implementing UNSCR 1540 coming from the IAEA will be more welcome than those pushed by the United States
- ◆ Office of Nuclear Security should be given the mission and resources to help countries implement UNSC 1540 – not by itself, but in coordination with donor-state efforts
 - Judge case-by-case which activities are most effectively done through IAEA, which in other venues
- ◆ Nuclear security peer reviews should become a commonplace part of the nuclear security business
 - UK, France, United States requested peer reviews for particular facilities as part of national commitments for Washington summit
 - China should request an IAEA security peer review, encourage others to do so as part of Seoul nuclear security summit

To summarize: key elements of effective nuclear security systems

- ◆ A robust design basis threat
 - Facilities, transporters required to protect against all plausible adversary capabilities and tactics (both outsiders and insiders)
- ◆ Effective regulation
 - Inspection, realistic assessment and testing of performance, real enforcement
 - Most nuclear managers will not invest in expensive security measures unless the government tells them they have to
- ◆ Strong nuclear security culture
 - All relevant employees must believe in the threat and the importance of nuclear security in addressing it
 - Employees must proactively be looking for ways to improve security
- ◆ Adequate resources
 - Governments, operators must make nuclear security a priority

For more information: The IAEA, WINS, and KINAC

- ◆ World Institute for Nuclear Security (WINS) provides an excellent source for specific “best practices”
 - Best practice guides already published on many topics, from managing guard forces to corporate governance of security to strengthening security culture
 - Membership is free – and guides available to all members
 - Workshops provide an excellent way to exchange ideas with nuclear security practitioners from many countries
- ◆ IAEA Office of Nuclear Security also provides wide range of key resources
 - Recommendations and guides in many key nuclear security areas
 - Peer review services – everything from physical protection at a site to review of regulations
 - Wide range of training and workshops available
- ◆ CIAE’s new center will provide a new source of training, materials, analysis

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...

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

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

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)

Learning from bad practices: U.S. pre-9/11 nuclear security rules

- ◆ NRC required U.S. power reactors and Category I nuclear material facilities to have effective protection against a specified design basis threat (DBT)
- ◆ *But*, serious weaknesses in inspection program
 - All violations that had not occurred twice in a year, or did not pose imminent threat, written off as “non-cited violations”
 - Sleeping guards not an imminent threat because no one attacking!
 - Unlikely to occur twice in a year with one inspection per year!
 - All violations in 5 years before 9-11 non-cited
- ◆ Unrealistic tests – and no consequence of failure
 - Sites allowed to have more guards, protections on test day than usual – and didn’t have to maintain enhanced protection afterward
 - Many sites *still* failed to protect
 - No fines or other consequences for failing to protect against DBT

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?