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Reducing the Proliferation Risk of the Civilian Nuclear Fuel Cycle

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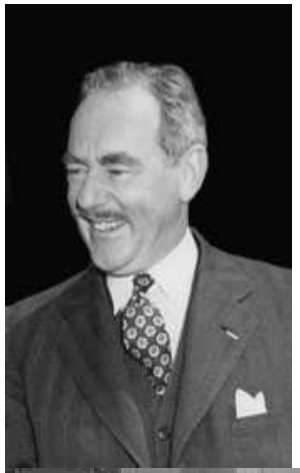
The Nonproliferation Regime and the Civilian Nuclear Fuel Cycle

- **A collection of treaties, conventions, norms, bilateral agreements, and national laws**
  - **Developed over time, in response to particular events, and often in an ad-hoc fashion**
  - **Elements differ in membership, scope, intent, and enforceability**
  - **Some cooperative, some coercive**
    - **Establishing norms, building confidence, verifying commitments, limiting the transfer of technology and material, reducing demand, monitoring and detection, interdiction**
- **Prevent the misuse or diversion of materials or technologies originally intended for the production of nuclear energy**
  - **Many elements linked to supporting the development of nuclear energy**
  - **Aims to both prevent proliferation *and* to reassure others that it has been prevented**
- **Some of the "limitations" of the nonproliferation regime were developed intentionally to balance competing priorities**

Origins of the Regime: International Control of Technology, Facilities, and Activities

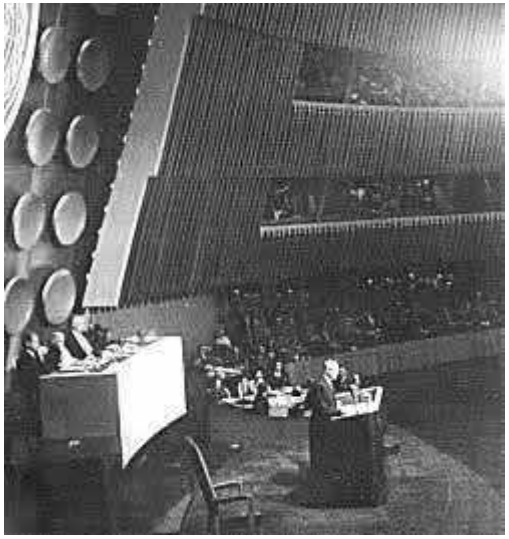
- **Agreed Declaration between U.S., UK and Canada (November 1945)**
  - **Limit information about atomic energy until safeguards against improper use developed**
- ***Report on the International Control of Atomic Energy* (Acheson-Lilienthal Report - March 1946)**
  - **"[A] system of inspection superimposed on *an otherwise uncontrolled exploitation of atomic energy by national governments* will not be an adequate safeguard."**
  - **An effective safeguards system must look to "the promise of man's future well-being as well as to his security"**
  - **Proposed an international agency to conduct all "intrinsically dangerous operations in the nuclear field"**
- **Baruch Plan (June 1946)**
  - **International ownership and control of fuel cycle technologies.**



Dean Acheson and David Lilienthal

Atoms for Peace and the International Atomic Energy Agency: Rules and Verification

- **Speech by U.S. President Dwight D. Eisenhower to the UN General Assembly (December 8, 1953)**
  - Nuclear energy development can occur on a national basis
  - Create an international agency to share material and equipment under safeguards
  - Seeks to create a uranium bank with contributions from U.S. and Soviet Union
  - Facilities and technologies offered in return for political commitment to peaceful use



- **International Atomic Energy Agency (1957)**
  - Promote peaceful uses
  - Authorized to administer safeguards, but only in limited circumstances:
    - IAEA supplies assistance
    - State requests safeguards
    - Requested by parties to a bilateral or multilateral agreement
  - Rights of inspectors to be specifically developed
  - No restrictions on indigenous development

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1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT)

- **All non-nuclear weapons state (NNWS) parties must conclude a comprehensive safeguards agreement (CSA) with the IAEA**
  - **NNWS insisted that safeguards obligations not infringe on NPT Article IV "inalienable right . . . to develop research, production and use of nuclear energy for peaceful purposes"**
  - **Minimize intrusion and protect commercial interests**

