The Nuclear Fuel Cycle:
The U.S. Global Nuclear Energy Partnership

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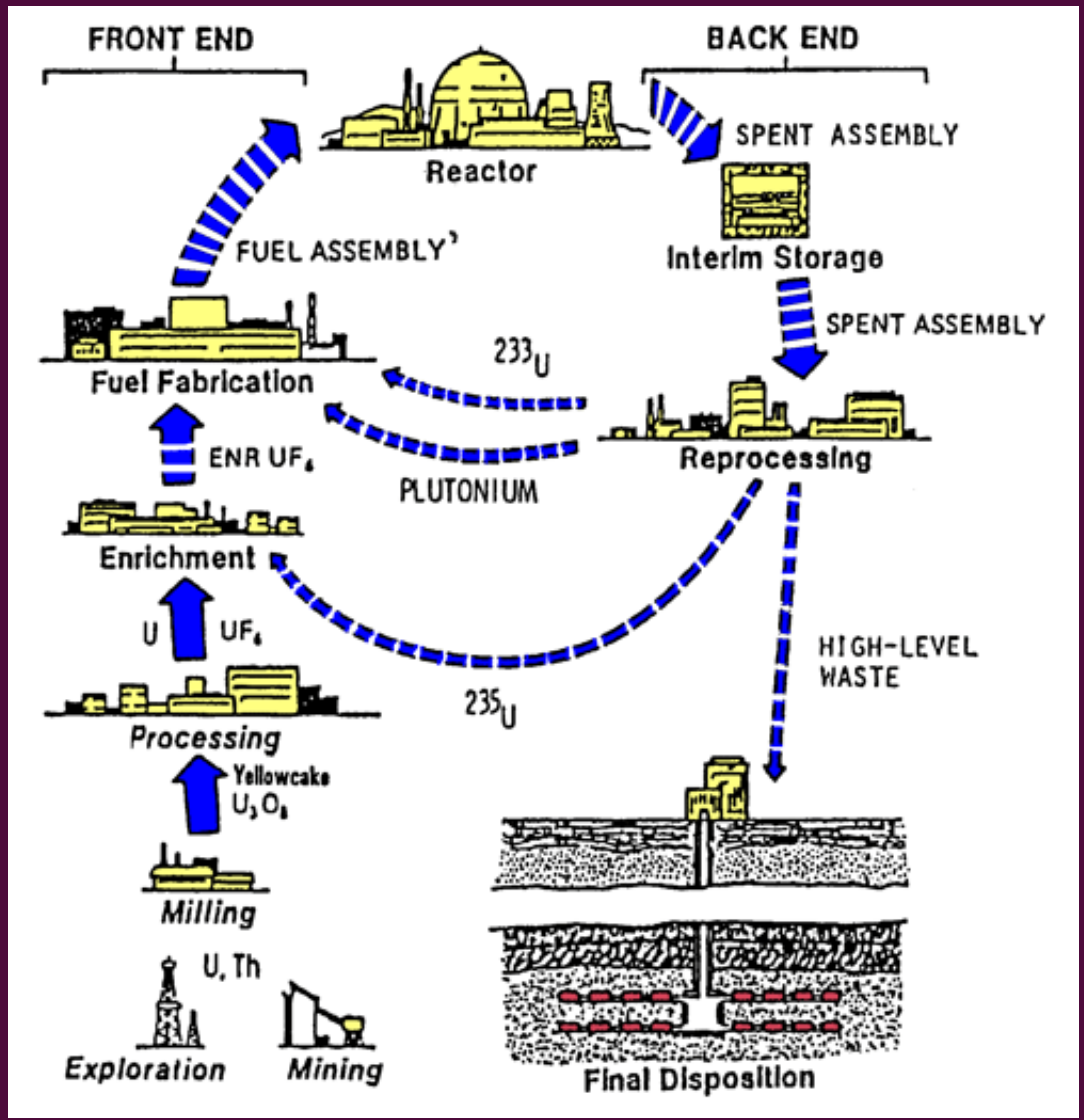
Outline

