Physics/Global Studies 280: Session 11

Plan for This Session

Module 4: Nuclear Terrorism

News

United Airlines Flight 175 is flown into the South Tower of the World Trade Center by suicide terrorists on 9/11, photo by Jim Saffey, source September 11 Digital Archive

Terrorism

The Threat and Preventing Nuclear Terrorism

What is terrorism?
Who is a terrorist?

1. **Case 1**
   Insurgent Group A attacked major civilian and symbolic targets in Nation 1, including financial and government sites.
2. **Case 2**
   Separatist Group B carried out a spree of attacks in Nation 2 targeting public spaces and government facilities.
3. **Case 3**
   A lone individual attacked a government building in Nation 3.
4. **Case 4**
   A lone individual shot and killed another individual.
5. **Case 5**
   Nation 4 conducted strikes that hit schools and hospitals in Nation 5 during an armed conflict.
6. **Case 6**
   Nation 6 conducted strikes on sites in Nation 7, including locations in and adjacent with hospitals and schools where combatants were believed to operate.
7. **Case 7**
   A criminal organization carried out a spree of attacks in major cities of Nation 8, including a passenger aircraft and a national security headquarters.

1. **Case 1**: An international extremist organization attacked financial centers and government buildings in Nation 1. The attacks were designed to cause mass casualties, get revenge and attention, and provoke a military response.
2. **Case 2**: An ethno-nationalist militant organization carried out a prolonged campaign of attacks in Nation 2, targeting civilian and government sites to pressure political concessions related to territorial status and sovereignty.
3. **Case 3**: A domestic anti-government extremist attacked a government building in Nation 3, motivated by opposition to govt authority and seeking to inspire broader resistance.
4. **Case 4:** The shooter was ideologically motivated.
5. **Case 5**: During an interstate war, Nation 4 launched precision strikes in Nation 5 that struck civilian infrastructure, including schools and hospitals. Nation 4 is attempting to conquer Nation 5.
6. **Case 6**: Nation 6 conducted military operations in Nation 7 targeting enemy command hubs and weapon depots embedded around hospitals and schools.
7. **Case 7**: A drug cartel in Nation 8 carried out a campaign of bombings against government facilities, civilian infrastructure, and a commercial airliner. The organization sought to coerce the government into changing extradition policy and reducing law enforcement pressure.

Categories of Violent Political Activity

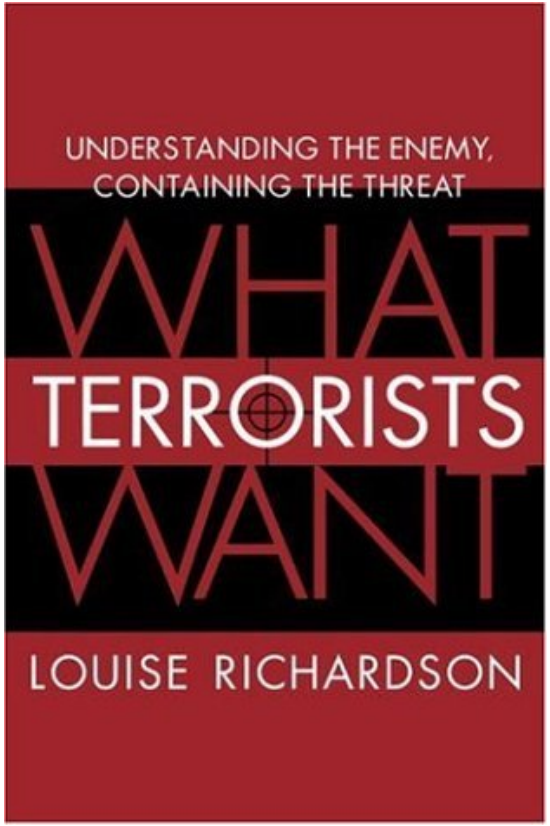
Terrorism: Deliberately and violently targeting civilians for political purposes

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.

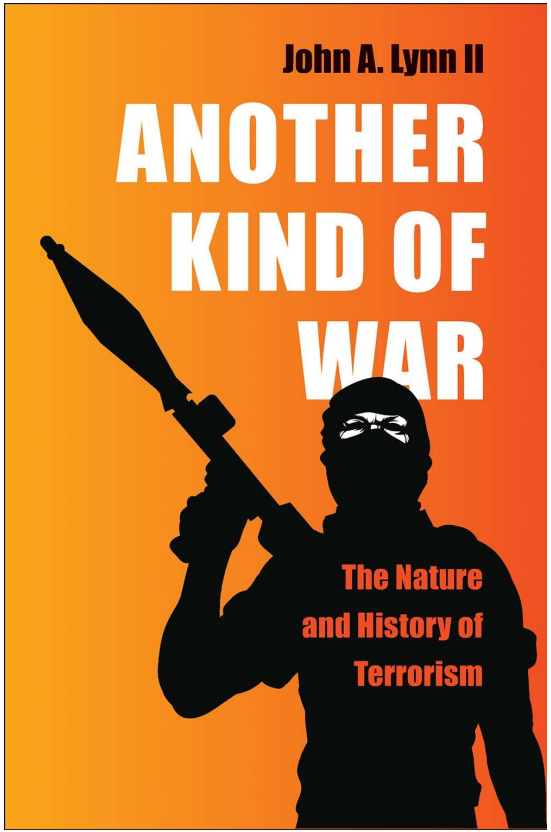
Guerilla warfare: A type of irregular warfare and combat in which a small group of combatants use mobile military tactics in the form of ambushes and raids to combat a larger and less mobile formal army. Guerilla warfare is not terrorism.

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
4. Conduct operations in accordance with the laws and customs of war


UNDERSTANDING THE ENEMY,
CONTAINING THE THREAT
WHAT
TERRORISTS
WANT
LOUISE RICHARDSON

2007


John A. Lynn II
ANOTHER
KIND OF
WAR
The Nature
and History of
Terrorism

2019

What is Terrorism?

Emeritus Professor John Lynn in *Another Kind of War* (p. 5-6) characterises terrorism by six traits:

1. employs violence or the threat of violence
2. attacks people or property
3. strikes defenseless victims, often described as civilians or noncombatants
4. strives to inflict fear and/or incite outrage in a much larger target audience
5. uses violence and its psychological impact to advance political, social, and cultural goals
6. propagates public knowledge of its actions to reach the target audience

A target of Red Guards being publicly abused during the Chinese Cultural Revolution. The placard hanging from his neck reads “Anti-Party Revisionist Huang.”

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A target of Red Guards being publicly abused during the Chinese Cultural Revolution. The placard hanging from his neck reads “Anti-Party Revisionist Huang.”

Is a mass shooter a terrorist?

Focusing Violence on the Defenseless

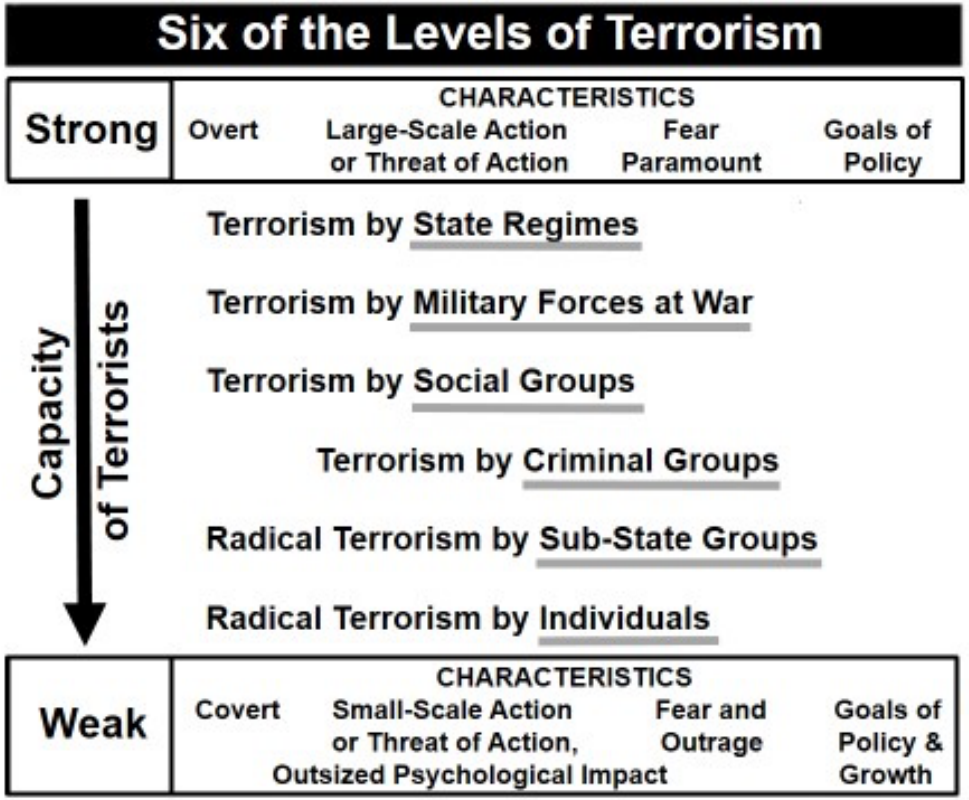
Three technical advantages for terrorists:

1. They can attack readily available “soft targets”
2. They magnify the moral shock they inflict by their actions
3. They spread a sense of vulnerability among the larger target audience

This tendency distinguishes terrorism from “kill or be killed” warfare. “Defenseless” or “noncombatant” victims can include military personnel who are not actively in a state of battle or struck at times when they cannot defend themselves.

Second intifada suicide bombing of a bus in Haifa by Hamas, 5 March 2003, photo by B. Zeleznik

Types of Terrorism



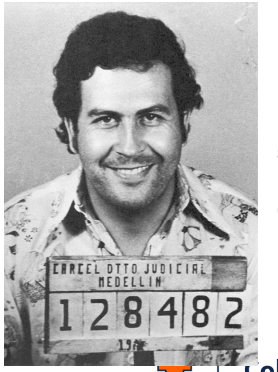
Six levels of terrorism, *Another Kind of War* Lynn 2019 p. 11

Types of Terrorism

In more detail, Lynn (p. 8) describes the six levels of terrorism as follows:

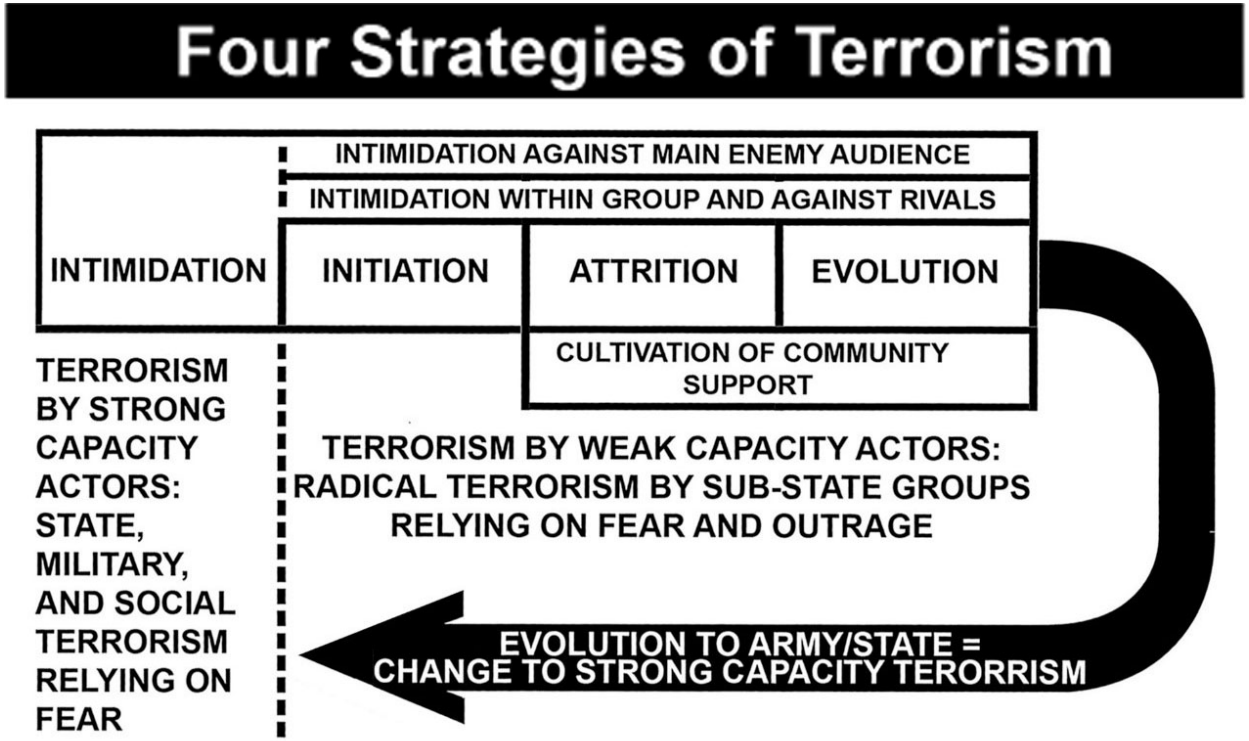
1. Terrorism by state regimes to impose their wills on their own populations
2. Terrorism by military forces to achieve victory in war
3. Terrorism by social groups to dominate or drive off other groups
4. Terrorism by criminal groups to achieve political ends
5. Radical terrorism by sub-state activist groups for a variety of purposes– political, social, economic, religious, ethnic,and so on
6. Radical terrorism by individuals