Approaches to Reducing Proliferation Risk

Cooperation ⟷ Coercion

- **Establishing Norms**
  - NPT
- **Building confidence**
  - NPT + Safeguards
  - Regional safeguards regimes (e.g., EURATOM)
- **Reducing demand for sensitive materials and technologies**
  - International control of sensitive technologies and materials
  - Security guarantees
  - Disarmament and arms control
- **Verifying activities and declarations**
  - NPT + Safeguards
  - Regional safeguards regimes (e.g., EURATOM)
  - Bilateral treaties
- **Restricting access to technology and material**
  - International control of sensitive technologies and materials
  - Proliferation resistant fuel cycles
- **Monitoring and Detection**
  - Bilateral treaties
  - National technical means

Focus on Key Elements

- Safeguards
- Multilateral approaches
- Material and technology restrictions
- Proliferation resistant technologies
- Addressing the causes of proliferation

Safeguards

- **Build confidence**
  - States accepting limitations on activities
- **Verify activities**
  - External review to ensure no misuse

International Nuclear Safeguards

Objective:

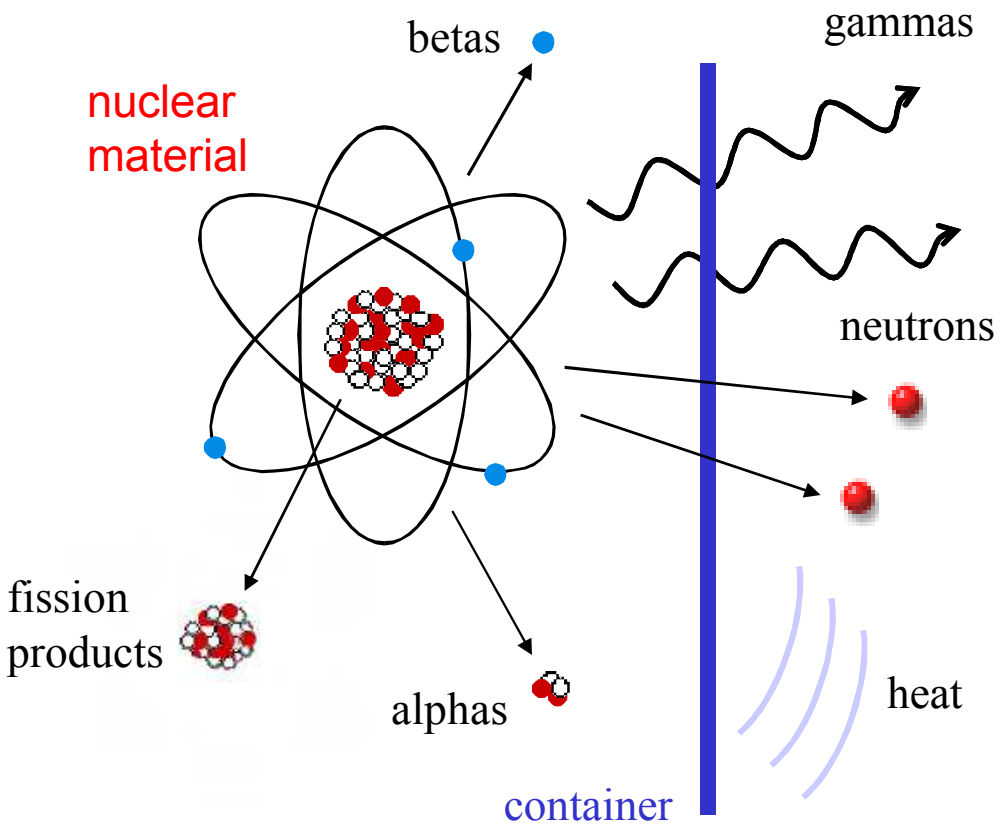
"…the timely detection of diversion of significant quantities
of nuclear material
from peaceful nuclear activities
to the manufacture of nuclear weapons
or of other nuclear explosive devices
or for purposes unknown,
and deterrence of such diversion by risk of early detection."