I. Nuclear Fuel Cycle
- Problems Associated with Spread of Fuel Cycle Technology.

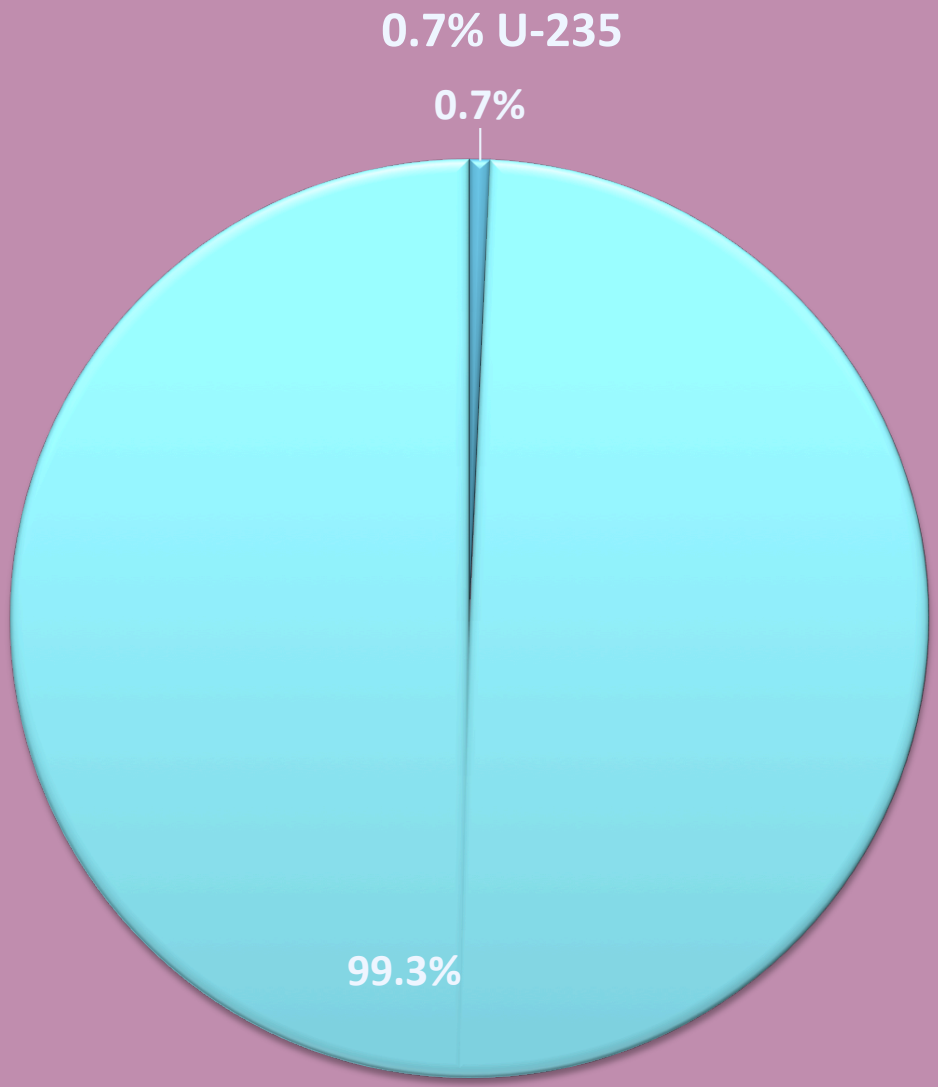
II. U.S. Global Nuclear Energy Partnership (GNEP): fuel cycle policy to solve problems.

