Physics 280: Session 11

Plan for This Session

Questions about the course

News and discussion

Module 4: Nuclear Terrorism

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BBC-History: 1-29-1996 France Stops Nuclear Testing to Join CTBT and South Pacific Nuclear Weapon Free Zone

1996: France halts nuclear testing

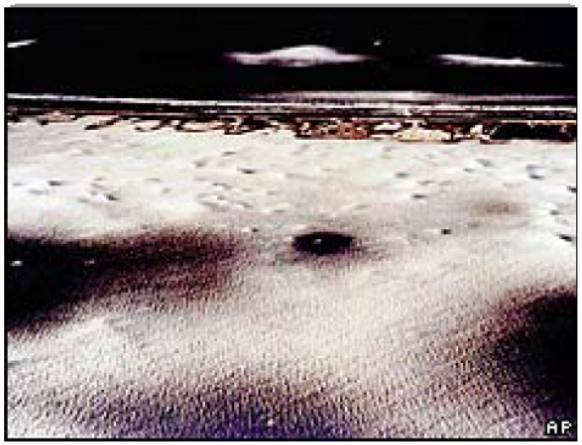
The French President, Jacques Chirac, has said France will no longer test nuclear weapons.

The announcement comes a day after France exploded its sixth and biggest nuclear device in the South Pacific.

There have been international protests including boycotts of French products since Mr Chirac announced the resumption of testing last June.

In a live broadcast to the nation, Mr Chirac said the tests mean that "the safety of our country and of our children is assured."

France will now sign an agreement for a nuclear-free zone in the South Pacific this year, as well as the international Comprehensive Nuclear Test Ban Treaty which unconditionally ends all future tests.



Nuclear tests have been carried out on Mururoa and Fangataufa atolls

In Context

Paris agreed to a 10-year compensation package for French Polynesia to rectify some of the damage caused by the programme of nuclear testing.

In 1995 France asked the UN's nuclear watchdog to measure radiation around the atolls; the study concluded that the levels posed no threat.

In 1999 Paris admitted that fractures had been discovered in the coral cone at the sites.

The atolls continue to be monitored.

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France 24: President Hollande visits French Polynesia to Discus Compensation for Victims of Nuclear Testing There

Latest update : 2016-02-23

Compensation for the victims of three decades of French nuclear tests was a focus of President François Hollande's visit to French Polynesia on Monday, his first stop on a tour of the Pacific and Latin America.

Hollande (http://www.france24.com/en/tag/francois-hollande/)'s first move was to lay a wreath at the grave of Pouvanaa a Oopa, the anti-colonialist considered the founder of modern Tahitian political culture. But the focus of the visit was very much on the victims of 193 nuclear tests carried out by France between 1966 and 1996 on the atolls Mururoa and Fangataufa.

The French president acknowledged Monday in Papeete that the nuclear tests conducted in French Polynesia (http://www.france24.com/en/tag/french-polynesia/) had affected the environment and the health of the islands.

"I recognise that the nuclear tests conducted between 1966 and 1996 in French Polynesia had an environmental impact, and caused health consequences," he said.

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France 24: President Hollande visits French Polynesia to Discus Compensation for Victims of Nuclear Testing There

Hollande said he wanted to “turn the page” on nuclear tests, while hailing Polynesia’s crucial role in developing France’s nuclear capabilities.

Without its overseas territories, “France would not now have nuclear weapons and the power of dissuasion”, he said, using the French expression for nuclear deterrence.

Hollande also announced a review of the application process for compensating the victims of the tests. Only around 20 people have received compensation for the spread of cancers allegedly linked to the tests from among some 1,000 plaintiffs.

France’s “nuclear debt” owed to Polynesia, dubbed the “Chirac Billion” (in Francs, now worth around €150 million), is an annual payment to the islands that has been reduced year after year, and which Polynesians want to be made permanent.

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Nuclear Terrorism

Topics covered in this module:

Part 1: Terrorism and how to counter it

Part 2: Reducing the threat of nuclear terrorism

Sources:

What Terrorists Want, by Louise Richardson

Preventing Catastrophic Nuclear Terrorism, by Charles D. Ferguson

Articles on Reading Assignments Page

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Terrorism and How to Counter It

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The Importance of Understanding Terrorism

Endeavoring to understand or explain terrorism is not to sympathize with it.

Instead, understanding the appeal of terrorism is the best way to effective counterterrorism policies.

Example: Gaining an understanding the Shining Path Maoist movement in Peru was much more effective in countering it than attempting to smash it —

- It had 10,000 members in the 1980s and controlled a large area of Peru
- Thousands of armed military and paramilitary forces were deployed over 20 years
- Shining Path and military units killed ~ 70,000 people, but terrorism did not diminish
- Only when the government established a special 70-man intelligence unit to study the Shining Path was it successfully countered
- The intelligence unit discovered that the leadership of the movement was highly centralized and depended on the academic Abimael Guzmán
- They studied everything about him and discovered he had a particular skin condition
- By old-fashioned police work and good electronic intelligence, Guzmán was tracked down though his medical prescription and captured with several of his top lieutenants

The Shining Path never recovered

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Terrorism and How to Counter It

Topics covered here and in the readings —

- What is terrorism?
- Where have terrorists come from?
- What causes terrorism?
- The three Rs of terrorism
  (Revenge, Renown, Reaction)
- Why do terrorists kill themselves?
- What changed on 9/11 and what did not
- What is to be done?

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Categories of Violent Political Activity (Important)

Terrorism*: Deliberately* and *violently* targeting *civilians* for *political* purposes (all *4 criteria* must be met)

Insurgency: An organized movement aimed at the overthrow of a constituted government through use of subversion and armed conflict. Insurgents may or may not commit terrorist acts.

Guerilla warfare: A type irregular warfare and combat in which a small group of combatants use mobile military tactics in the form of ambushes and raids to combat a larger and less mobile formal army. Guerilla warfare is not terrorism.

Regular armed forces: Must satisfy the four Hague Convention (Hague IV) conditions (1899 and 1907): (1) be commanded by a person responsible to a party to the conflict, (2) have a fixed distinctive emblem recognizable at a distance, (3) carry arms openly, and (4) conduct operations in accordance with the laws and customs of war.

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What is Terrorism?

Terrorism is **deliberately** and **violently** targeting **civilians** for **political** purposes.

Terrorism often (but not always) has *3 other characteristics* —

1. The point of terrorism is not to defeat the enemy but to send a message.
2. The act and the victim usually have symbolic significance.
3. The *victim* of the violence and the *audience* the terrorists are trying to reach *are not the same*.

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Terrorism Carried Out by Governments – 1

Richardson argues that to have a clear understanding of the behavior of *terrorist groups*, we must understand them as sub-state actors. Although states and their leaders are not *terrorist groups,* states may engage in terrorism.

The terrorism committed by states can be divided into three categories:

1. State-sponsored terrorism: State sponsorship of terrorist acts against inhabitants of *other* countries as an instrument of foreign policy.

For example, to hurt other countries without risking the consequences of overtly attacking them (e.g., Libyan support of terrorist acts against U.S. interests during the 1980s, Iraqi support of Palestinian terrorist acts against Israel during the 1990s, Iranian support of terrorism against Israel by Hezbollah in Lebanon and Hamas in Gaza).

For example, as a way to engage in proxy warfare or covertly bring about internal change in another country without risking a direct confrontation (e.g., U.S. support of terrorist groups in Angola and Nicaragua).

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Terrorism Carried Out by Governments – 2

2.State terrorism: Use of terrorism by a government against its own citizens, to coerce them into accepting the government's authority (examples: Germany in the 1930s, Argentina in the 1970s, Iraq in the 1980s and 1990s).

3.War terrorism: Use of terrorism by a government against the civilians of another country with which it is at war (examples: the German and Allied bombing campaigns in World War II, which damaged London, and destroyed Coventry, Dresden, Hiroshima, Nagasaki, Rotterdam and were deliberate efforts to target civilian populations in order to force the hands of their governments).

Collective punishment of communities that produce partisans is another example of targeting civilians to achieve political ends and is therefore terrorism (example: collective punishment of villages of resistance fighters in the Ukraine, Italy and France through German troops in WWII).

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Understanding Terrorists – 1

Richardson points out that:

- Terrorism, even religious terrorism, is neither new nor the primary preserve of Islam
- Terrorists have sometimes later become statesmen

She argues that the causes of terrorism are not to be found in objective conditions of poverty or privation or in a ruthless quest for dominance, but rather in a "lethal triple cocktail" that combines —

1. a disaffected individual
2. an enabling community
3. a legitimizing ideology

Richardson argues that terrorists are neither crazy nor amoral but rather are rationally seeking to achieve a set of objectives within self-imposed limits.