IAEA Information Circular (INFCIRC)153, paragraph 28

Traditional Safeguards

- **Ensure that nuclear materials are present and used as intended.**
  - State declares nuclear materials and facilities
  - Independent inspections periodically verify the correctness of the declaration:
    - confirm facility design information
    - examine operator records & reports
    - identify & count items
    - assay nuclear materials
  - Containment and surveillance measures ensure "Continuity of Knowledge": i.e., that no changes occur between inspections
    - seals
    - video cameras

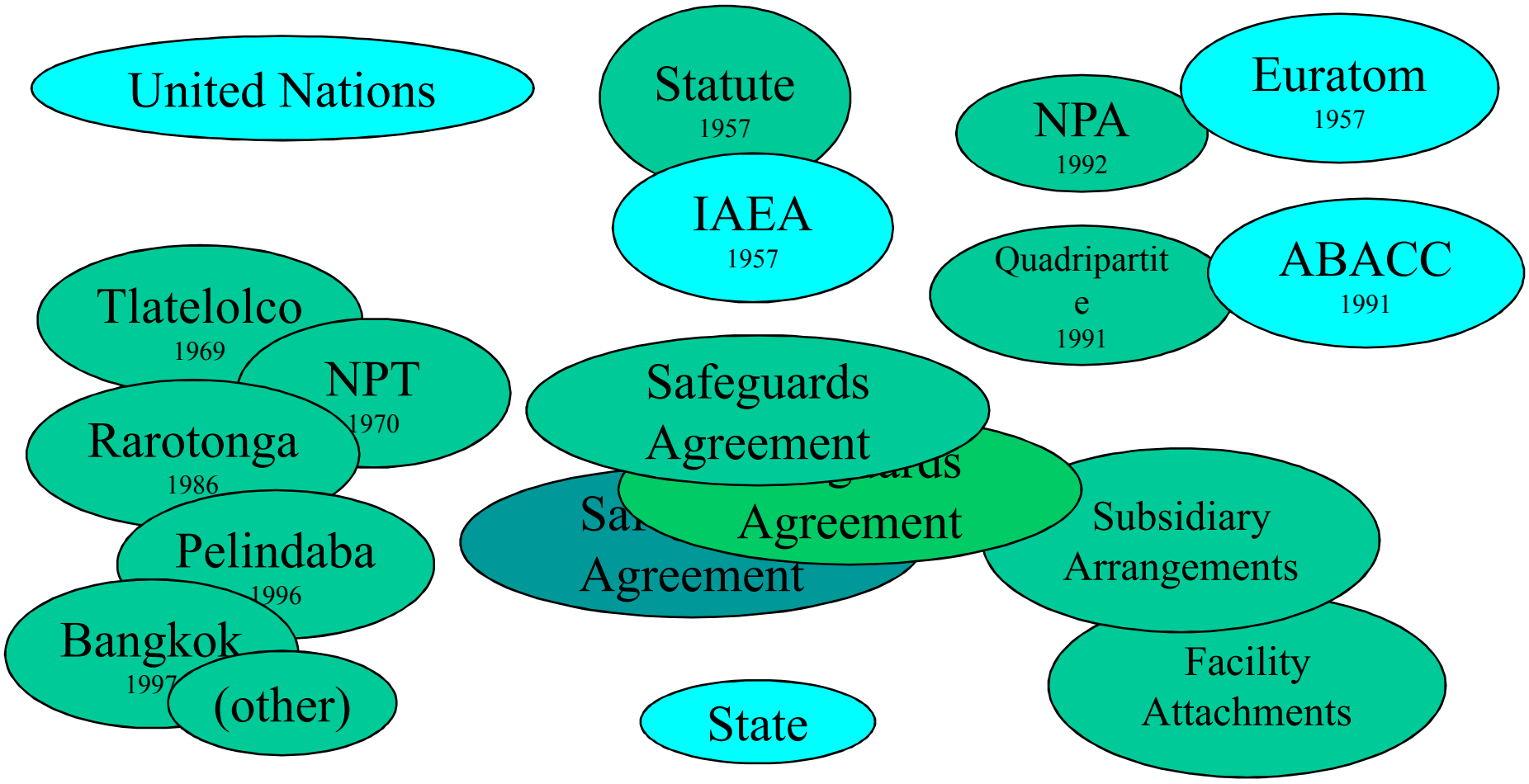
Nuclear materials emit penetrating neutron and/or gamma radiation, which can be monitored readily



- The type and intensity of the radiation can reveal precisely what nuclear material is present. It is a "*signature*" of the nuclear material.
- Emission is affected by other elements present.
- The time distribution of neutrons can also convey information.