Saddam Hussein in 1998, source Iraqi News Agency



Mugshot of Pablo Escobar in 1977, source Colombia National Registry, Colombian National Police

Strategies of Terrorism



Four strategies of terrorism, *Another Kind of War* Lynn 2019 p. 433

Strategies of Terrorism

Four basic strategies of terrorists according to Professor John Lynn in *Another Kind of War*

Intimidation: Uses fear to suppress resistance and enforce compliance. Fundamental strategy of strong-capacity terrorists.

- E.g., Khmer Rouge, Cambodia 1975-79

Initiation: Perfect for small groups. Precipitates larger things to come. Draws attention to weaknesses of the enemy (or keepers of the status quo).

- E.g., Red Army Faction, Germany 1970s

Attrition: Success by wearing down enemy resistance. Requires a slightly larger group capable of enduring.

- E.g., Provisional Irish Republican Army

Evolution: Increasing in size and resources in order to engage in higher levels of warfare.

- E.g., Islamic State, Hezbollah, Hamas

Terrorism Carried Out by Governments

Louise Richardson in *What Terrorists Want* argues *"terrorist groups"* are best understood as sub-state actors (Lynn's fifth level). Although states and their leaders are not necessarily terrorist groups, states may engage in terrorism (Lynn's first and second levels).

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 of overtly attacking them (e.g., Libyan support of terrorist acts against US interests during the 1980s, Iraqi support of Palestinian terrorist acts against Israel in 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 direct confrontation (e.g., US support of terrorist groups in Angola and Nicaragua).

Terrorism Carried Out by Governments

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

3. War terrorism: Use of terrorism by a government against civilians of another country with which it is at war (e.g., 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 (e.g., collective punishment of villages of resistance fighters in Ukraine, Italy, and France via German troops in WWII).

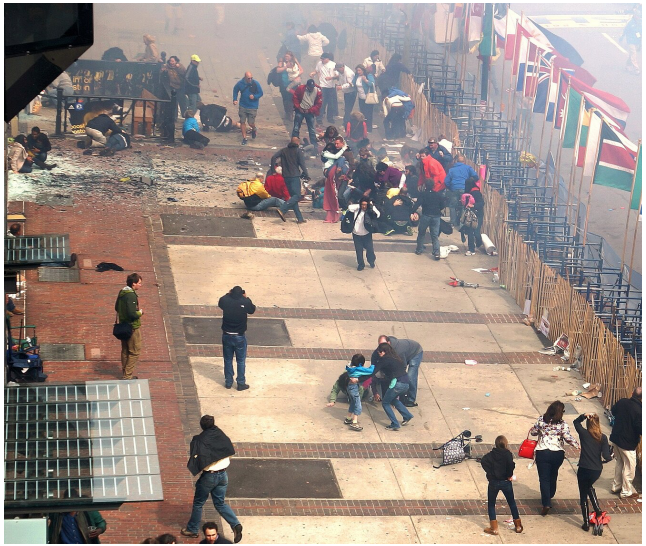
Radical Terrorism Carried Out by Individuals

Richardson 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

Terrorists acting at the individual level or with a handful of people often fit this description

- (e.g., Boston Marathon bombers who were motivated by Islamist ideology but unaffiliated with any formal terrorist group).



Individuals who had come to watch the Boston marathon rush to aid those injured by the explosions, 15 April 2013, photo by Aaron Tang

Motivations of Terrorism

Terrorists act for three basic reasons according to Richardson *What Terrorists Want*

Terrorists are rational actors with political goals, not irrational or purely evil individuals. They use violence strategically to achieve three main objectives:

1. Revenge

- Retaliation for perceived injustices (real or symbolic).
- Motivated by grievance and a sense of humiliation or victimization.

2. Renown

- Desire for recognition, status, and publicity.
- Violence is a communication strategy aimed at attracting attention to a cause.

3. Reaction

- Intend to provoke an overreaction from governments.
- Harsh responses can polarize societies, radicalize supporters, and validate terrorist narratives.

Terrorism is a *communication* strategy designed to influence audiences (governments, constituencies, recruits), not just to harm victims. Effective counterterrorism should avoid playing into the “reaction” terrorists seek.

Three Waves of Radical Terrorism by Sub-State Groups

Lynn classifies the *radical terrorism* carried out by sub-state actors into three waves beginning after the failures of the *Revolutions of 1848*.

1. 1848-1920: the emergence of violent political terrorism
    - E.g., Narodnaya Volya, Russia 1880s
        i. Composed of small, socialist cells attempting to overthrow the Tsarist regime.
        ii. Assassinated Tsar Alexander II (hand-thrown bomb).
2. 1945-1980: national liberation terrorism and urban guerilla groups
    - E.g., Front de liberation nationale (FLN), Algeria (and France) 1950s
        i. Guerilla cells opposing French colonial presence; initiating the Algerian War.
        ii. Bombing of cafes and markets; assassinations.
3. 1980-present: Islamist terrorism
    - E.g., Al Qaeda, 1988 to present
        i. Transnational terrorist network.
        ii. Most well-known for September 11, 2001 attacks.

Before the Three Waves of Radical Terrorism

Lynn classifies the terrorism carried out before the *Revolutions of 1848* as pre-modern. He points out:

- Much of the terrorist tactics carried out before this time was by state actors
  - E.g., French Reign of Terror
- Those perpetrated by groups and individuals had not cemented into "an ongoing transnational repertoire of armed resistance"
  - Terrorism had not yet become an "ism"
- Most consisted of targeted assassinations which can be included among terrorist tactics, but do not on their own consist of terrorism in the modern sense
  - E.g., Sicari and Hashashins

Confronting Terrorism

Richardson's six rules for countering terrorism:

1. Have defensible and achievable goal
   - Defeating and eliminating terrorism is unachievable
   - Capturing/eliminating those responsible for the 9/11 attacks has been achievable
   - Containing terrorism is achievable
   - Don't let short-term tactics undermine long-term goals
2. Live by your principles
   - Don't abandon democracy when it is threatened
3. Know your enemy
   - Play the intelligence game
   - Assess the terrorist's goals and capabilities
   - Determine the terrorist's resource supply and consumption pathways

Ignati Grinevitsky and Vera Figner of Narodnaya Volya

Confronting Terrorism

4. Separate the terrorists from their community
   - Terrorist groups rely on recruitment
   - Weakening their appeal to the communities they draw from diminishes them
5. Engage others in countering terrorists with you
   - Communicate strategies with allies
6. Have patience and keep your perspective
   - Long-term strategies are needed to confront terrorist threats (especially when their roots may be centuries old)

Italian demonstrators carry a banner saying: Rome is with the American People, for Peace against Terrorism. 12 September 2001, photo by Associated Press

Protestors march along Whitehall in London as part of the anti-Iraq War march. 15 February 2003, source Imperial War Museums, UK

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 Al Qaeda threat with the Saddam Hussein threat

Missed Opportunities

- Educating the American public about the realities of terrorism and the costs of being the sole superpower
- Mobilizing the international community behind the US in a transnational campaign against terrorism

Example: Shining Path Maoist Movement in Peru

The initial response by the Peruvian government by the growing threat from the Shining Path movement was harsh and blind.

- The movement had thousands in its ranks in the 1980s and controlled large swaths of land in Peru
- Around 70,000 people died or disappeared in the 1980s and 90s both at the hands of the Shining Path and the government forces

Alberto Fujimori, president of Peru from 1990 to 2000, during a visit to the European Commission. 21 October 1991, source European Commission

Abimael Guzman, former professor of philosophy who became the leader of Shining Path.1993, source Wikimedia Commons

Example: Shining Path Maoist Movement in Peru

By gathering improved intelligence on the movement, the Peruvian government was able to better understand and more effectively counter it.

- In 1990, the National Police of Peru created a “Special Intelligence Group” (GEIN) specifically for identifying, locating, and capturing leadership of terrorist groups
- GEIN determined that the Shining Path was built on a cult of personality around academic Abimael Guzmán
- Discovering that Guzmán suffered from psoriasis, he was tracked and captured using his psoriasis cream prescriptions
- The Shining Path never recovered after Guzmán’s capture

Marco Miyashiro, commander of GEIN , 19 April 2018, source expreso

Key Questions for Confronting Terrorism

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

- Who is tough on terrorists?
- Who is soft on terrorists?

Instead, it should be:

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

With improved security measures and intelligence, we can protect ourselves from even the most dangerous weapons and sophisticated attacks.

But, it's important to remember, terrorists cannot derail democracy by planting a bomb

News

Post

Visegrád 24
@visegrad24

BREAKING:

Panic at Guadalajara International Airport in Jalisco after a CJNG Cartel attack on the airport in response to the founder and long-time leader of the cartel “El Mencho” having been killed in an army operation a few hours ago.

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What’s happening

Trending in United States
El Mencho
Trending with CJNG, Nemesio Oseguera Cervantes

Trending in United States
Tourette
Trending with Delroy, BAFTAs

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What's happening

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El Mencho
Trending with CJNG, Nemesio Oseguera Cervantes

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Trending with Delroy, BAFTAs

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Huffington Post

Visegrád 24

5 languages

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  - Israel–Gaza war
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- Founders

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From Wikipedia, the free encyclopedia

Visegrád 24 is an account on X (formerly Twitter) and news website that publishes opinions and often unverified information related to current events, including the Russian invasion of Ukraine and the Gaza war.[1][2] One of its founders is South-African Polish content creator and advertiser Stefan Tompson.[3] It has close ties to the Law and Justice party,[4] as well as to other conservative parties in the Visegrád Group countries, as the name suggests.

Visegrád 24

VISEGRAD24

Type of site	Online newspaper
Available in	English
Owner	Intermarium Foundation
Founders	Adam Starzyński Stefan Tompson
URL	www.visegrad24.com
Current status	Active

News

Misinformation

In 2022 and 2023, Polish media outlet OKO.press and Visegrad Insight published, respectively, that Visegrád 24 was a propaganda and misinformation hub funded by the Polish government.[4][10] The left-leaning Israeli newspaper *TheMarker* wrote in December 2023 that Visegrád 24 "spreads a blatant pro-Israel and pro-Ukraine narrative, including through fake news" from "a pair of Polish right-wing extremists who take an Islamophobic and xenophobic line".[11][12]

Israel–Gaza war

Other

Founders

Justice party,[4] as well as to other conservative parties in the Visegrád Group countries, as the name suggests.