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Understanding Terrorists – 2

Richardson argues that —

- The behavior of terrorists can be understood in terms of
  - ***long-term political objectives***, which differ across groups
  - ***more immediate objectives***, which are shared by terrorists with very different long-term objectives
- Terrorists' generally have much more success achieving their immediate objectives than achieving fundamental change.
- When terrorists act, they are seeking 3 immediate objectives (the "3 Rs"):
  - to exact revenge
  - to achieve renown (glory)
  - to force their adversary to react

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The 3 Standard Initial Reactions to Terrorism

There are 3 standard phases in an inexperienced society's reaction to terrorism —

Phase 1: Demonstrate resolve by adopting a draconian response that goes largely unchallenged by the public

Phase 2: Polarization of politics —

- The right demands tougher measures and denounces opponents as unpatriotic
- The left objects to many coercive measures

Phase 3: More reasoned reflection, when —

- Draconian measures have failed to produce the desired results
- The adversary has demonstrated his implacable commitment to harming the nation

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Six Basic Rules for Containing Terrorism

Rule 1: Have a defensible and achievable goal

- If the goal of the U.S. is to defeat terrorism or eliminate terrorism, it can never be achieved
- By contrast the goal to capture those responsible for the 9/11 attacks, has been achievable
- *Containing* the threat of terrorism *is* achievable
- By keeping this more modest and concrete goal firmly in sight and planning accordingly, the U.S. can ensure that its short-term tactics do not undermine its long-term goals

Rule 2: Live by your principles

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Six Basic Rules for Containing Terrorism (cont'd)

Rule 3: Know your enemy

Rule 4: Separate the terrorists from their communities

Rule 5: Engage others in countering terrorists with you

Rule 6: Have patience and keep your perspective

U.S. counterterrorism policy after 9/11 did not initially follow these six rules, but improved with time.

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Example: US Reaction to 9/11

Richardson argues that the early response was marked by two significant mistakes and two major missed opportunities

Mistakes:

- declaration of a “global war on terror”
- conflation of the threat posed by al-Qaeda with the threat posed by Saddam Hussein

Missed opportunities:

- the opportunity to educate the American public to the realities of terrorism and the costs of U.S. sole superpower status
- the opportunity to mobilize the international community behind the U.S. in a transnational campaign against transnational terrorists

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Impact of 9/11 in the United States

Richardson argues that the declaration of a “global war on terror” — has been a mistake and is likely to fail

She argues for a different approach —

- appreciate the factors driving the terrorists
- deprive them of what they need

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Key Questions for Countering Terrorism

In thinking about counterterrorism policies, the question should *not* be

- Who's tough on terrorists?
- Who's soft on terrorists?

What matters is —

- *What actions are effective against terrorism?*
- *What are their costs?*

We are likely to experience terrorism in the future, just as we have in the past.

We are going to have to learn to live with and accept it as a price of living in a complex world in which communication is relatively easy.

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The Relation of Democracy to Terrorism

Through improved security measures and enhanced intelligence, we can protect ourselves against the most dangerous weapons and the most sophisticated attacks.

It's important to remember that —

- Terrorists cannot derail our democracy by planting a bomb in our midst
- Our democracy can be derailed only if we conclude that it is inadequate to protect us
- Democratic principles are the strongest weapons against terrorists

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Reducing the Threat of Terrorism

Richardson argues we should recognize that —

- Terrorism will continue to be employed as long as it is deemed effective
- Technological developments will make it easier for ever smaller groups to employ weapons of ever greater lethality against us
- Political, social, and economic developments will continue to produce disaffected individuals
- We will never be able to prevent every attack, but we can control our reaction to those attacks

If we keep terrorist attacks in perspective and recognize that the strongest weapons in our arsenal against terrorism are precisely the hallmarks of democracy that we value, then we can contain the terrorist threat.

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iClicker Question

Which of the following is *not* a defining characteristic of terrorism?

A. The act must be violent or threaten violence

B. The violence must be against civilians

C. The individual victims must be randomly chosen

D. The violence must be deliberate

E. The violence must have a political purpose

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iClicker Question

Terrorism

Which of the following is *not* one of the “lethal triple cocktail” of factors that Richardson argues leads to terrorism?

A. Extreme poverty

B. A disaffected individual

C. A legitimizing ideology

D. An enabling community

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iClicker Answer

Terrorism

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Reducing the Threat of Nuclear Terrorism

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Reducing the Threat of Nuclear Terrorism

Two Ongoing Parallel Approaches

1. Invasion and war (has led to insurgencies)
2. Cooperative efforts to secure or intercept nuclear explosive materials

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iClicker Question

Islamic State of Iraq and Levant (ISIS/ISIL)

Which countries see groups declaring affiliation with ISIL?

A. Iraq

B. Syria and Iraq

C. Syria, Iraq and Lybia

D. Syria, Iraq, Lybia and Afghanistan

Why these countries?

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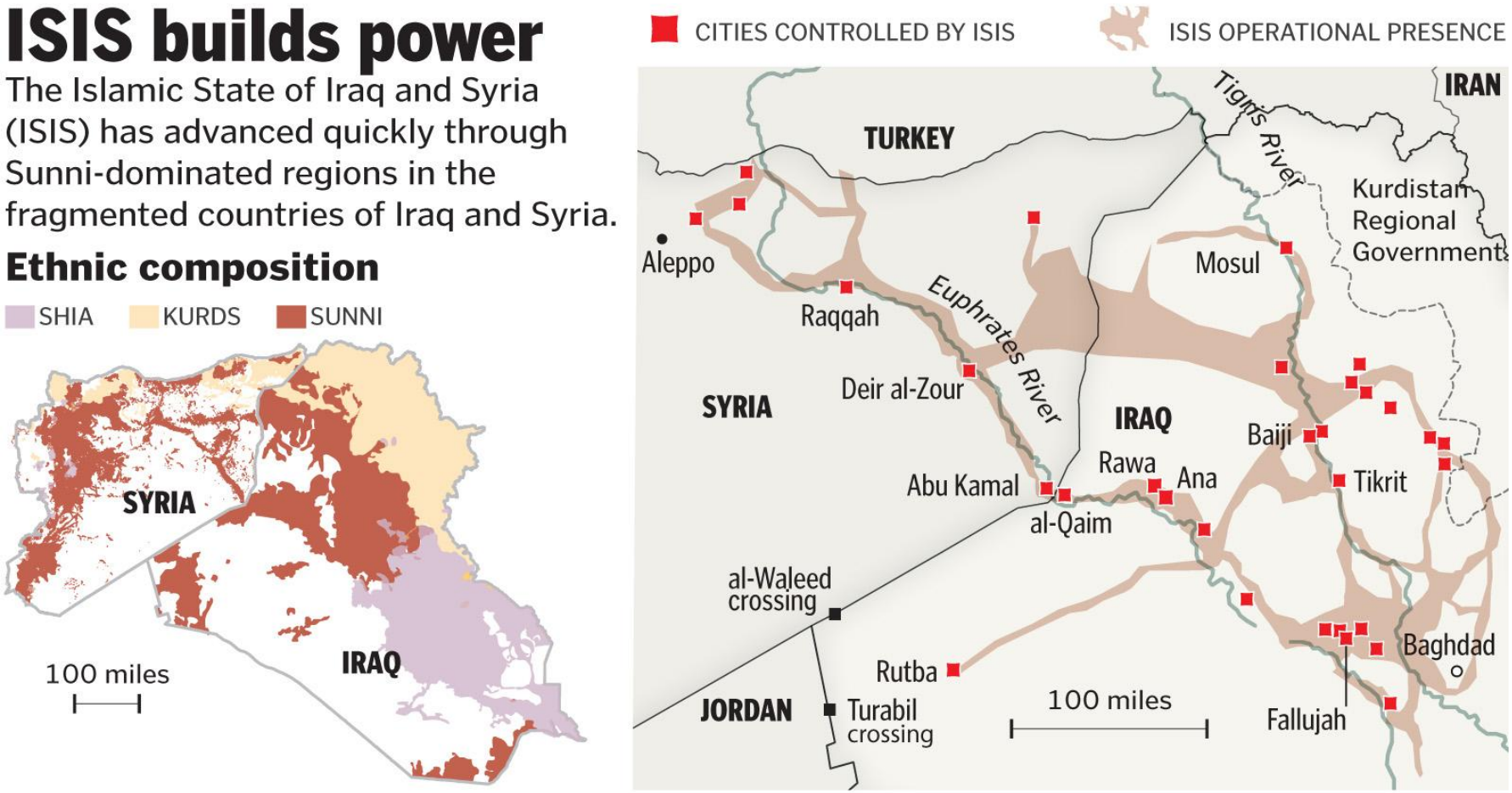
Regions Controlled by ISIS in Syria and Iraq



Boston Globe – June 2014

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iClicker Answer

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B. Syria and Iraq

C. Syria, Iraq and Lybia

D. Syria, Iraq, Lybia and Afghanistan

Groups that have declared allegiance to ISIL also in Lybia and Afghanistan!
See for example NPR Feb-18-2015:

http://www.npr.org/blogs/parallels/2016/02/18/387149112/how-isis-has-expanded-beyond-its-syrian-stronghold