A wide variety of technical measures exists to detect, identify and assay nuclear and fissile materials.

Safeguards Agreements, required by a variety of agreements, provide the legal context for international nuclear safeguards.



Strengthened Safeguards/Additional Protocols

- **Iraq**
  - NPT signatory state with IAEA Safeguards Agreement
  - Before 1991: no diversion of declared nuclear materials
  - Inspections revealed clandestine program
- **"93+2"**
  - Detect clandestine nuclear activities
  - Make safeguards more efficient
  - Verify not only the *correctness* of a declaration, but also its *completeness*
- **Four key elements:**
  - States must provide more information to the IAEA
  - Expand the number and type of facilities IAEA can inspect
  - Increase ability to conduct short-notice inspections
  - Use of environmental sampling at both declared and undeclared sites

107 States have signed Additional Protocols

77 States have ratified Additional protocols

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International Control or Multilateral Management of Sensitive Technologies and Materials

- **Reducing demand**
  - **If control is effective**
- **Restricting access**

- **1974 Indian Nuclear Test Renews U.S. Interest in Multilateral Approaches**
- **U.S. proposes "the establishment of internationally approved facilities to handle all the spent fuel arising from power reactors" (1974)**
- **1975 NPT Review Conference Declaration raises the idea of "regional or multinational nuclear fuel cycle centers" to facilitate "protection and the application of safeguards."**

Indira Gandhi visiting the site of the 1974 "Smiling Buddha" nuclear test

Discourage the acquisition of sensitive technologies and the stockpiling of sensitive materials.

Considerable thought has been given to multilateral approaches

- Regional Nuclear Fuel Cycle Centers (1975-1977)
  - Multinational fuel cycle facilities, especially reprocessing
- International Nuclear Fuel Cycle Evaluation (1977-1980)
  - Multinational fuel cycle facilities; storage of plutonium
  - Proliferation resistant fuel cycles and improved safeguards
- International nuclear fuel supply agency or authority (1978)
  - Fuel bank
- Committee on International Plutonium Storage (1978-1982)
  - Convened to consider IAEA storage and management of plutonium under Article XII.A.5
  - Group failed to reach agreement on how such a system should work
- Committee on Assurances of Supply (1980-1987)
  - Role of IAEA in multilateral fuel cycle service systems
- Conference for the Promotion of International Cooperation on the Peaceful Uses of Nuclear Energy (1987)
- IAEA Study: "Multilateral Approaches to the Nuclear Fuel Cycle" (2005)
- GNEP's Reliable Fuel Services; the Putin Initiative; "Six Country Proposal"; IAEA Standby Arrangements System

Restricting Access to Sensitive Materials and Technologies

- Restricting access

- Article III.2 of the NPT
  - Signatories shall not provide “designed or prepared equipment or material for the processing, use or production of special fissionable material."
- Zangger Committee (1972)
  - Maintains a Trigger List (triggering safeguards as a condition of supply) of nuclear-related strategic goods to assist NPT Parties in identifying equipment and materials subject to export controls.
- Nuclear Suppliers Group (1974)
  - Voluntary arrangement of 45 supplier states
  - Requires recipients to implement safeguards
- Implementation of national export control laws
  - Training and assistance programs
- UNSCR 1540

Intrinsic Proliferation Resistance

- Restricting access

- "Intrinsic proliferation resistance features are those features that result from the technical design of nuclear energy systems, including those that facilitate the implementation of the extrinsic measures"
- Can we design technologies which make it more difficult to produce weapons-useable material and/or which produce material that is more difficult to convert into weapons-usable material?
  - More difficult? Yes
  - Impossible? No
- Any fuel cycle can be misused. There is no proliferation-proof fuel cycle.