	Stefan Tompson
URL	www.visegrad24.com
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Menu

CBC

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Canadians urged not to travel to Mexico as violence explodes in wake of cartel leader's death

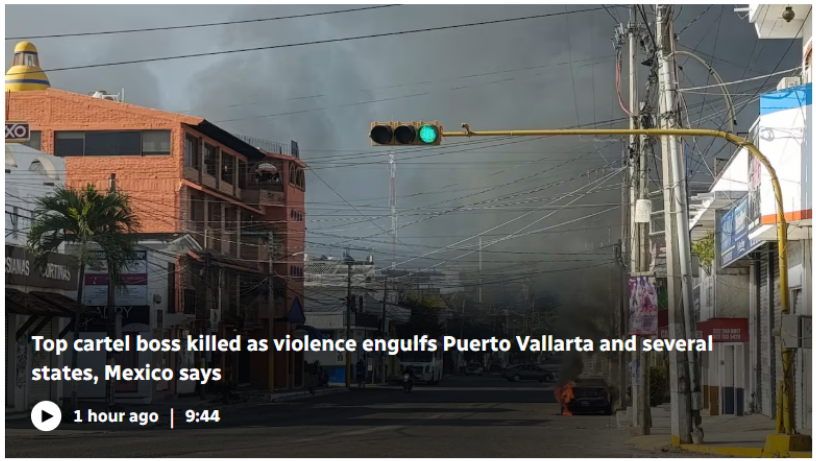
Shelter-in-place order in Puerto Vallarta, where Canadians are being advised to keep a low profile

LIVE

36 Minutes Ago

IN PHOTOS | Violence erupts in Mexico

More on the special forces operation that resulted in the death of cartel boss 'El Mencho'



'Everything is shut down': Manitobans in Puerto Vallarta take shelter to avoid violence

NEW

'It's been scary,' says N.L. woman stuck in Puerto Vallarta

Physics/Global Studies 280: Session 12

Plan for This Session

News

Module 4 Cont'd: Nuclear Terrorism

Video Presentation: Last Best Chance

News

U.S. EMBASSY & CONSULATE IN MOROCCO

By U.S. MISSION MOROCCO

9 FEBRUARY, 26

Joint Communique: United States and Kingdom of Morocco on the Conclusion of the Second Plenary Meeting of the Global Forum to Prevent Radiological and Nuclear Terrorism (Global FTPRNT)

The Moroccan Ministry of Foreign Affairs, African Cooperation and Moroccan Expatriates and the United States Department of State are honored to announce the successful conclusion of the second plenary meeting of the Global Forum to Prevent Radiological and Nuclear Terrorism (Global FTPRNT), held from February 3–5, 2026, in Rabat, Morocco. Global FTPRNT is a key security effort for both the United States and Morocco, helping to protect our citizens from potential attacks and safeguarding our economic stability against the disruptive impact of radiological and nuclear (R/N) incidents. The Forum urges all participating countries to share resources to prevent malicious actors from exploiting R/N materials to threaten our people and economic stability.

Over the course of three days, participants from across the globe engaged in substantive discussions, scenario-based exercises, and expert exchanges focused on strengthening international cooperation to prevent, detect, and respond to the threat of R/N terrorism. A highlight of the plenary was the comprehensive counter-R/N terrorism demonstration, coordinated by the Moroccan Ministry of the Interior, which simulated a multi-agency response to a radiological incident. Participants tested crisis decision-making, practiced interagency coordination, and applied nuclear forensics, detection, and mitigation strategies in a realistic setting. The lessons learned from this exercise will inform future preparedness and response efforts.

News

U.S. EMBASSY & CONSULATE IN MOROCCO

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9 FEBRUARY, 26

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Delegates also shared best practices and lessons learned on legal frameworks, emerging technologies, and strategic communications, reinforcing the importance of investing in robust national and international partnerships. The Forum underscored the need for continued innovation, information sharing, and renewed financial commitments to address the evolving risk environment.

The United States and Morocco express their deep appreciation to all participants for their active engagement and commitment to advancing the objectives of the Global FTPRNT. The outcomes of this plenary will inform future initiatives and strengthen collective efforts to counter R/N terrorism.

Looking ahead, the United States is pleased to announce that the Republic of Korea will host the third plenary meeting of the Global FTPRNT in 2027. This commitment reflects the growing international momentum to address R/N terrorism and exemplifies how the Forum generates shared responsibility among its members.

FTPRNT – inaugural meeting in Bucharest, November 2023, 63 countries collaborating to prevent radiological and nuclear terrorism.

➔ Interim while US-Russian co-chaired GICNT (Global Initiative to Combat Nuclear Terrorism) has paused all activities after the Russian invasion of Ukraine.

Reducing the threat of nuclear terrorism

United States Army soldiers wearing NBC suits during a simulated nuclear terrorist attack training exercise in McCormick, South Carolina in 2011, photo by Staff Sgt. Eric Harris, source US Air Force

Delivery Methods Other Than Long-Range Ballistic Missiles Pose a Greater Threat

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

US 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 2015* and *Office of the Director of National Intelligence (ODNI) Annual Threat Assessment of the US Intelligence Community, 2025*

In Pictorial Form …

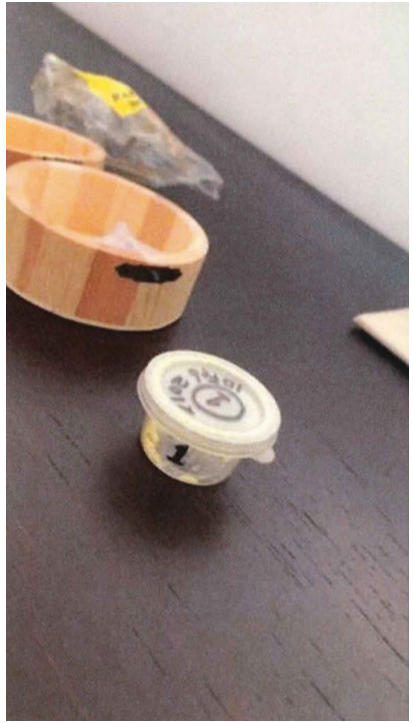
(Clay Bennett/The Christian Science Monitor - May 5, 2001)

Stealing a Bomb

About 10,000 nuclear weapons are in arsenals, with all but about 1,500 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.



Yellowcake sample from Takeshi Ebisawa case, 6 February 2025, source Superseding Indictment, filed publicly in US District Court for the Southern District of New York, case S3:22-cr-2566

Buying a Bomb

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 DHS's Domestic Nuclear Defense Office (DNDO), now under the Countering Weapons of Mass Destruction Office.

Buying a Bomb

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 —

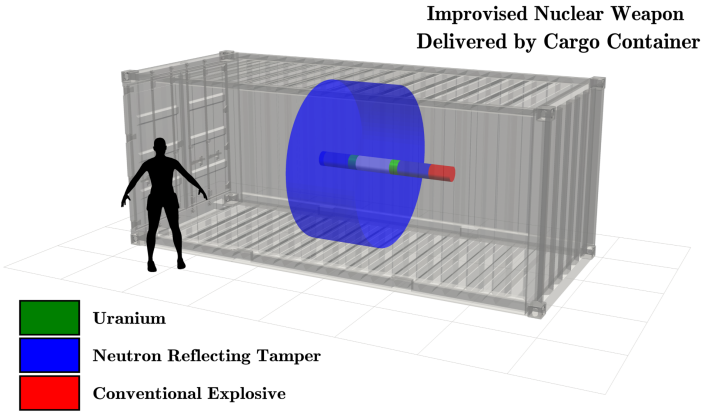
- Pakistan is known to have around 170 nuclear warheads
- It has a relatively new nuclear safeguard and command system
- Taliban and al-Qaeda forces have a formidable presence
- Concerns with regards to stability: eg. Pakistani leaders have been frequent assassination targets
- The infamous (A.Q. Khan) black market originated in Pakistan

Building a Bomb

Most likely scenario: gun-type bomb with illicitly acquired HEU.

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



Schematic of a gun-type nuclear weapon housed in a cargo container, source Improvised Nuclear Weapons with 60%-Enriched Uranium
(Caplan, Razavimaleki 2025, Bulletin of the Atomic Scientist, July, 2025).

Building a Bomb

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

Terrorists would have to acquire already made HEU.

There is enough HEU in worldwide stockpiles to make ~ 19,600 Hiroshima-type 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, Iran, and many countries with civilian reactor facilities.

Building a Bomb

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.

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

There is enough plutonium worldwide to make ~ 93,270 Nagasaki-type 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.

Building a Bomb

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 (most difficult for Pu) —

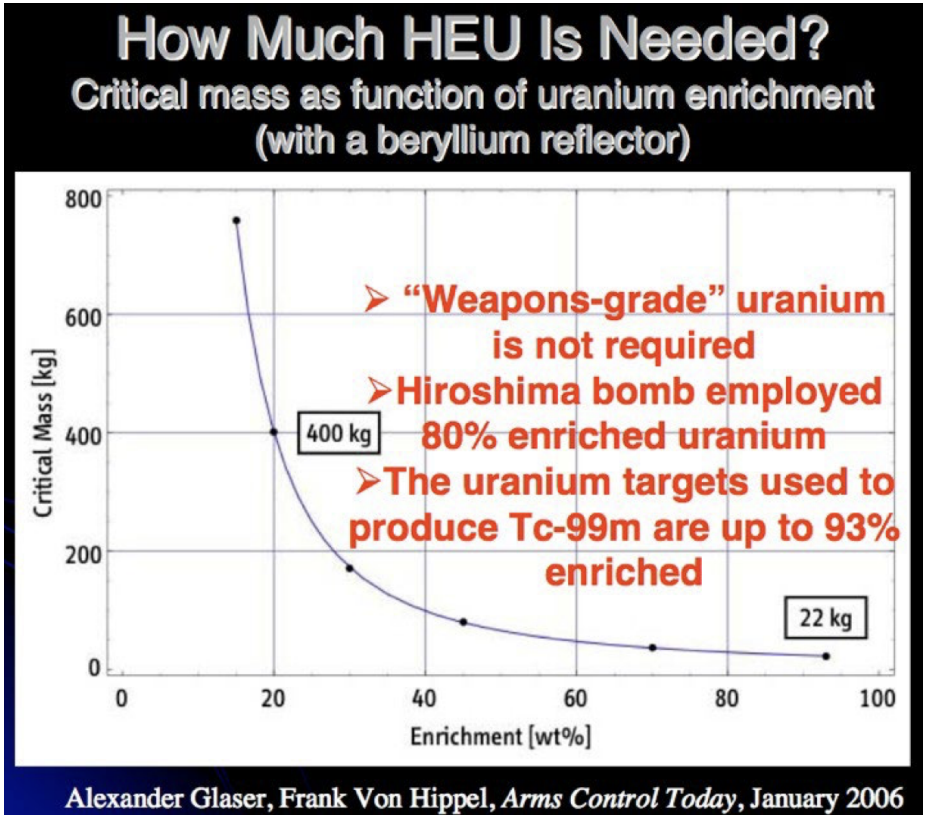
- Designing high explosive lenses
- Machining and assembling precision parts
- Triggering the implosion
- Handling of radiation/toxicity hazards

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

The Problem of Dual-Use of HEU

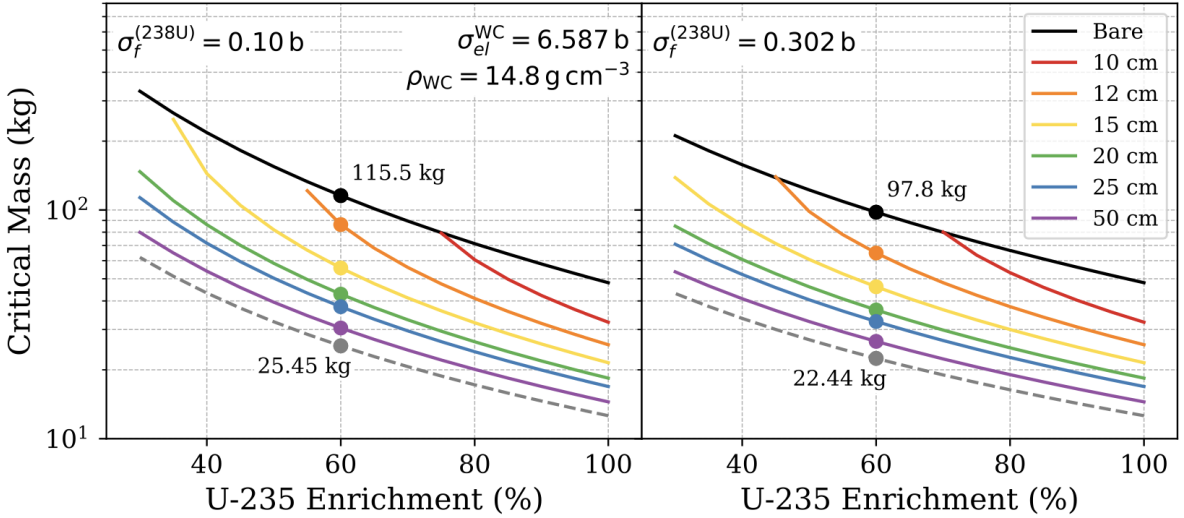


HEU is also used in civilian applications: research reactors, medical isotope production.