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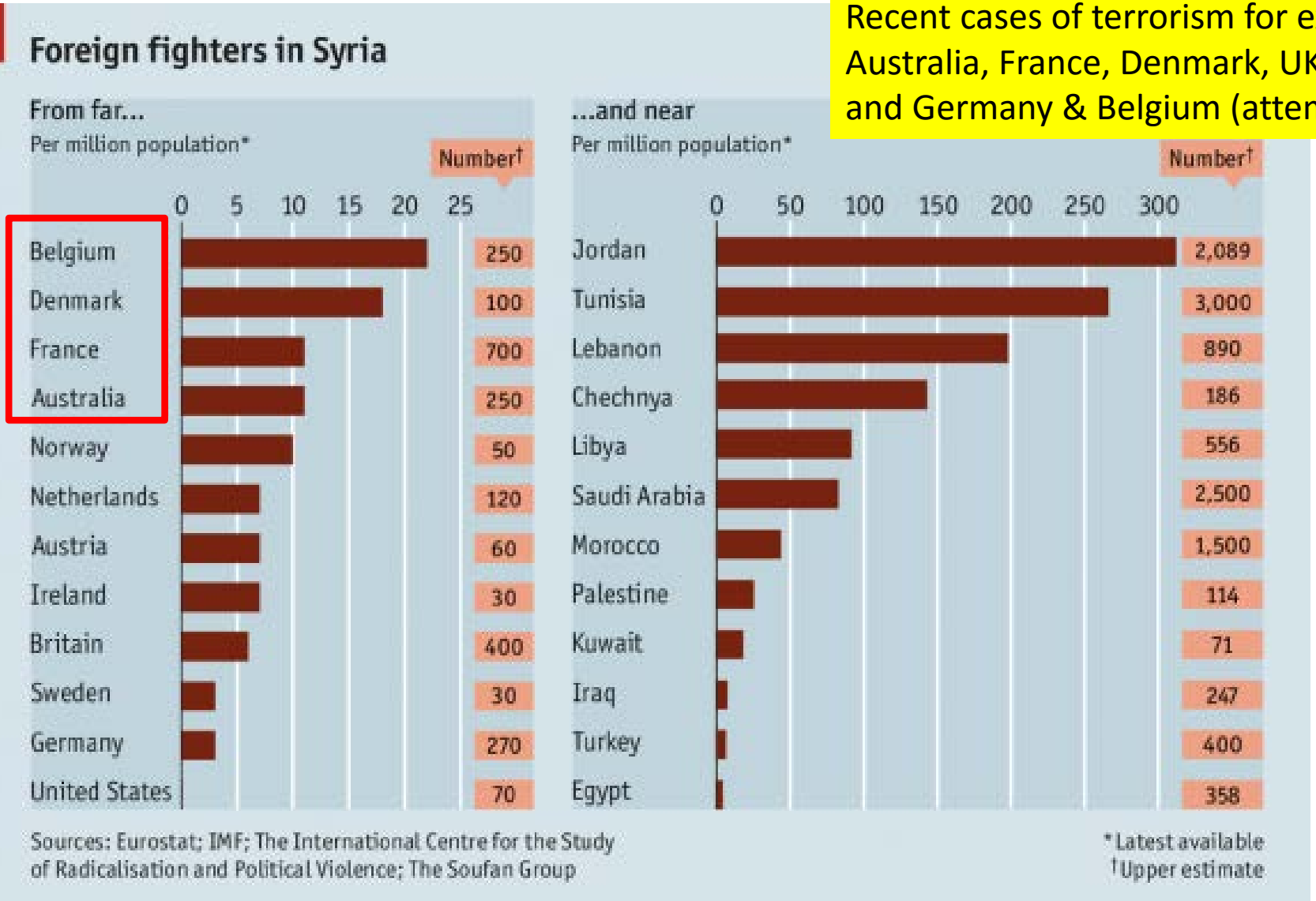
Origin of Foreign Fighters vs Richardson's lethal cocktail: disaffected individual, enabling community, legitimizing idealogy

Recent cases of terrorism for example, in Australia, France, Denmark, UK and Germany & Belgium (attempts)



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Delivery Methods Other Than Long-Range Ballistic Missiles Pose Greater Threats

Several countries are capable of developing mechanisms to launch SRBMs, MRBMs, or land-attack cruise missiles from forward-based ships or other platforms.

U.S. territory is more likely to be attacked with [nuclear weapons] using non-missile delivery means—*most likely from terrorists*—than by missiles, primarily because non-missile delivery means are —

- **less costly**
- **easier to acquire**
- **more reliable and accurate**

They also can be used without attribution.

— *Unclassified summaries of past National Intelligence Estimates of Foreign Missile Developments and the Ballistic Missile Threat Through 2016*

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In Pictorial Form …

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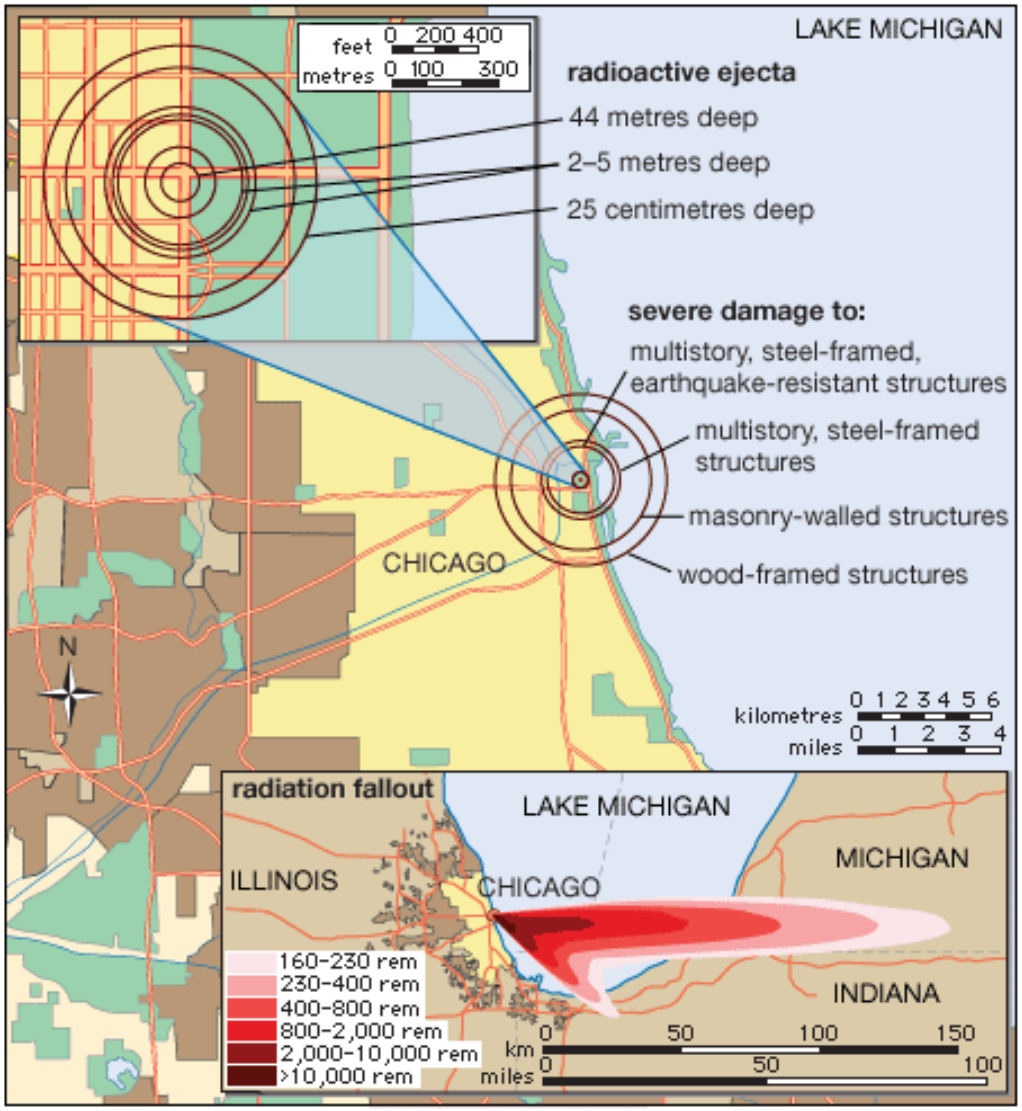
A possible (?) Scenario

I) Select high profile symbolic target eg NATO summit (Chicago in May of 2012 with all NATO heads of state present)

II) Smuggle fissile material and other weapon's components illegally into the country.

III) Rent nearby house or apartment to setup nuclear device.