IAEA, STR-332, "Proliferation Resistance Fundamentals for Future Nuclear Energy System " Report on COMO meeting held in Como, Italy on October 28-31, 2002.

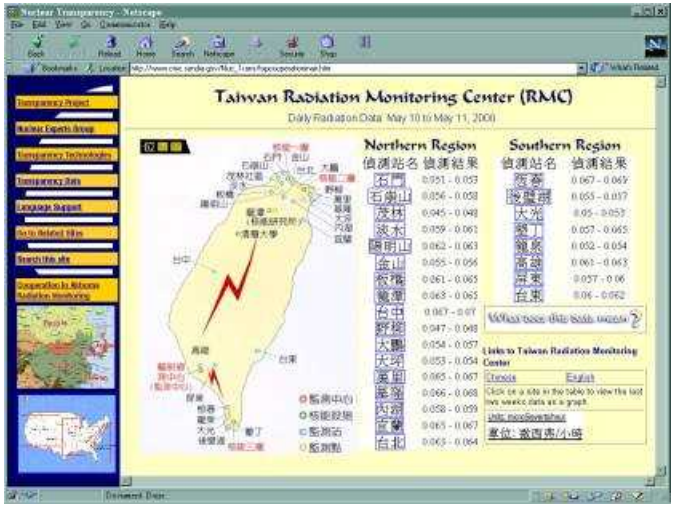
Addressing the Causes of Proliferation

- Build confidence
- Reduce demand

- Focuses on the "why" of proliferation, rather than the "how"
  - Intended to complement – not replace – other approaches
- Why do states seek weapons capabilities?
  - Security drivers
    - Current or historical conflict
    - Border disputes
  - Threat drivers
    - Concern that the other guy is developing a weapons capability
  - Status?
  - Domestic politics?

Concepts for Addressing Demand

- **Cooperative monitoring**
  - The process of obtaining and sharing agreed information among parties
    - Build confidence, reduce tensions, address misperceptions, etc.
  - E.g.,: The “Open Skies” treaty
- **Improving transparency**
  - Transparency is “a cooperative process of providing information to outside parties so that they can independently assess the safety, security, and legitimate management of nuclear materials.” (Pilat 1997)
  - Nuclear transparency can be used to address two questions:
    - How do we establish that our neighbor’s nuclear activities are no threat, either by accident or by proliferation?
    - How might we demonstrate that our own activities pose no threat, either by accident or proliferation?



CSCAP regional web site with near-real-time radiation and back-end-of-fuel-cycle data

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Elements of the Nonproliferation Regime

- **Establishing Norms**
  - NPT
  - UNSCR 1540
- **Building confidence**
  - NPT + Safeguards
  - Additional Protocol
  - Regional safeguards regimes (e.g., EURATOM)
  - Cooperative monitoring/transparency
- **Reducing demand for sensitive materials and technologies**
  - Multilateral fuel cycle service systems
  - International control of sensitive technologies and materials
  - Addressing security concerns
  - Security guarantees
  - Disarmament and arms control
- **Verifying activities and declarations**
  - NPT + Safeguards
  - Additional Protocol
  - Regional safeguards regimes (e.g., EURATOM)
  - Bilateral treaties
  - Cooperative monitoring
- **Restricting technology and material**
  - Export controls
  - Nuclear suppliers group
  - Zangger Committee
  - Multilateral fuel cycle service systems
  - International control of sensitive technologies and materials
  - Proliferation resistant fuel cycles
  - UNSCR 1540
  - Proliferation Security Initiative
- **Monitoring and Detection**
  - Additional Protocol
  - Bilateral treaties
  - National technical means

Questions

- Is there a problem?
  - Has the nonproliferation regime “failed”?
- Where are the gaps?
- Cooperation vs. coercion
- Universality
- Should we treat different states differently?
  - Efficient allocation of resources
- Enforcement mechanisms
- Technology
- Capability
  - States and international community
- What’s driving the demand?
- Can knowledge ever been totally controlled?