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

The Problem of Dual-Use of HEU

Weapons-grade uranium (90% U-235) is not required to build a bomb.



Critical mass vs. U-235 enrichment dependence on WC tamper outer radius, source Improvised Nuclear Weapons with 60%-Enriched Uranium (Caplan 2025, https://arxiv.org/pdf/2507.20390)

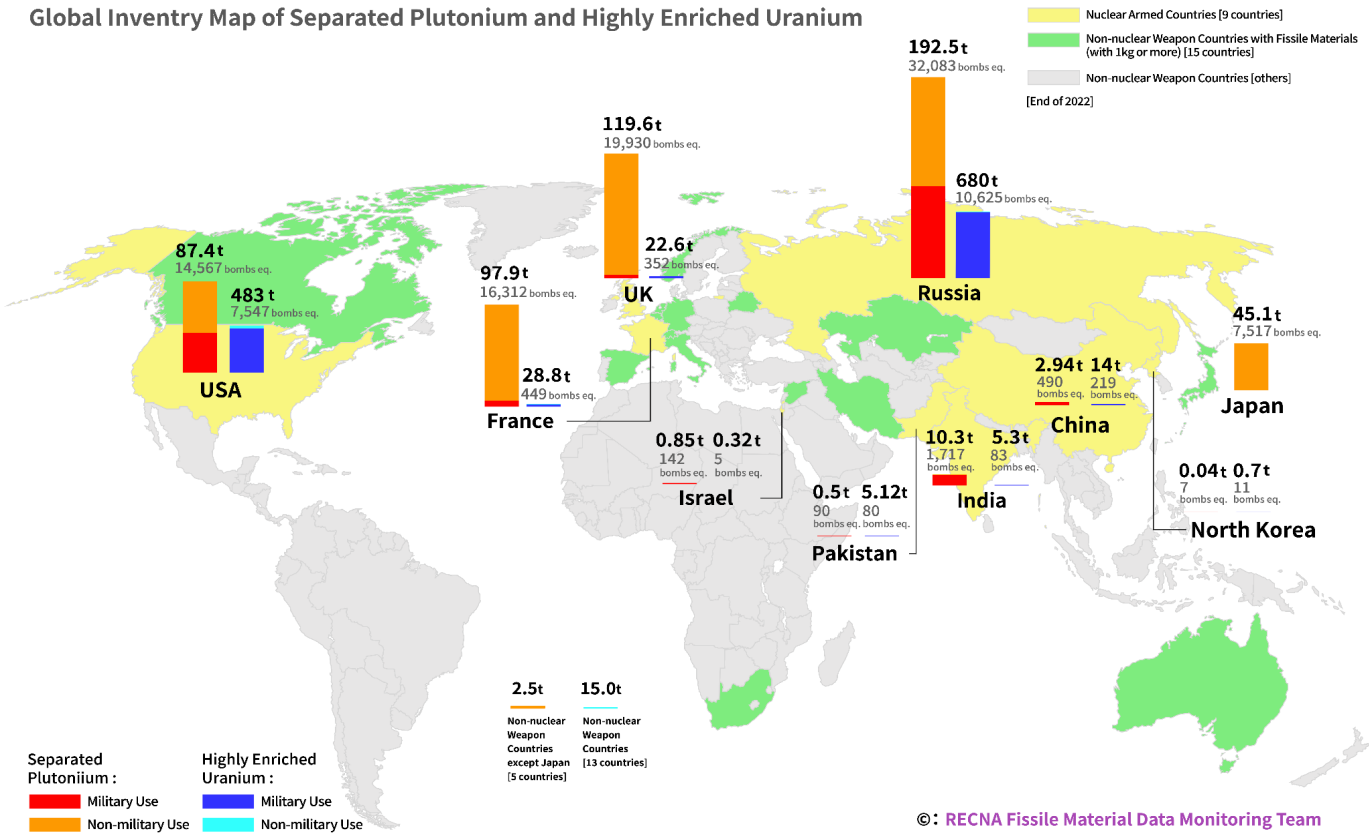
Availability of Uranium from “Atoms for Peace”

- During the 1950s and 1960s, the US Atoms for Peace program and the corresponding Soviet program constructed hundreds of research reactors, including reactors for export to more than 40 countries. Find research reactor image

- 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.

Remnants of “Atoms for Peace”



Nuclear Weapon Materials in Former Soviet Union in the 1990s

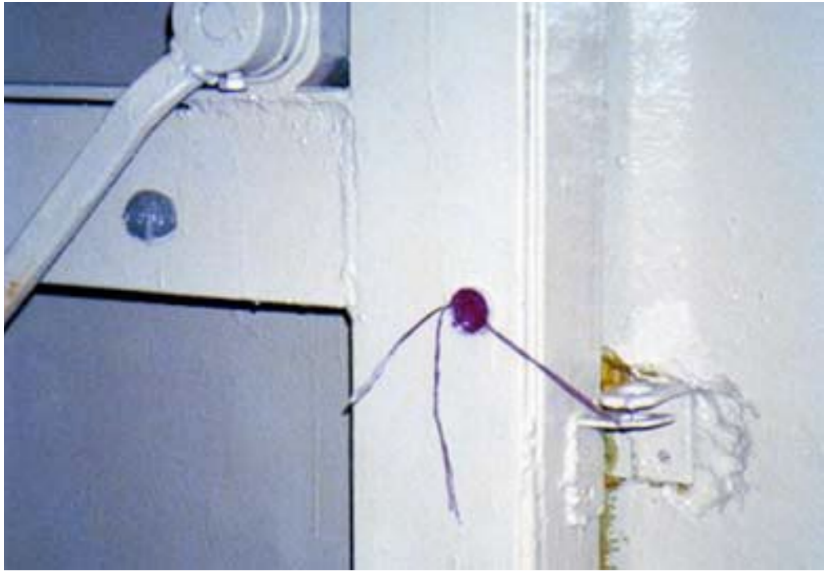
Further reading: Innovations: Technology Governance, Globalization, *Cooperation to Secure Nuclear Stockpiles*, 2006.

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.

Nuclear Weapon Materials in 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.



Nuclear Weapon Materials in Former Soviet Union in the 1990s

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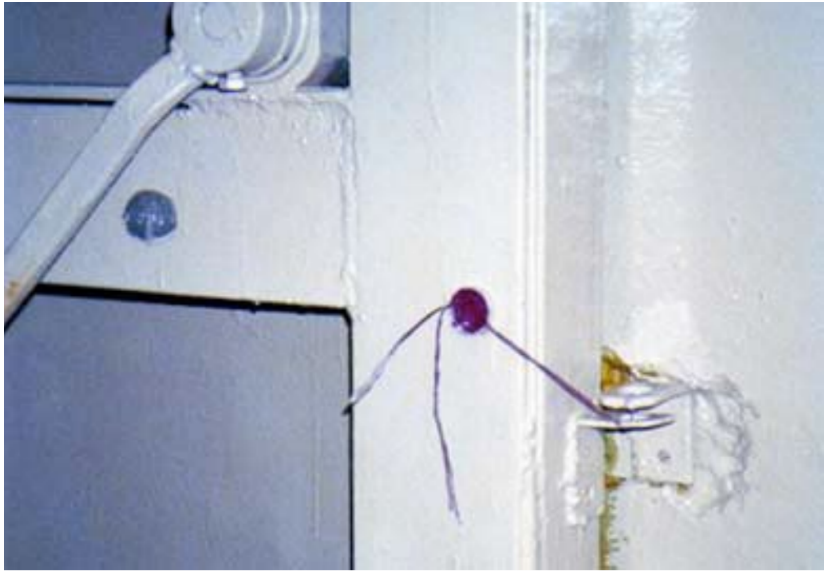


The situation in Former Soviet Republics triggered intense efforts to collect and secure nuclear materials. Example, the Global Threat Reduction Initiative (GTRI), collects Pu, HEU and converts civilian HEU reactors to LEU.

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

Video Presentation

Video Presentation: Last Best Chance

Physics/Global Studies 280: Session 13

Plan for This Session

Module 4 Cont'd: Nuclear Terrorism

News

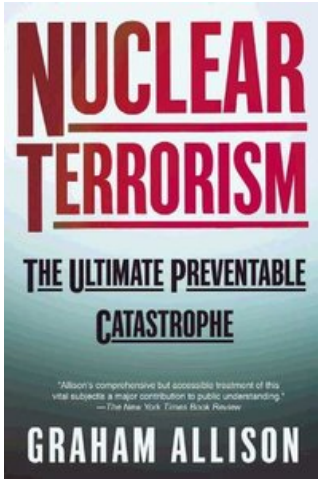
What We Need To Do

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



What We Need To Do

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.

What We Need To Do

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.

What We Need To Do

3. No New Nuclear Weapon 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.

Graham Allison 13 Years Later

On May 18, 2018, Graham Allison published an article *Nuclear Terrorism: Did We Beat the Odds or Change Them?* reflecting on the state of affairs thirteen years after his book *Nuclear Terrorism: the Ultimate Preventable Catastrophe* was published.

In the article, he stands by his estimation that the odds of a nuclear terrorist attack in the next decade are greater than even and extends this assessment to the future.

He contends that certain actions taken over the prior thirteen years did in fact decrease the risk of nuclear terrorism. However, other events have contributed to an increase in the risk of nuclear terrorism.

Based on his assessment, Allison outlines suggested actions to decrease the risk for the future.

Graham Allison 13 Years Later

Factors and Actions That Have Reduced the Risk of Nuclear Terrorism

- Relentless US–led campaign to destroy terrorists who sought to attack the US.
- Development of defenses against terrorism to include the standup of fusion centers within the FBI and the new DHS, and improvements to the TSA and border security.
- Multi-billion dollar increase in funding for intelligence groups targeting terrorism.
- Heightened public awareness of terrorist threat.
- US–Russian nuclear security cooperation.
- US–led Nuclear Security Summit process that created action-forcing deadlines.
- Complete removal of nuclear-weapons usable material from over a dozen countries
- More than 50 civilian research reactors shut down or converted from highly enriched uranium to low enriched uranium.
- Iran nuclear deal that halted Iran's nuclear advance.

Graham Allison 13 Years Later

Factors and Actions That Have Increased the Risk of Nuclear Terrorism

- Inexorable advance of science and technology, diffusion of nuclear know-how.
- North Korea's growing nuclear stockpile, seen as a validation for rogue states that nukes = security.
- Metastasis of terrorists: AQ → ISIL → Affiliates →?
- US airstrikes and special forces raids in seven Muslim-majority countries.
- Pakistan's growing nuclear arsenal and development of tactical nukes.
- Collapse of US–Russia nuclear security cooperation after Russia's invasion of Crimea in 2014.
- Erosion of confidence in the nonproliferation regime.
- Potential for large-scale reprocessing of plutonium in China and Japan.
- Growing possibility that the Trump Administration will let Iran escape the constraints on its nuclear ambitions.

Intercepting Nuclear Weapons and Materials

Terrorist organizations known to have sought nuclear weapons or weapon materials:

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

Border Security

- Over 30 million shipping containers enter the US each year by seaport, truck, and rail
- Challenge → inspection for fissile materials!