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chicagotribune.com

Trial to begin of three charged with planning attacks at NATO summit

Mary Wisniewski

Reuters

7:31 AM CST, January 21, 2014

advertisement

CHICAGO (Reuters) - Opening statements are due to begin on Tuesday in the trial of three men accused of plotting to attack high-profile targets, including President Barack Obama's re-election campaign headquarters, during the 2012 NATO summit in Chicago.

Brent Betterly, 25, Brian Church, 25, and Jared Chase, 29, are being prosecuted under an Illinois anti-terrorism law adopted after the September 11, 2001 al Qaeda attacks.

The Threat of Nuclear Terrorism

Terrorist pathways to a nuclear bomb —

- Stealing a bomb
- Buying a bomb
- Building a bomb

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Stealing a Bomb

- About 25,000 nuclear weapons are in arsenals, with all but about 1,000 in Russia and the United States
- Stealing a bomb would be difficult but not impossible
- Activating a stolen bomb would be difficult —
  - The weapons of the United States, Britain, China, and France are protected by specialized security codes (permissive action links = “PALs”)
  - Most but not all Russian weapons have PALs
  - Whether the weapons of India, Israel, Pakistan, and North Korea use PALs is unknown

There are serious concerns about the security of Pakistani nuclear weapons and Russian tactical nuclear weapons.

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Buying a Bomb – 1

- Nuclear-armed states are unlikely to sell a nuclear weapon because of the prospect of devastating retaliation
- But deterrence hinges on a credible retaliatory threat and credible evidence that a weapon transfer has occurred
- Gathering evidence that an explosion was produced by a transferred weapon is difficult
- Nuclear forensics and nuclear event attribution programs receive increased attention following the National Defense Authorization Act of 2010

  ➔ Nuclear Forensics and Attribution Act signed 2-16-2010 to establish the National Technical Nuclear Forensics Center within Homeland Securities Domestic Nuclear Defense Office (DNDO).

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Buying a Bomb – 2

More likely routes for terrorists to buy or be given a nuclear weapon —

- Corruption among nuclear custodians
- Nuclear black markets
- A coup that brings to power officials sympathetic to terrorists

Pakistan is of particular concern —

- It has a relatively new nuclear command and control system
- Taliban and al-Qaeda forces have a formidable presence
- Elements in Pakistan's military intelligence agency sympathize with the Taliban
- Concerns with regards to stability: eg. Pakistani leaders have been frequent assassination targets
- The infamous (A.Q. Khan) black market originated in Pakistan

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Physics 280: Session 12

Plan for This Session

Questions about the course

News

The threat of nuclear terrorism

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Newsweek, 2-14-2016: Concern that Nuclear Custodian's in India Contribute to Proliferation Risk

OPINION

INDIA'S ROCK 'N' ROLL APPROACH TO GUARDING ITS NUCLEAR SITES

BY ADRIAN LEVY AND R. JEFFREY SMITH ON 2/14/16 AT 4:38 PM

As a result, the Kalpakkam shooting alarmed Indian and Western officials who question whether this country, which is surrounded by unstable neighbors and has a history of civil tumult, has taken adequate precautions to safeguard its sensitive facilities and keep the building blocks of a devastating nuclear bomb from being stolen by insiders with grievances, ill motives or, in the worst case, connections to terrorists.

Although experts say they regard the issue as urgent, Washington is not pressing India for quick reforms. The Obama administration is instead trying to avoid any dispute that might interrupt a planned expansion of U.S. military sales to New Delhi, several senior U.S. officials said in interviews.

- Several kilograms of what authorities described as semiprocessed uranium were stolen by a criminal gang, allegedly with Pakistani links, from a state mine in Meghalya, in northeastern India, in 1994. Four years later, a federal politician was arrested near the West Bengal border with 100 kilograms of uranium from India's Jadugoda mining complex that he was allegedly attempting to sell to Pakistani sympathizers associated with the same gang. A police dossier seen by the Center for

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Newsweek: 2-14-2016

OPINION

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- Then, in 2003, members of a jihad group, Jamaat-ul-Mujahideen, were caught in a village on the Bangladesh border with 225 grams of milled uranium—allegedly

- In 2008, another criminal gang was caught attempting to smuggle low-grade uranium, capable of being used in a primitive radiation-dispersal device, from one of India's state-owned mines across the border to Nepal. The same year, another group was caught moving an illicit stock of uranium over the border to Bangladesh, the gang having been assisted by the son of an employee at India's Atomic Minerals Division, which supervises uranium mining and processing.

- In 2009, a nuclear reactor employee in southwest India deliberately poisoned dozens of his colleagues with a radioactive isotope, taking advantage of numerous gaps in plant security, according to an internal government report seen by the CPI.

- And in 2013, leftist guerillas in northeast India illegally obtained uranium ore from a government-run milling complex in northeast India and strapped it to high explosives to make a crude bomb before being caught by police, according to an inspector involved in the case.

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Newsweek: 2-14-2016

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The paramilitary Central Industrial Security Force (CISF), which has a total of 95,000 personnel under civilian rather than military control and a $785 million budget, is supposed to keep all these nuclear materials from leaking from India's plants. But it is short-staffed, ill-equipped and inadequately trained, according to a confidential draft Home Ministry report about the force's future, dated November 2013, seen by the CPI.

"Weapons supply is down by 40 percent, and training equipment by more than 45 percent," compared with what officials running the force had sought, the report stated.

This critical account roughly matches what the U.S. intelligence community has stated in its annual classified rankings of global nuclear security risks, based on detailed assessments of safeguards for materials that could be used in explosives or "dirty bombs" laced with radiation, according to three current or former senior Obama administration officials.

They said that India's security practices have repeatedly ranked lower in these assessments than those of Pakistan and Russia, two countries with shortcomings that have provoked better-known Western anxieties.

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Peace Activists Break into Y-12 Complex in Oakridge

The Washington Post

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Judge orders restitution in Oak Ridge peace activist break-in, but postpones sentencing

By Dan Zak, Published: January 28 - 2013

KNOXVILLE, Tenn. — A federal judge has ordered a Catholic nun, a Vietnam veteran and a house painter from Duluth, Minn., to pay full restitution of $53,000 for damaging one of the nation's most secure sites for nuclear weapons production. The three were convicted of sabotage last year for breaking into the facility and were facing sentencing Tuesday.

In the predawn hours of July 28, 2012, the trio cut through four fences at the Y-12 National Security Complex in nearby Oak Ridge, Tenn., where the fuel for the atomic bomb dropped on Hiroshima, Japan, was produced during the Manhattan Project.

Having essentially circumvented a glitch-ridden security apparatus that cost $150 million a year, they splashed blood and spray-painted biblical messages on the exterior of the building that warehouses an estimated 400 tons of highly enriched uranium — enough to fuel 10,000 nuclear bombs.

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Peace Activists Break into Y-12 Complex in Oakridge

The break-in prompted a two-week shutdown of operations at Y-12, four congressional hearings and a raft of reports on the mismanagement of site security. The National Nuclear Security Administration responded to the break-in with a variety of security compensations, from the installation of 2,850 linear feet of concertina wire to requiring that malfunctioning security tools be repaired within 24 hours.

Babcock & Wilcox Technical Services Y-12, the site's private contractor for management and operations, was docked $12.2 million in fees and lost a 10-year contract worth $23 billion to manage both Y-12 and the Pantex Plant in Amarillo, Tex., where nuclear weapons are assembled and disassembled.

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Building a Bomb – 1

Some problems that terrorist organizations wishing to construct a nuclear explosive would confront —

- Assembling a team of technical personnel
- Substantial financial costs
- Radiation and chemical hazards
- Possibility of detection
- Acquisition of nuclear-explosive material

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Building a Bomb – 2

No terrorist organization currently has the ability to produce weapons-usable enriched uranium.

Hence terrorists would have to acquire already made HEU.

There is enough HEU in worldwide stockpiles to make ~ 30,000 bombs.

Most HEU is under military control, but 40 countries have civilian HEU, including in more than 120 research reactors and related facilities.

The HEU stockpiles most vulnerable to theft are in Pakistan, Russia, and many countries with civilian reactor facilities.

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Building a Bomb – 3

No terrorist organization currently has the ability to make plutonium for a weapon. Nuclear reactors to produce plutonium and reprocessing plants to extract plutonium from spent reactor fuel require resources available only to States.

Hence terrorists would have to seize plutonium from existing stockpiles or receive aid from a State.

There is enough plutonium worldwide to make ~ 30,000 bombs.

Plutonium is under both military and civilian control.

Both pose a risk. The United States, Britain, France, and Russia have stopped producing plutonium for weapons. China may have stopped.

India, Israel, Pakistan and possibly North Korea are continuing to make plutonium for weapons.

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Building a Bomb – 4

To make a Hiroshima-style gun-type bomb, terrorists would need about 50 kg (110 pounds) of weapons-grade HEU.

They could try to reduce the amount needed by using special techniques.

An implosion-type bomb can use either HEU or Pu, but the technical challenges are significant —

- Designing high explosive lenses
- Machining and assembling precission parts
- Triggering the implosion

A simple implosion-type bomb would require only 25 kg (55 pounds) of HEU or 4 to 10 kg (9 to 22 pounds) of Pu

Terrorists would be aided by the fact that they would not need to meet military requirements.

The key barrier for terrorists is acquiring enough HEU.

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Insecure Nuclear Explosive Materials

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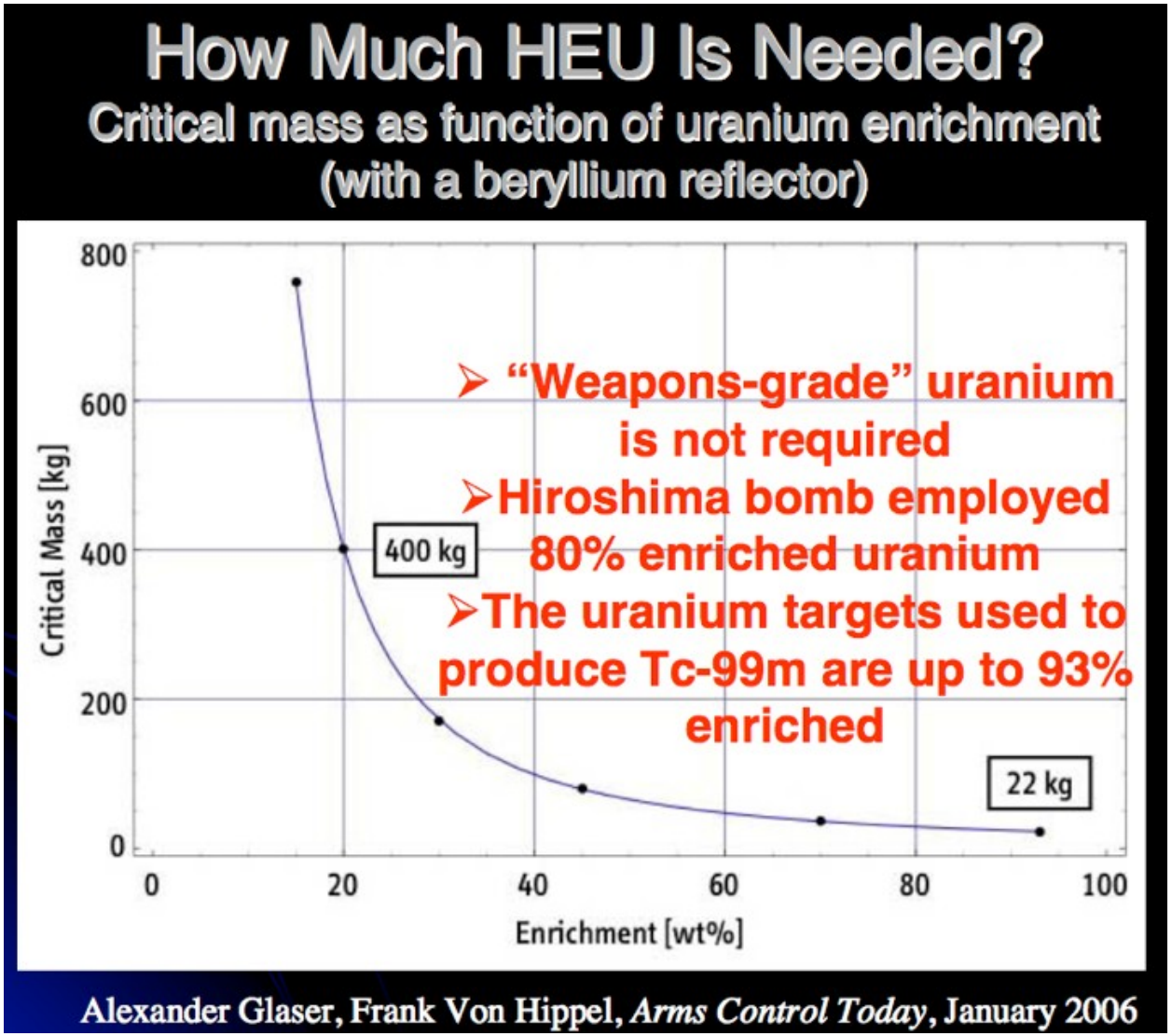
The Problem of Dual Use of Highly Enriched Uranium



HEU is also used in civilian applications: research reactors, medical isotope production.

It is challenging to protect HEU in civilian facilities from theft or from secret transfer of HEU to a clandestine weapons program.

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Availability of Uranium from “Atoms for Peace”

Atoms for Peace

- During the 1950s and 1960s, the U.S. Atoms for Peace program and the corresponding Soviet program constructed hundreds of research reactors, including reactors for export to more than 40 other countries.

- These reactors were originally supplied with low-enriched Uranium (LEU), which is not usable for nuclear weapons, but demands for better reactor performance and longer-lived fuel led to a switch to weapons-grade Highly Enriched Uranium (HEU).

- In addition there are important medical applications for isotopes that require HEU for their production.

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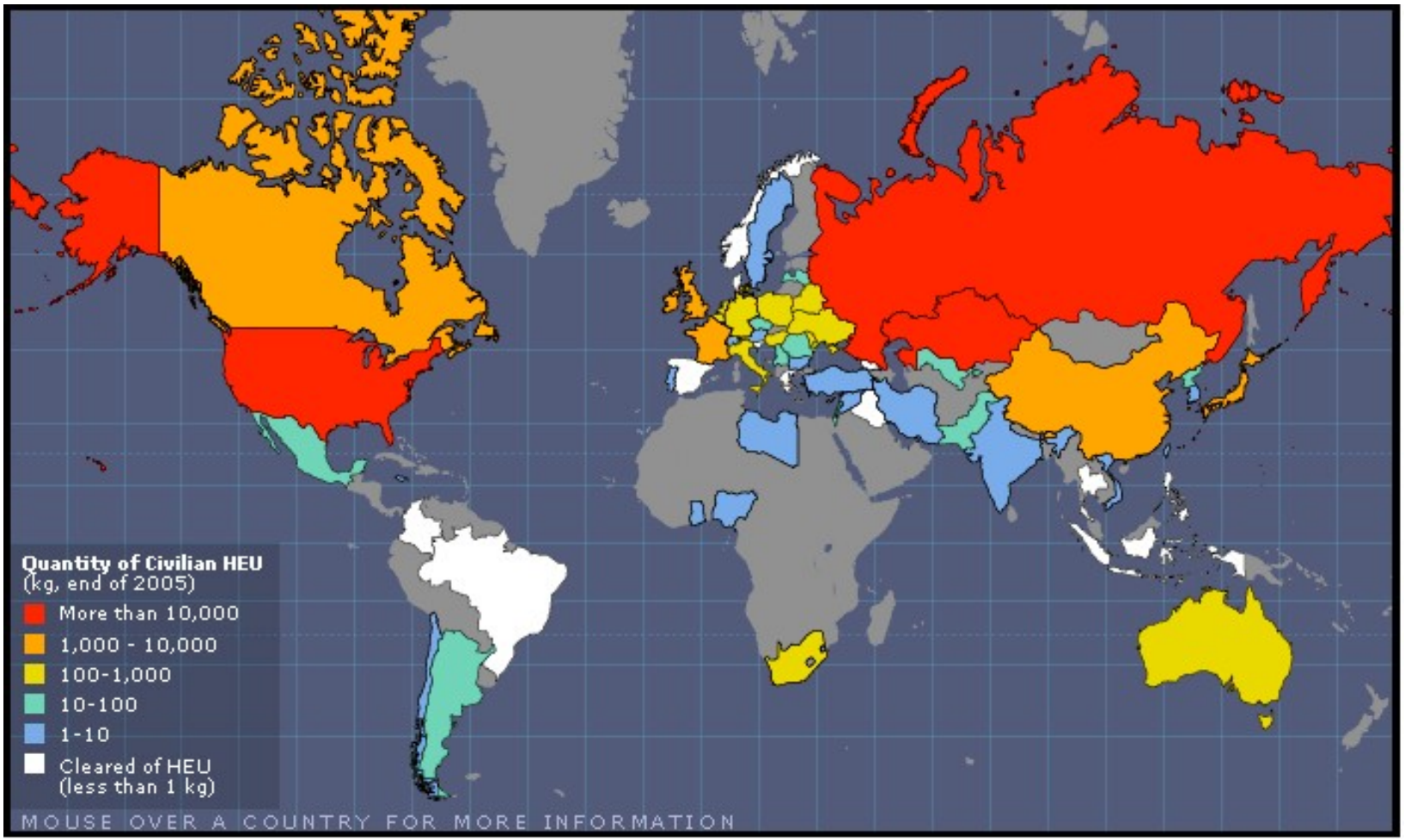
Availability of Highly Enriched Uranium
Effect of "Atoms for Peace"



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Availability of Nuclear Weapon Materials in the Former Soviet Union in the 1990s

In 1994, Building 116 at the Kurchatov Institute in Moscow had enough HEU for a bomb at its research reactor, but had an overgrown fence and no intrusion detectors or alarms, an example of the poor state of security at many nuclear facilities after the collapse of the Soviet Union.