Truck passing through radiation portal monitor at the port of Newark, New Jersey, photo by US Customs and Border Protection

Intercepting Nuclear Weapons and Materials

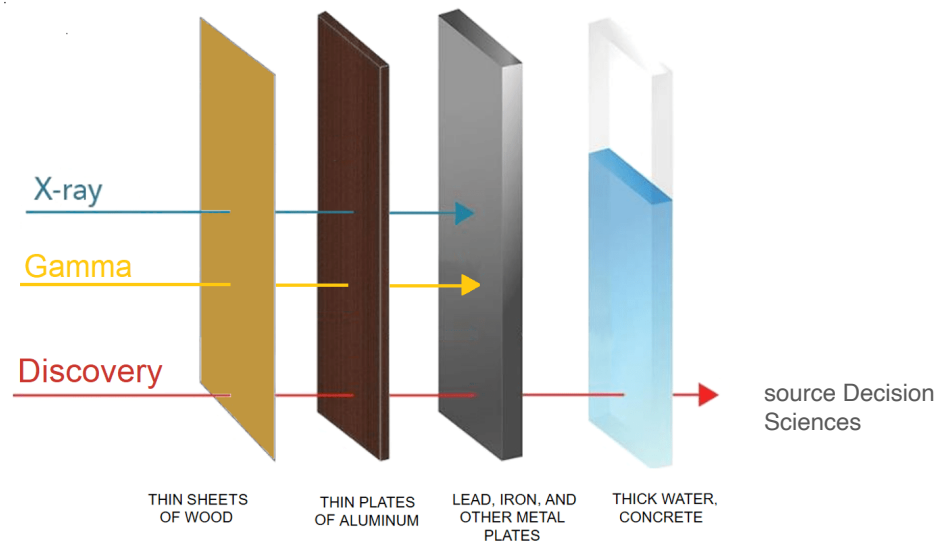
What do ceramics, bananas, and kitty litter have to do with border security?

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

Avoiding False Positives: Passive Muon Tomography

Detect scattering of cosmic ray muons by high-z nuclei in nuclear explosive materials.

- Significantly lowers false positive alarms.
- High average scan time compared to X-Ray and Gamma Ray scans.



Avoiding False Positives: Passive Muon Tomography

Technology pioneered by Los Alamos National Laboratory and commercialized by Dr. Mike Sossong (UIUC nuclear physics alum) at Decision Sciences in San Diego, winning the 2011 Columbus Scholar Award of the Homeland Security Department.

Artist rendering of truck passing through Decision Sciences Discovery portal, source Decision Sciences

Nuclear Forensics

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

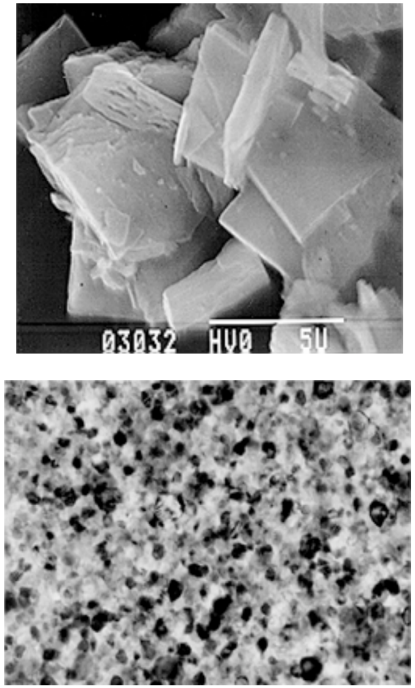
Nuclear forensic capabilities in the US are coordinated between the NNSA's Office of Nuclear Forensics and several DOD (now Department of War) and DHS offices.
DOE forensics R&D has been consistently funded between 37 and 45 million USD annually over at least the last five years.

How nuclear forensics supports criminal prosecution and a national nuclear security regime, source International Atomic Energy Agency

Nuclear Forensic Techniques

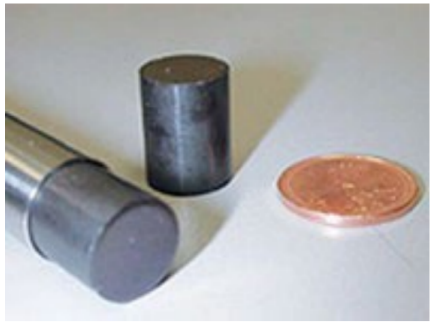
Electron Microscopy

- 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.



SEM (top) vs. TEM (bottom) images of material flakes, source Analyst, 2005: 130

Nuclear Forensic Techniques



Fuel pellet, source 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 height, radius, and type of hole (if present), are specific to certain types of reactors.

Nuclear Forensic Techniques

Spectroscopy

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

- Impurity composition reveals the production process and previous geolocation

Nuclear Forensic Techniques

Age

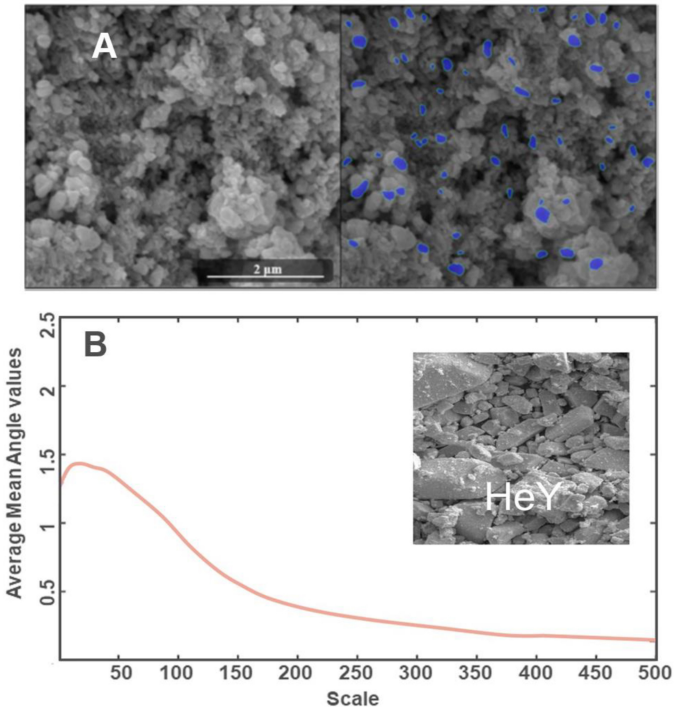
- As a radiological sample gets “older,” the parent isotope disintegrates and its daughter nuclides accumulate.
- Knowledge of the age helps identify when the material was produced

$^{18}O/^{16}O$ 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, former geolocation can be identified.

Nuclear Forensic Techniques

- Recent trends have moved towards micro-analysis
  - Fast, non-invasive techniques for identifying elemental impurities such as laser-induced breakdown spectroscopy (LIBS) in the field precipitates full lab workflows
  - Minor constituent isotopic composition analysis for clues on starting material or processing location
- Incorporation of machine learning/statistical toolchains
  - Morphology
  - SEM image analysis
  - Signature identification
- Evaluation of advanced reactor signatures

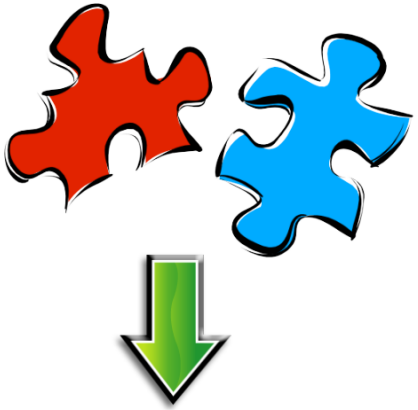


Example SEM images used for powders morphology analysis, source TrAC Trends in Analytical Chemistry 2022

Nuclear Forensic Techniques

- By using the techniques and analysis methods of nuclear forensics, one can create a “nuclear fingerprint” of the material.

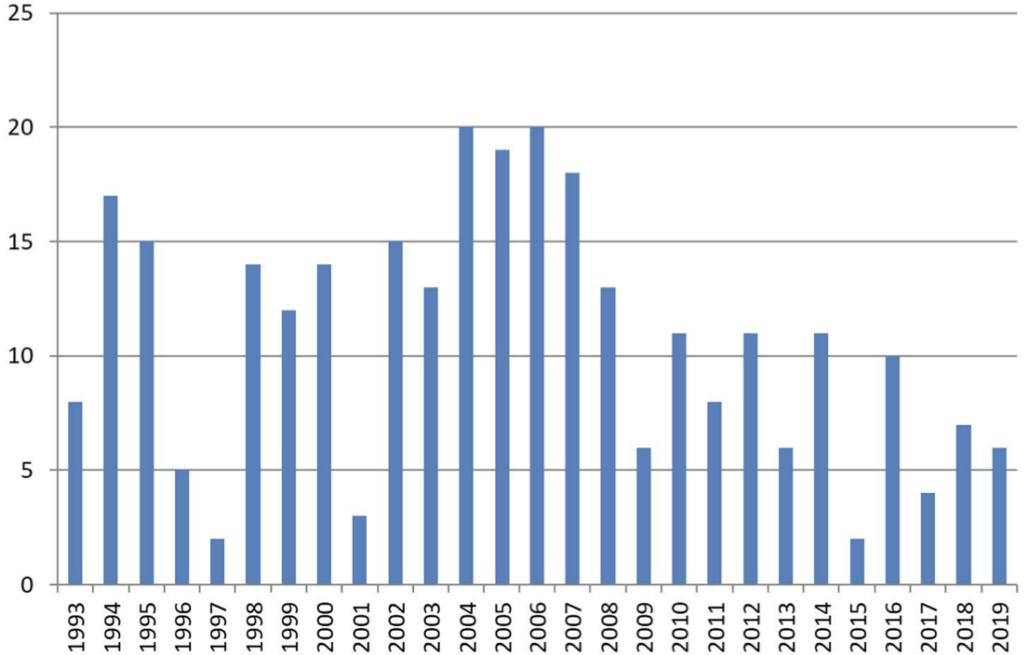
- Information, such as material type, reactor type, production plant, production date, enrichment process, intended use, and geolocation, are pieces of the puzzle that must be solved to form a larger historical picture of the radiological evidence.



Incidents of Illicit Trafficking in Nuclear and Radioactive Material

Group I

Incidents related to trafficking or malicious use, 1993-2019

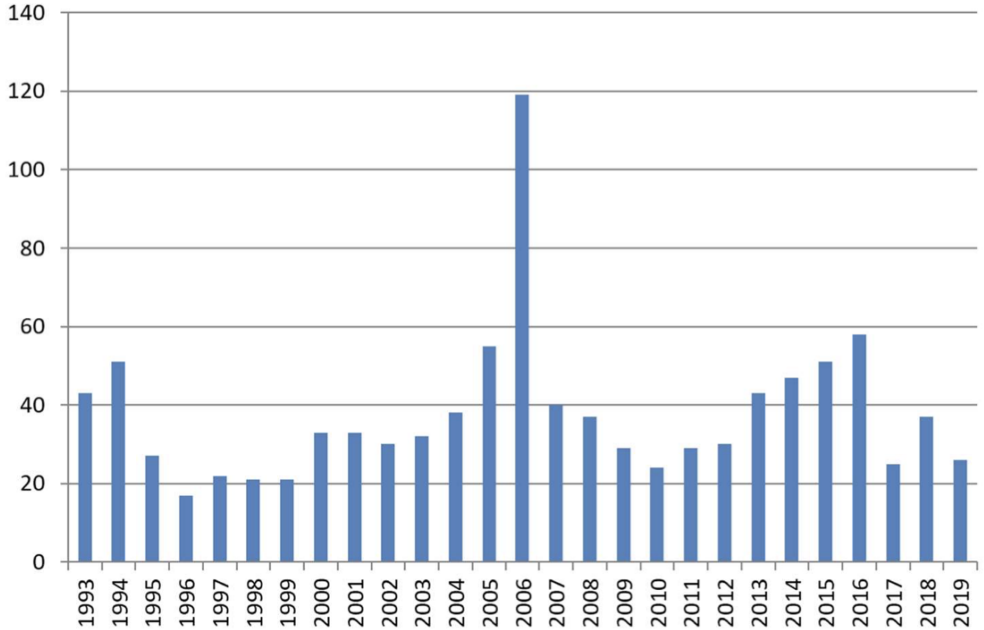


source International Atomic Energy Agency

Incidents of Illicit Trafficking in Nuclear and Radioactive Material

Group II

Confirmed incidents where it cannot be determined if they are related to Trafficking or Malicious Use, 1993-2019

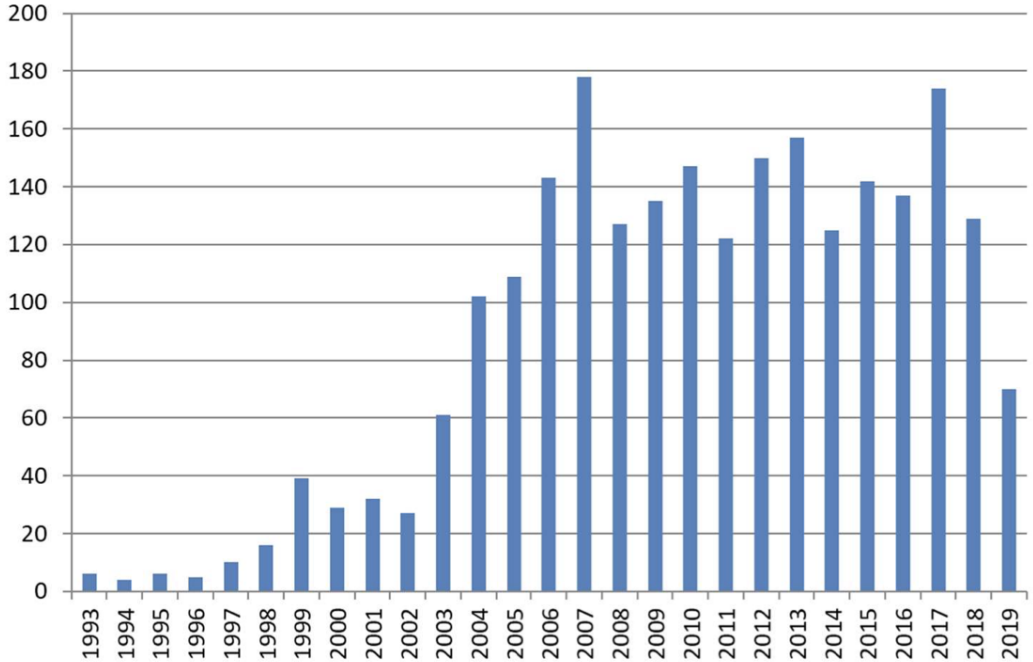


source International Atomic Energy Agency

Incidents of Illicit Trafficking in Nuclear and Radioactive Material

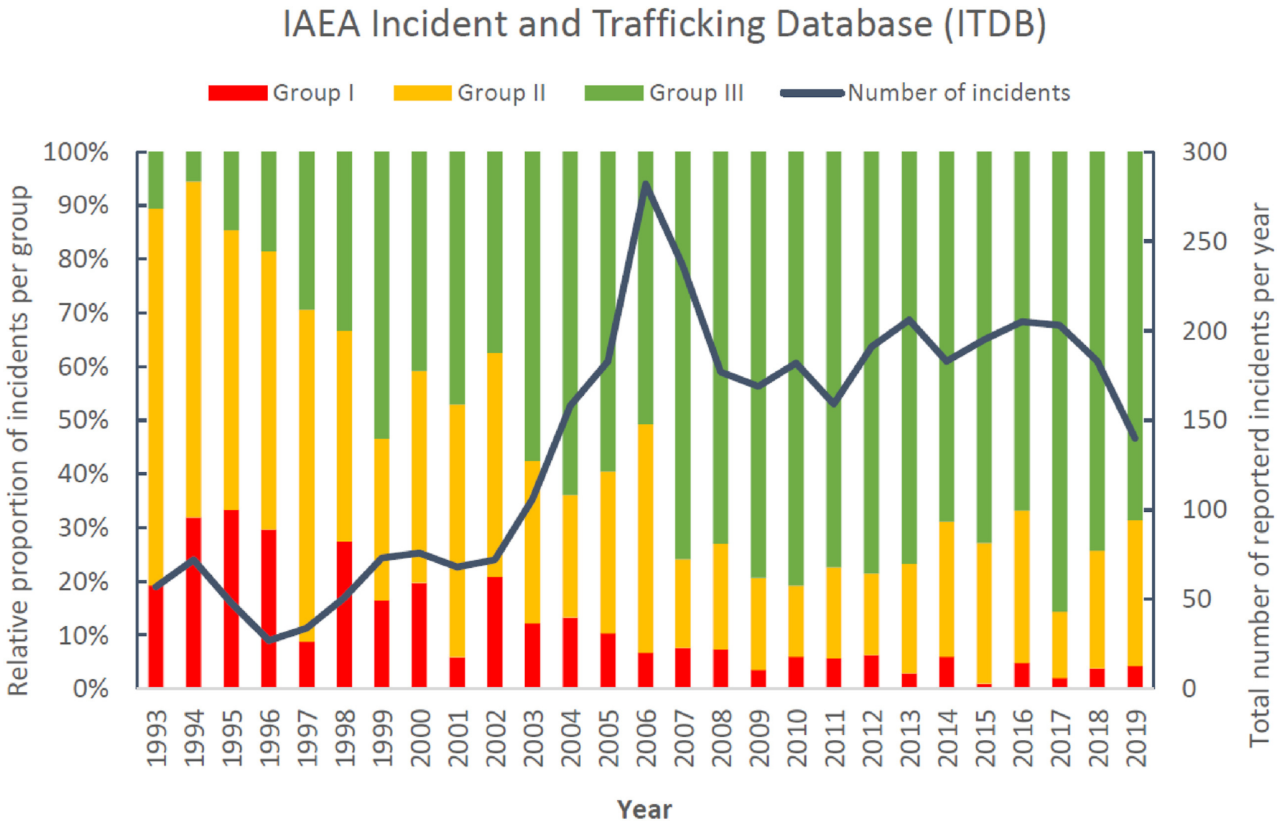
Group III

Incidents not connected to Trafficking or Malicious Use, 1993-2019



source International Atomic Energy Agency

Incidents of Illicit Trafficking in Nuclear and Radioactive Material



Number of incidents of nuclear and other radioactive material out of regulatory control reported to the ITDB. Data extracted from IAEA. Group I: Trafficking or malicious use, Group II: Undetermined intent, Group III: Not connected with trafficking or malicious use, source TrAC Trends in Analytical Chemistry 2022

(Old News)

THE NEW YORK TIMES **OP-ED** THURSDAY, OCTOBER 24, 1991

A Grand Uranium Bargain

By Thomas L. Neff

CAMBRIDGE, Mass. The Soviet Government is struggling to transform itself economically and politically while maintaining control of more than 24,000 nuclear weapons in the newly independent republics. Mikhail Gorbachev has pledged to dismantle thousands of them, but the bankrupt Government may not be able to pay for doing so in ways that prevent misuse or wider proliferation. There is, however, a way to pay for disarmament that also provides economic motivation to the republics and the central Government.

The warheads contain substantial amounts of valuable material that can be processed for use in commercial nuclear power plants. It may be advantageous for the U.S. to buy or barter for such materials and turn them safely to commercial use. This can be done in ways that protect Western and Soviet commercial and security interests.

Dr. Thomas Neff from the Center of International Studies at Harvard proposed for the US to buy Soviet area weapons material diluted from HEU to LEU at market prices for use in US nuclear power reactors. See Neff's Op-Ed in the NY-Times of 10-24-1991.

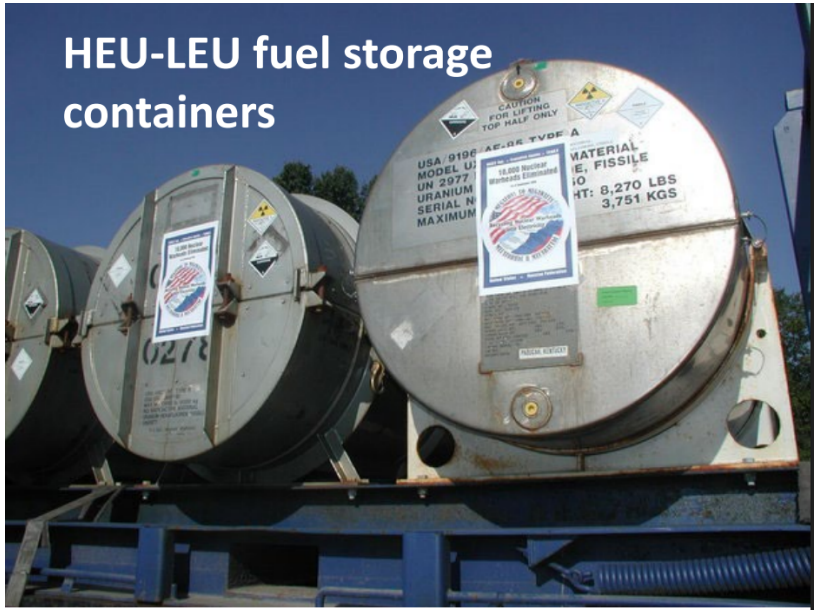
- funds Soviet effort to control > 24,000 nuclear weapons in the newly independent republics.
- stabilizes western market for LEU reactor fuel.
- prevents HEU from Soviet stocks to be deviated into black market channels.
- addresses demands from non-nuclear weapons states in the NPT that superpowers reduce arsenals!
- commercial value of 500 tons of HEU in 1991 is about $5 Billion.

The Highly Enriched Uranium Purchase Agreement → Megatons to Megawatts

- October-24 1991 — Neff's proposal as Op-Ed in the NY-Times
- August-28 1992 — US-Russian negotiations in Moscow start
- August-31 1992 — President George W. Bush announces agreement
- February-18 1993 — 20 year US-Russian agreement signed by President Bill Clinton
- January-14 1994 — Commercial contract between United States Enrichment Corporation (USEC) and Techsnabexport (TENEX) a commercial subsidiary Russia's Ministry for Atomic Energy signed: HEU-LEU contract.
- 1994 to 2013 — 500 tons of former Soviet weapons HEU diluted to LEU and used as fuel in US civilian nuclear reactors produced up to 10% of US electricity needs.

The Highly Enriched Uranium Purchase Agreement → Megatons to Megawatts

- largest scale non-proliferation effort to date.
- prevented HEU from Soviet stocks to be deviated into black market channels.
- partially addressed demands from non-nuclear weapons states in the NPT that superpowers reduce arsenals.
- bi-partisan support in the US across Bush-Clinton-Bush-Obama administrations.



Securing Vulnerable Nuclear Materials

2004 NNSA establishes Global Threat Reduction Initiative (GTRI)

- Identify, secure, remove and/or facilitate 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

- 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 disposition of excess nuclear and radiological materials.
- Protect: Protect high priority nuclear and radiological materials from theft.

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.

GTRI Removals 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.

GTRI Protections 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.

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 Ukraine.

South Africa

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

President Obama meets with Ukrainian President Viktor Yanukovych, source politico

An On-going and Challenging Process…

Belarus

Belarus had 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 88.7 kilograms of HEU were transported.

Belarus suspended the agreement in August 2011 following US sanctions imposed in response to President Alexandr Lukashenko's suppression of political opposition.

Alexandr Lukashenko wearing the uniform of the commander-in-chief of the Belarusian Armed Forces 2001, source kremlin.ru

After GTRI 2015-present

- In 2015, GTRI was folded into NNSA's Office of Material Management and Minimization (M3).
  - 2017: Ghana's GHARR-1 Miniature Neutron Source Reactor was converted to LEU fuel, and all HEU was removed from Ghana.
  - 2023: Kazakhstan commenced operation of its IVG.1M reactor after its successful conversion to LEU fuel.
  - 2023: Completion of conversion away from HEU targets in world Mo-99 supply chain.

- As of 2023, a substitute fuel has been identified for Technical University of Munich's FRM II neutron source, greenlighting path to LEU conversion.