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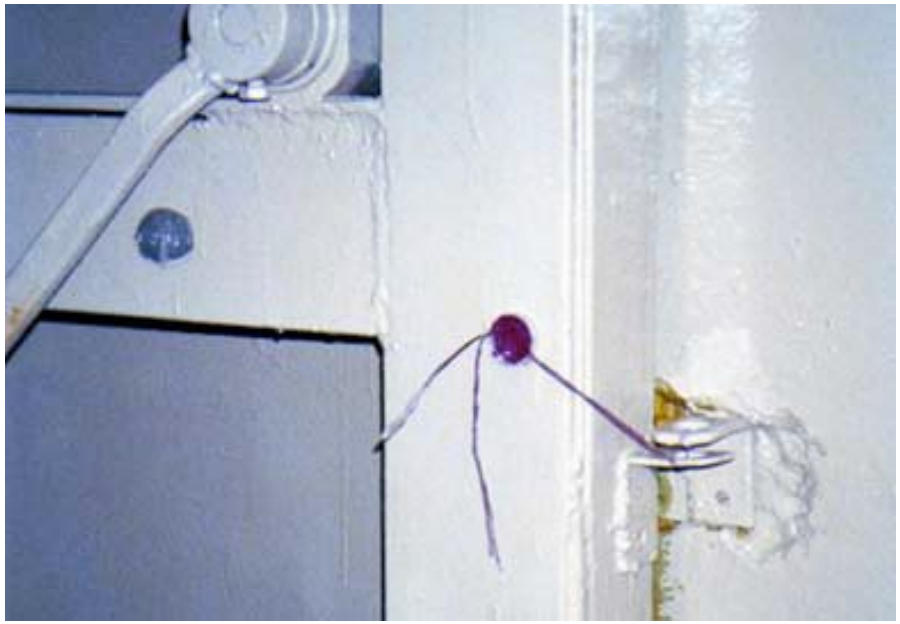
Availability of Nuclear Weapon Materials in the Former Soviet Union in the 1990s

Left and below: Inadequate security measures at former Soviet nuclear facilities, such as the padlock and wax seal shown, would allow easy access to anyone wishing to steal materials.



The situation in Former Soviet Republics triggered intense efforts to collect and secure nuclear materials. Example, the Global Threat Reduction Initiative (GTRI), collects Pu, HEU and converts civilian HEU reactors to LEU.

Much progress has been made in securing nuclear materials in former SU states !

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Programs to Intercept and Secure Nuclear Materials

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Intercepting Nuclear Weapons and Materials

Terrorists organizations known to have sought nuclear weapons or weapon materials —

- Al-Qaeda
- Jemaah Islamiyah
- Chechnyan Separatists
- Hezbollah
- Aum Shinrikyo

Border Security —

15 million shipping containers enter the U.S. each year; only 6% are inspected carefully

A truck passes through a radiation portal monitor at the port of Newark, New Jersey.

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Intercepting Nuclear Weapons and Materials

What do ceramics, bananas, and kitty litter have to do with border security?

They naturally contain radioactive isotopes and accounted for 80 percent of the over 10,000 radiological false alarms made by portal monitors between May 2001 and March 2005.

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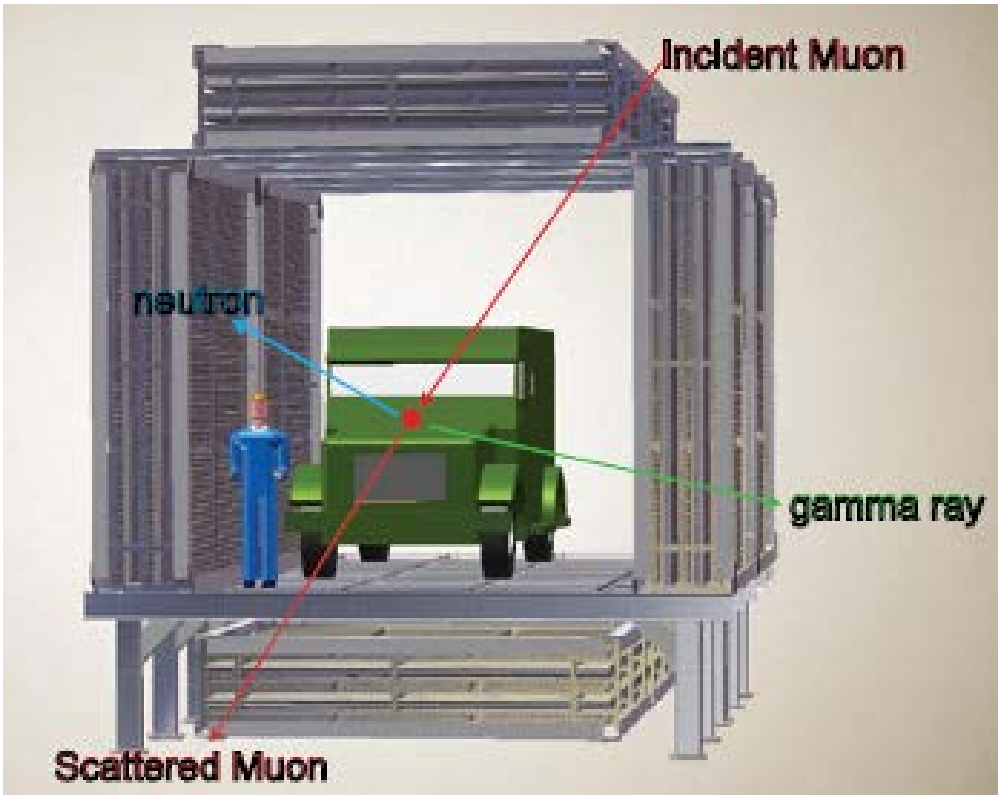
Intercepting Nuclear Weapons and Materials

Port Scanners: Avoiding False Positive Alarms
Passive Muon Tomography

Solution: detect scattering of cosmic ray muons of high-z nuclei in nuclear explosive materials ! Very specific, low number of false positive alarms.



UIUC nuclear physics graduate Dr. Mike Sossong helped to develop this technology at Los Alamos National Laboratory and now is director of research at Decision Science Corporation in San Diego.

Dr. Sossong won the 2011 Columbus Scholar Award of the Homeland Security Department for commercializing this technology

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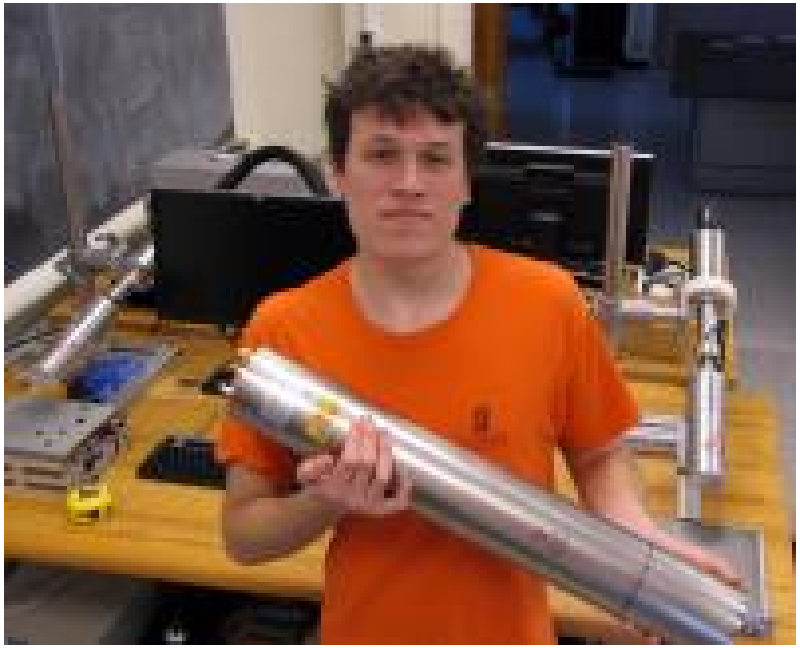
Intercepting Nuclear Weapons and Materials

Research on active interrogation for NEM using neutrons

Example:

Brent Heuser, Ling Jian Meng at NPRE
"Interrogation of Special Nuclear Material Using the UIUC Pulsed Neutron Facility"
funded by the UIUC Engineering College Strategic Research Initiative



Idea: neutrons get captured by nuclides
In the resulting decay gamma rays of characteristic energy are emitted.

NPRE Student (former 280 TA)
Rick Kustra with a gamma detector used

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Identifying the Sources of Dangerous Nuclear Materials (Nuclear Forensics)

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Nuclear Forensics Definitions

Nuclear Attribution is the process of identifying the source of nuclear or radioactive material used in illegal activities, to determine the point of origin and routes of transit involving such material, and ultimately to contribute to the prosecution of those responsible.