Current Status

- Funding for M3 continues as of FY2025 via the Defense Nuclear Nonproliferation appropriation.
- On May 23, 2025, Trump executive order (Reinvigorating the Nuclear Industrial Base) halted the surplus plutonium "dilute-and-dispose" program (except for South Carolina legal obligations) and directed DOE to establish a program to make surplus plutonium available for advanced-reactor fuel.

Video: Israel, Iran, and secret nukes—Why a diplomatic solution in Iran is the best option

By Erik English | Nuclear Risk

With Khamenei dead, Crown Prince Pahlavi could be Iran's next leader. What would it mean for nuclear security?

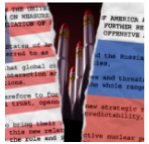
By Vesal Razavimaleki, Matt Caplan | Nuclear Risk

Israel and the US strike Iran. It is a tragedy of Tehran's own making

By Nicole Grajewski | Nuclear Risk

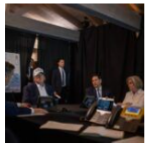
Trump's war on Iran: grave dangers and, at best, limited benefits

By Matthew Bunn | Nuclear Risk



The experts comment: New START expires, bringing both risks and opportunities

By François Diaz-Maurin | Nuclear Weapons



President Trump just started a dangerous, pointless war against Iran

By Joe Cirincione | Nuclear Risk

Anthropic's showdown with the US Department of War may literally mean life or death—for all of us

By Gary Marcus | Artificial Intelligence

With Khamenei dead, Crown Prince Pahlavi could be Iran's next leader. What would it mean for nuclear security?

The Third Wave

Islamist Terrorism in the Nuclear Context

Ayman Al-Zawahiri and Osama bin Laden on a card advertising rewards up to $25,000,000 “for information leading to the whereabouts or capture of these two men.” source CIA via psywarrior.com

What is the Third Wave?

Islamist Terrorism: 1980-present

Left: Hassan al-Banna

Right: Sayyid Qutb

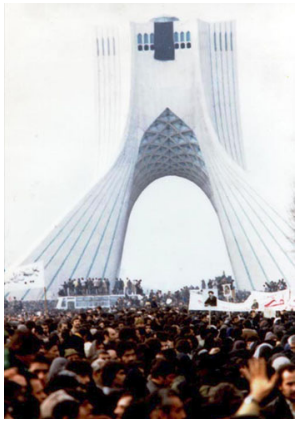
- Regional jihad scope
  - E.g., Hamas and Hezbollah
- Global jihad scope
  - E.g, Al Qaeda and ISIS

- Influenced by Salafism
  - A revivalist movement seeking to return to the practices of the first three generations of Muslims in the 6th to the 9th centuries
  - Often associated with Wahhabism, founded by Muhammad ibn Abd al-Wahab (1703-1792) who forged a pact with Muhammad bin Saud to form the first Saudi state

- Salafism gained traction in the twentieth century due largely to such individuals as:
  - Hassan al-Banna (1906-1949) founded the Muslim Brotherhood in Egypt in 1928
  - Sayyid Qutb (1906-1966), an Egyptian educator and administrator who wrote fundamental works on Islam, has been called "the godfather of modern revolutionary Islam."

What is the Third Wave?

- Catalyzed by three major events:
  - The 1979 Islamic Revolution in Iran that overthrew the Shah, replaced the government with an Islamic Republic, which then became a major supporter of terrorism outside Iran.
  - The 1979 Soviet Invasion of Afghanistan that drew in jihadists from around the Muslim world. This invasion sparked the Soviet-Afghan War that ended in 1989.
    The Taliban and al-Qaeda arose from that conflict.
  - The 1982 Israeli Invasion of Lebanon. Hezbollah, supported by Iran, took form as a resistance to the "Israeli occupation." The Israelis expected another quick victory, but were mired in South Lebanon until 2000.



Ashura procession in Tehran's Shahyad (later renamed Azadi) Square during the 1979 Revolution

Afghan fighters in the Soviet-Afghan War, source Edwin Lux private collection

Israeli troops in Southern Lebanon, photo by Michael Zarfati, IDF Spokesperson's Unit

The Taliban: Origins

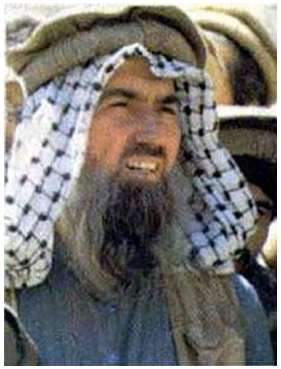
- After the Soviet Union invaded Afghanistan in 1979, Islamic mujahideen waged war against the Soviet forces.
- Subsequently, the CIA and the Saudi Arabian General Intelligence Directorate (GID) funnelled funding and equipment through the Pakistani Inter-Services Intelligence Agency (ISI) to the Afghan mujahideen.
- About 90,000 Afghans were trained by Pakistan's ISI during the 1980s.
- After the fall of the Soviet-backed regime, three mujahideen factions refused to participate in the transitional government and launched attacks to bid power aided respectively by Pakistani ISI, the Islamic Republic of Iran, and Saudi Arabia.
- The Taliban emerged during this Afghan Civil War, ruling Afghanistan from 1996 until the 2001 US-led invasion and again taking over after the 2021 US-withdrawal.

Left: Mullah Omar, founder and leader of the Taliban from 1994 to 2013, photo by Khalid Hadi

Right: Afghan fighters in the Soviet-Afghan War, source Edwin Lux private collection

Al Qaeda: Origins

- The Soviet-Afghan War drew jihadists from the Arab world to aid the Afghan Mujahideen in their fight against the Soviet Union.
- Among these Afghan Arabs were Osama bin Laden, Abdullah Yusuf Azzam, and Ayman al-Zawahiri.
- In the aftermath of the war, those three individuals and several other formed Al Qaeda after a series of meetings in Peshawar, Pakistan.
- At odds with the Saudi government over their seeking US assistance after Saddam Hussein's invasion of Kuwait, Bin Laden and Al Qaeda were ousted from Saudi Arabia in 1991, eventually settling in Afghanistan, under Taliban protection.
- In 1996 and 1998, Bin Laden authored two fatawa declaring war on the United States.
- These fatawa were followed by an increase in Al Qaeda attacks/bombings leading up to the 9/11 attacks.



Left: Abdullah Yusuf Azzam, Palestinian-Jordanian jihadist and mentor to Osama bin Laden, image author unknown

Right: Osama bin Laden and Ayman al-Zawahiri during a 2001 interview, source Hamid Mir

Pakistan, the Taliban, and Al Qaeda

- ISI-Taliban links: Pakistan's ISI trained Afghan mujahideen during the Soviet-Afghan War then supported the Afghan Taliban for "strategic depth."
- US officials have cited the Haqqani Network, mercenary group closely affiliated with the Taliban, as having close ties to the Pakistani military (denied by Pakistan).
- After the 2001 US invasion of Afghanistan, Taliban leadership operated from Pakistani territory, despite simultaneous domestic Pakistani entanglements with Tehrik-e-Taliban (TTP, Pakistani Taliban).
- Recent US and UNSC intelligence judges Taliban-al-Qaeda ties remain strong and symbiotic.
- Ayman al-Zawahiri's 2022 presence in Kabul underscored ongoing links.

Top: Pakistani ISI Seal

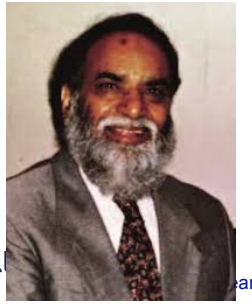
Bottom: Jalaluddin Haqqani, founder and leader of the Haqqani Network from the 1970s until his death in 2018, photo by Mohammad Riaz

Pakistan, the Taliban, and Al Qaeda

- Pakistan's arsenal is managed via the National Command Authority (NCA)
  - Risk of extremist infiltration remains of high concern

- Two Pakistani nuclear scientists, Sultan Bashiruddin Mahmood and Chaudhry Abdul Majeed, founded Ummah Tameer-e-Nau (UTN)
  - Shared WMD-relevant information with Osama bin Laden and the Taliban
  - US named UTN a Specially Designated Global Terrorist (SDGT)
  - Pakistan (and others) froze UTN assets (December 2001)

- Repeated TTP attacks on sensitive Pakistani bases (e.g., Kamra Air Base, 2012) demonstrate capability and intent, even if nuclear weapons weren't targeted.



Left: Sultan Bashiruddin Mahmood

Right: Prime Minister Imran Khan chairing a 2021 NCA meeting

Further reading: Noor, International Journal of Nuclear Security, *Assessing Nuclear Security Risks in Pakistan*, 2023.

Pakistan, the Taliban, and Al Qaeda

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What would happen in the event of large-scale unrest/military strain/state failure?

The A.Q. Khan Nuclear Network

- A global centrifuge and design black market run by Pakistani nuclear scientist Abdul Qadeer (AQ) Khan
  - Exposed in 2003–2004 with Khan's confession in 2004
- The network operated via shell companies set up in Dubai which facilitated shipments.
- In 2003, merchant vessel BBC China was intercepted carrying nuclear centrifuges from Malaysia to Libya, leading to the unraveling of the network.
  - Libya handed over a list of its suppliers identifying Khan and his associates
- Clients of the network
  - Libya: A near turnkey enrichment plant and nuclear weapon blueprints; program rolled back in 2003–2004 IAEA oversight.
  - North Korea: P-1/P-2 centrifuges and technical data instrumental in North Korea's uranium enrichment track.
  - Iran: P-1/P-2 centrifuge designs/components that seeded Iran's enrichment program.

AQ Khan in Islamabad, Pakistan in 2013, photo by BK Bangash/Associated Press

The Islamic Republic of Iran

- 1979 Islamic Revolution topples the Western-friendly Iranian constitutional monarchy and founds an Islamic Republic
  - Constitution based on the Guardianship of the Islamic Jurist, elevating the Supreme Leader above elected bodies, establishing clerical control of government

- Pursues a policy of exporting the Islamic Revolution
  - Islamic Revolutionary Guard Corps (IRGC) created as a parallel military organization tasked specifically with defending the revolution rather than the state
  - Quds Force created as a branch of the IRGC responsible for extraterritorial operations

Top: Khomeini returns to Iran after 14 years of exile, helped off the plane by one of the Air France pilots, source sajed.ir

Left: President Richard Nixon with the Shah of Iran in the Oval Office July 24, 1973, source The Nixon Library

The Islamic Republic of Iran's Proxies

- Referred to by the Islamic Republic as the Axis of Resistance
- Consists of a coalition of militant groups across the Middle East
  - Most notably, Lebanese Hezbollah, the Houthis in Yemen, several militias in Iraq, Hamas, and many smaller Palestinian militias
  - Also includes groups in Afghanistan, Bahrain, and Syria (and until its downfall the Assad regime in Syria)