Nuclear Forensics is the analysis of intercepted illicit nuclear or radioactive material and any associated material to provide evidence for nuclear attribution.

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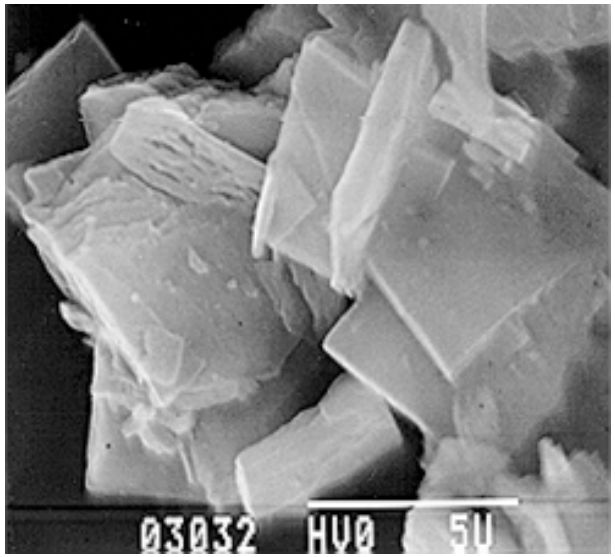
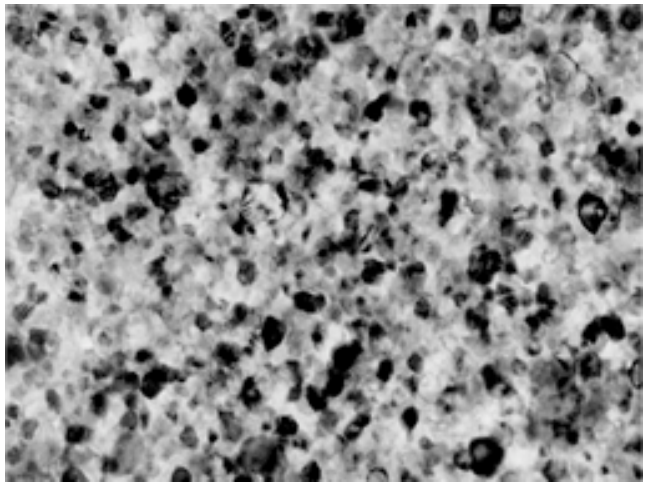
Nuclear Forensic Techniques

Electron Microscopy and Spectroscopy

- Typography, morphology, elemental composition, and crystallographic structure
- Scanning Electron Microscopy (SEM) produces images of the surface at high magnification.
- Transmission Electron Microscopy (TEM) uses electrons that pass through the sample to produce images of the internal structure.





Source: Analyst, 2005: 130

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Nuclear Forensic Techniques

http://www.nti.org/e_research/cnwm/threat/russia.asp

Analyst, 2005: 130

Profilometry —

- Measures the surface roughness of fuel pellets.
- **Production facilities use two types of grinding procedures** to reach the desired cylindrical shape: dry grinding and wet grinding. Wet grinding produces a smoother finish.

Size and features —

- The **dimensions of the fuel pellet**, including the height, radius, and the type of hole present (if any), **are specific to certain types of reactors**.

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Nuclear Forensic Techniques: Spectroscopy

Isotopic composition reveals the enrichment process, intended use, and reactor type.

Impurity composition reveals the production process and previous geolocation.

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Nuclear Forensic Techniques

Age —

- As a radiological sample gets “older,” the parent isotope disintegrates and its daughter nuclides accumulate.
- Knowledge of the age helps an analyst identify when the material was produced.

$^{18}O/^{16}O$ Ratio —

- Certain ratios are observed in rainwater, and these “variations up to 5 percent...depend upon average temperature, average distance from the ocean, and the latitude” (Mayer).
- By these means, an analyst can identify the former geolocation of the material.

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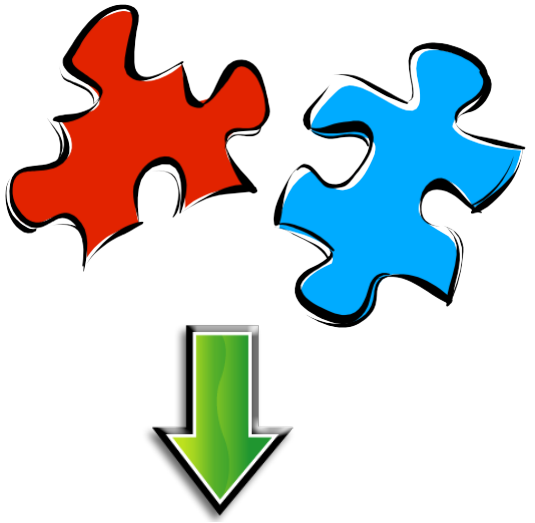
Nuclear Forensic Techniques: Conclusion

- By using the techniques and analysis methods of nuclear forensics, one can create a “nuclear fingerprint” of the material.
- Information, such as material type, reactor type, production plant, production date, enrichment process, intended use, and geolocation, are pieces of the puzzle that must be solved to form a bigger picture of the radiological evidence’s history.



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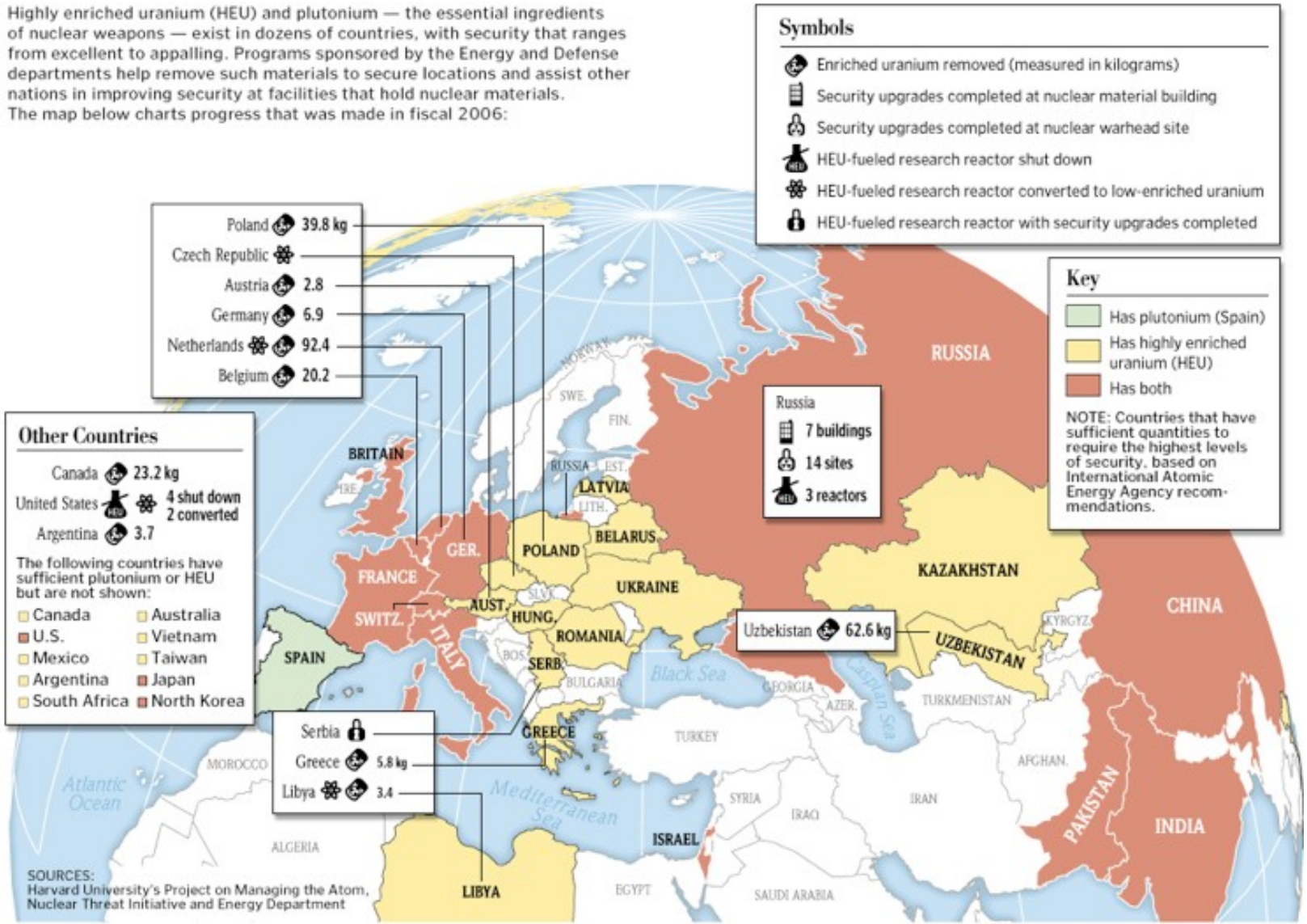
Securing Vulnerable Nuclear Materials



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Securing Vulnerable Nuclear Materials

2004 National Nuclear Security Administration (NNSA) establishes Global Threat Reduction Initiative (GTRI) in the Office

➔ identify, secure, remove and/or facilitate the **disposition of high risk vulnerable nuclear and radiological materials** around the world that pose a threat to the United States and the international community.

Three initiatives are:

Convert: **Convert or shutdown research reactors and isotope production facilities** from the use of highly enriched uranium **(HEU) to** low enriched uranium **(LEU)**.
Remove: Remove or confirm the **disposition of excess nuclear and radiological materials**.
Protect: Protect high priority nuclear and radiological materials from theft.

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GTRI Conversions 2004 – 2014

(1) Successfully **converted to LEU fuel or verified the shutdown of 49 HEU research reactors in 25 countries**: Argentina, Australia, Bulgaria, Canada, Chile, China, the Czech Republic, France, Germany, Hungary, India, Japan, Kazakhstan, Libya, the Netherlands, Portugal, Poland, Russia, Ukraine, the United Kingdom, United States, Uzbekistan, and Vietnam.

(2) Verified the **cessation of the use of HEU targets for isotope production in Indonesia**.

(3) Accelerated the **establishment of a reliable supply of the medical isotope molybdenum-99 (Mo-99) produced without HEU** by establishing partnerships with South Africa, Belgium, and the Netherlands to convert Mo-99 production from HEU targets to LEU targets, and with four domestic commercial entities to produce Mo-99 in the United States with non-HEU technologies.

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GTRI Removal Since 2004 - 2014

(1) Removed or confirmed the disposition of more than 4,100 kilograms of HEU and plutonium (more than enough material for 165 nuclear weapons).

(2) Removed all weapons-usable HEU from 16 countries and Taiwan, including: Greece (December 2005), South Korea (September 2007), Latvia (May 2008), Bulgaria (August 2008), Portugal (August 2008), Romania (June 2009), Taiwan (September 2009), Libya (December 2009), Turkey (January 2010), Chile (March 2010), Serbia (December 2010), Mexico (March 2012), Ukraine (March 2012), Austria (December 2012), and Czech Republic (April 2013).

(3) **Removed more than 36,000 disused and unwanted radiological sources from sites across the United States.**

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GTRI Protection 2004 - 2014

(1) **Completed physical protection upgrades at more than 1,700 buildings in the United States and internationally** with high-activity radiological sources;

(2) Provided **Alarm Response Training to more than 3,000 site security, local law enforcement officers and other first responders** from across the country on responding to a potential incident involving radiological material.

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Countries that have given up all HEU

Ukraine

Following Ukraine's commitment at the April 2010 nuclear security summit in Washington to get rid of all of its HEU by 2012. The last HEU, 128 kg, was removed on March 27th from two facilities in the Ukraine.

South Africa

NNSA has completed a contract with South Africa for the return of U.S.-origin spent HEU fuel to the United States. the contract, signed in August 2010, covers 6.3 kilograms of U.S.-origin HEU spent fuel. HEU was returned August 2011.

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This Remains a Challenging Process

Belarus

Belarus has committed to give up its stockpile of highly enriched uranium (HEU) by the end of 2012.

Prior to the agreement, Belarus, Russia, the United States, and the International Atomic Energy Agency conducted two secret operations in which portions of Belarusian HEU were moved into secure facilities in Russia.

In these operations, a total of 85 kilograms of HEU were transported.

Belarus has suspended the agreement in August 2011 over US protests concerning human right violations in Belarus.

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iClicker Question (Use Channel C-C)

Which country has given up all civilian HEU in 2012?

A. Belarus

B. Germany

C. Ukraine

D. Russia

E. France

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iClicker

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iClicker Question (Use Channel C-C)

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A. Belarus

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D. Russia

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What We Need To Do

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What We Need to Do (Important)

In the September/October 2006 issue of the Bulletin of the Atomic Scientists, Harvard University professor **Graham Allison discusses a "nuclear 9/11" and concludes that "a nuclear terrorist attack on the United States is more likely than not in the decade ahead**."

The centerpiece of a strategy to prevent nuclear terrorism must be to ***deny terrorists access to nuclear weapons or materials***

To accomplish this, he formulates the doctrine of "Three No's" —

1. **No loose nukes**
2. **No new nascent nukes**
3. **No new nuclear weapon states**

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What We Need to Do (Important)

1. No Loose Nukes

Insecure nuclear weapons or materials anywhere pose a grave threat to all nations everywhere.

The international community can therefore rightly insist that all weapons and materials—wherever they are—be protected to a standard sufficient to ensure the safety of citizens around the world.

Russia has been the principal focus of concern for the past two decades, but other countries—such as Pakistan, North Korea and India — are of growing concern.

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What We Need to Do (Important)

2. No New Nascent Nukes

Construction of any national production facilities for enriching uranium or reprocessing plutonium must be prevented.

The former head of the IAEA, Mohamed ElBaradei, has said that the existing NPT system made a mistake in allowing non-nuclear weapon states to build uranium enrichment and plutonium production plants.

Closing this loophole will require deft diplomacy, imaginative inducements, and demonstrable readiness to employ sanctions to establish a bright line.

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What We Need to Do (Important)

3. No New Nuclear Weapons States

This means drawing a line under the current eight nuclear powers (the United States, Russia, Great Britain, France, China, India, Pakistan, and Israel) and unambiguously declaring “no more”.

North Korea poses a decisive challenge to this policy. But if North Korea is accepted as a nuclear weapons state, South Korea and Japan are likely to follow within a decade, making Northeast Asia a far more dangerous place than it is today

The spread of nuclear weapons states makes it more likely that nuclear weapons or materials will be sold to others, including terrorists, or stolen by them.

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Physics 280: Session 11

Plan for This Session

Questions about the course

Midterm: Thursday March 17th, 2:00-3:20pm ➔ modules 1-5: Multiple Choice Qs
Room 1000 Lincoln Hall + 1 essay questions
[old exams available on course web-page, 50% of Qs will be from last 3 years]

Vote for Additional Midterm-Office-Hours

(A) Sunday March 20th 1-3pm
(B) Sunday March 20th 3-5pm
(C) Sunday March 20th 4-6pm
(D) Sunday March 20th 5-7pm
(E) Sunday March 20th 6-8pm

News and discussion

Video Presentation: Last Best Chance

Discussion

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Reuters

World | Fri Feb 26, 2016 2:28pm EST

Related: WORLD

Iran briefly overstepped a limit set by nuclear deal, IAEA says

VIENNA

Iran briefly exceeded a limit set by a deal with major powers under which sanctions against it were lifted, the U.N. nuclear watchdog said on Friday, but Tehran then came back within the permitted bounds.

Under its July deal with the United States, Russia, China, France, Britain and Germany, Iran is allowed to have 130 tonnes of heavy water, a moderator in reactors like the one it has disabled at Arak and a chemical it produces itself.

"On 17 February, the agency verified that Iran's stock of heavy water had reached 130.9 metric tonnes," the International Atomic Energy Agency (IAEA), which polices the deal, said in a regular report on Iran's nuclear program sent to its member states.

By Wednesday, however, 20 tonnes of heavy water had been shipped out of the country, bringing the stock back under the threshold of 130 tonnes, apparently in keeping with a soft limit under the terms of the July 14 deal, which is formally called the Joint Comprehensive Plan of Action (JCPOA).

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The New York Times

Iranian President and Moderates Make Strong Gains in Elections

By **THOMAS ERDBRINK** FEB. 29, 2016

TEHRAN — Nearly three years after Iran's reform-minded president was elected, the most reactionary voices in Iranian politics are losing ground to moderates buoyed by the sweeping nuclear deal with big powers, including the United States.

Though hard-liners still control the most powerful positions and institutions of the state, two national elections last week appeared to build on the slow but unmistakable evolution toward a more moderate political landscape — now and into the future.

Allies of President Hassan Rouhani made strong gains in parliamentary elections, controlling the entire 30-seat delegation representing the capital, Tehran, and carving out an influential minority bloc. At the same time, the two most radical clerics were ousted from the Assembly of Experts, a panel with the constitutional duty to select the nation's next supreme leader, should that position become vacant.

The voting was seen as a referendum of sorts on the nuclear deal, and virtually every prominent critic of the pact was defeated.

The results also gave some weight to President Obama's carefully couched hopes that the nuclear deal — which was heavily criticized by his American political adversaries — might introduce changes that could gradually bring Iran out of its confrontational posture with the West and, most pointedly, with the United States.

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Reducing the Threat of Nuclear Terrorism

Video: “Last Best Chance”

2005, Nuclear Threat Initiative (NTI)

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Discussion of “Last Best Chance”

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End of Nuclear Terrorism Module

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