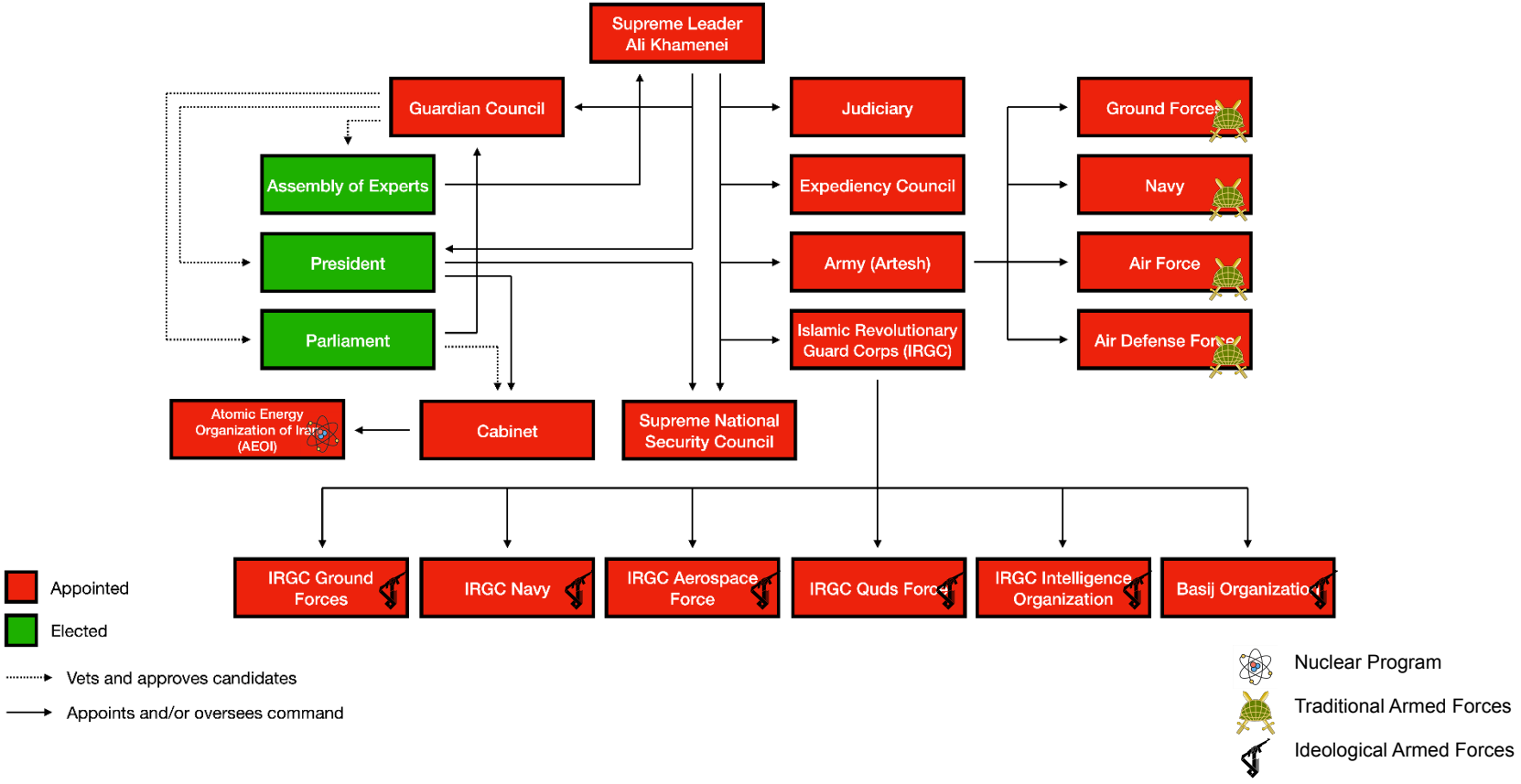
- Financed by the Islamic Republic and trained/resourced by the Quds Force

- Mechanism for hard power projection with a component of plausible deniability

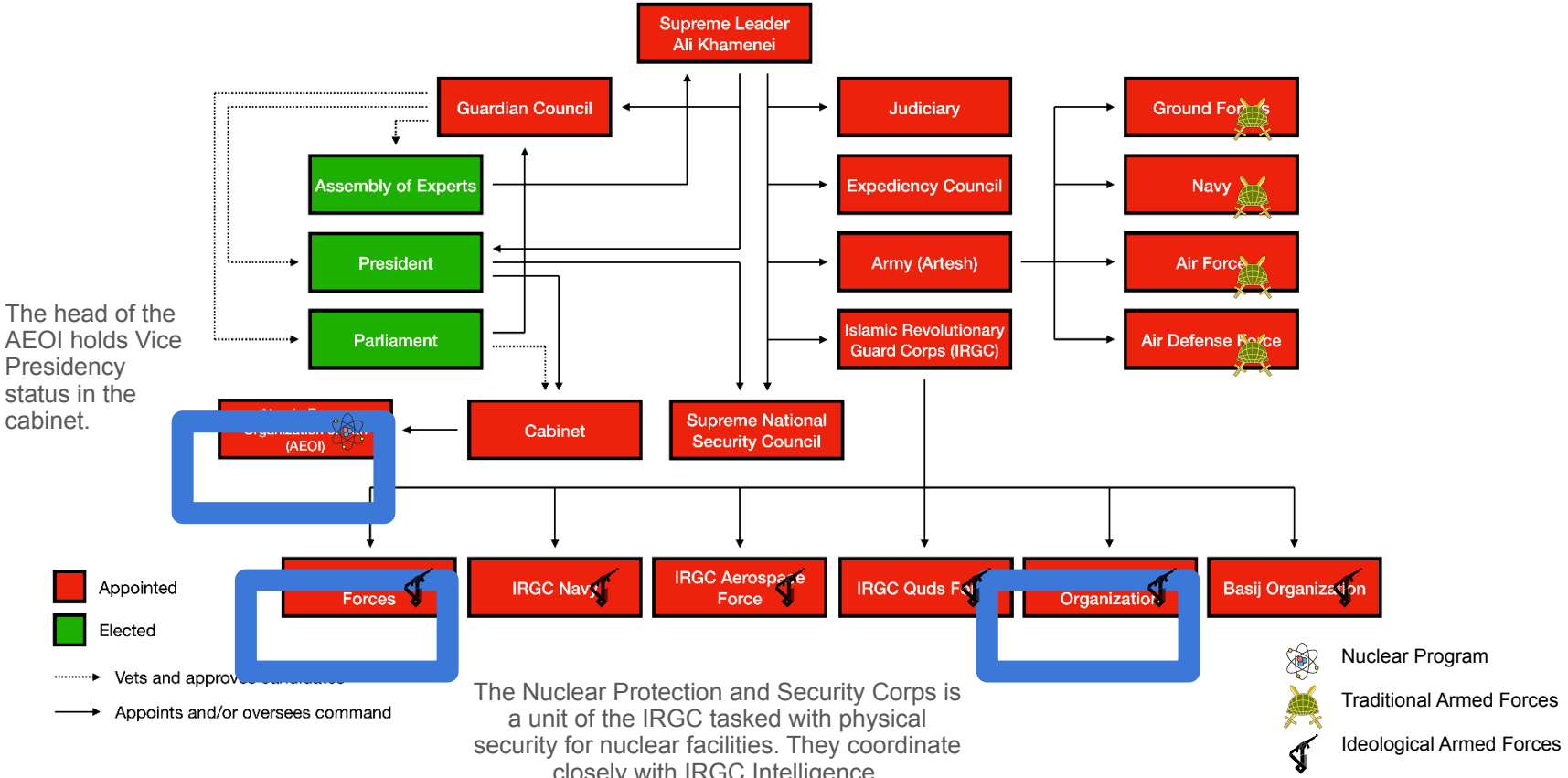
Hassan Nasrallah, Secretary-General of Hezbollah (now deceased), and other Hezbollah leaders conferring with the Islamic Republic's Supreme Leader Ali Khamenei in 2005, source khamenei.ir

Further reading: Congressional Research Service, *Iran: Background and US Policy*, 2024.

Iranian Nuclear Program within the Islamic Republic Bureaucracy



Iranian Nuclear Program within the Islamic Republic Bureaucracy

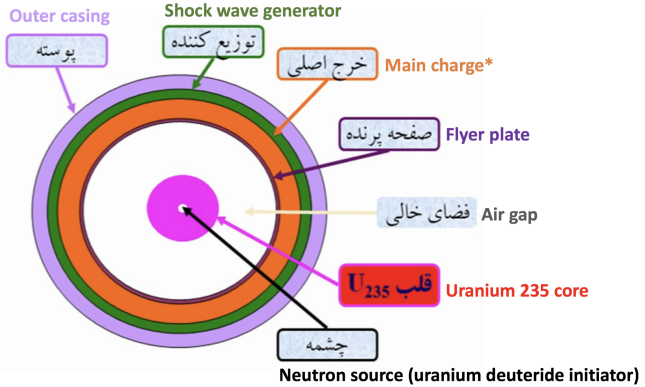


The head of the AEOI holds Vice Presidency status in the cabinet.

The Nuclear Protection and Security Corps is a unit of the IRGC tasked with physical security for nuclear facilities. They coordinate closely with IRGC Intelligence.

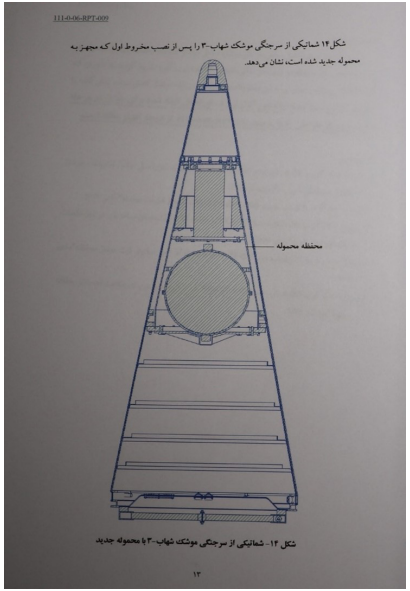
Iranian Nuclear Program

- 2002 exposure of the Amad Plan, a covert and extensive nuclear program
  - Main facilities included:
    - Natanz - major enrichment facility
    - Fordow - secondary enrichment facility
    - Isfahan - uranium conversion facility and fuel manufacturing plant
    - Arak - heavy water reactor under development



Left: Schematic from the Iran Nuclear Archive (with added translations) of Iran's design for a miniaturized nuclear weapon, source Institute for Science and International Security

Right: Schematic from the Nuclear Archive of a Shahab 3 re-entry vehicle with a payload inside, source Institute for Science and International Security



Further reading: Albright and Stricker, Institute for Science and International Security, *Going for the Bomb: Part II*.

Iranian Nuclear Program

- Iran's IR-1 centrifuge design (1990s) was based directly on the Pakistani P-1 centrifuge designs/components received from the AQ Khan Network, and its IR-2 and IR-4 (2009) were based on P-2 designs
- Several new centrifuge designs generated since (most notably the IR-6)
- Demonstrated technical capability to enrich up to 60% U-235

Three Iranian centrifuge designs on display, source Iran Watch

Further reading: Iran Watch, *Iran's Centrifuges*.

Timeline: Where are we now?

- JCPOA (2015)
  - Iran reduced stockpile and capped enrichment in exchange for sanctions relief
- US exits JCPOA (2018)
  - Maximum Pressure: broad US sanctions returned
  - Iran enriches past JCPOA limit to 5% U-235
- Biden years (2021–2024)
  - Sanctions waivers to coax Iran to return to nuclear talks
  - Iran enriches to 60% U-235
  - Talks stalled amid regional crises and IAEA access disputes
- Trump 2.0 (2025)
  - Maximum Pressure restored via new National Security Presidential Memorandum
  - Israel-Iran “12-day War” and US bombing of major Iranian nuclear sites
- UN/EU “snapback” (Sept–Oct 2025)
  - E3 triggered UN sanctions snapback
  - EU reimposed measures (arms, missiles, nuclear activities)
  - Russia/China do not recognize snapback

Nuclear Security Risk Scenarios

- Caplan and Razavimaleki raise concerns about rogue elements
  - Ideologically motivated mid-level technocrats or IRGC divert HEU without approval
  - Coerce or utilize recent military failures to recruit a small number of co-conspirators
  - Covert design and construction of the simplest gun-type, “Little Boy”-like bomb
  - Likelihood increases with lack of IAEA oversight

- Politicians cite the security implications of regime instability/collapse
  - Bureaucratic collapse leads to lack of supervision of existing HEU stocks
    - Economic uncertainty for nuclear stockpile stewards increases nuclear black market risk
  - Ideologically motivated actors obtain unsupervised access to any radioactive material (not just HEU)
  - Opposition elements argue likelihood increases without plan of action in case of regime change

Further reading: Caplan and Razavimaleki, The Bulletin, *Nuclear terrorists wear suits*, 2025.
Singh, The Washington Institute, *Policy Steps to Prevent a Nuclear Iran*, 2025.
Further listening: Iran Prosperity Project, *Security Panel*, 2025.

The Islamic Republic of Iran's Proxies

Does the relationship between the Islamic Republic and its proxies present a unique nuclear terrorism risk?

Top Left: Qasem Soleimani, head of the Quds Force until his death by US airstrike in 2020, source BBC

Top Right: Hezbollah soldiers, source NYT

Bottom Left: Hamas's Ismail Haniyeh meeting with Khamenei, source AP

Bottom Right: Hezbollah leadership meeting with Khamenei, source khamenei.ir