III. Next Steps: Obama Administration

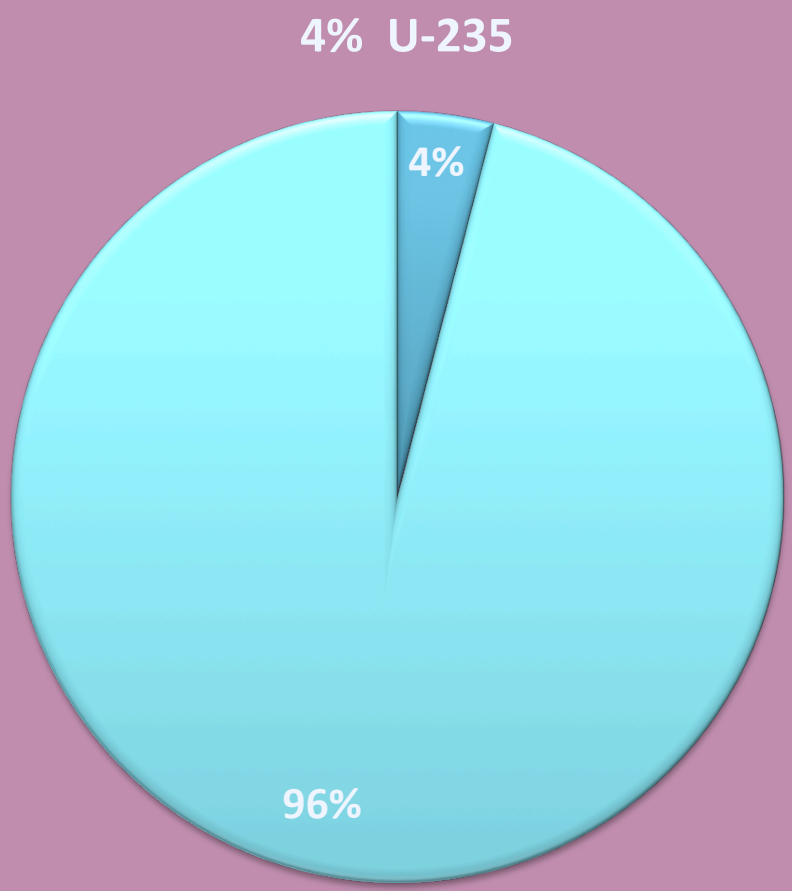
Nuclear Fuel Cycle



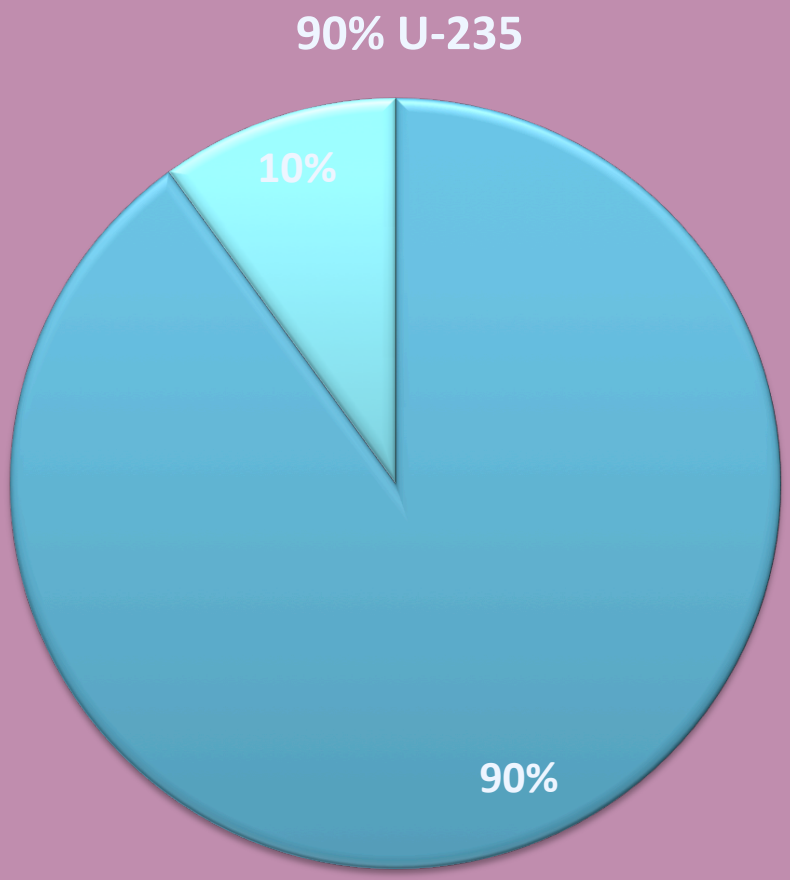
Natural Uranium



Enriched UF_6



Reactor-grade



Weapons-grade

U-235
U-238

Nuclear Fuel Cycle Problem #1

Dual Use Nature of Enrichment Technology

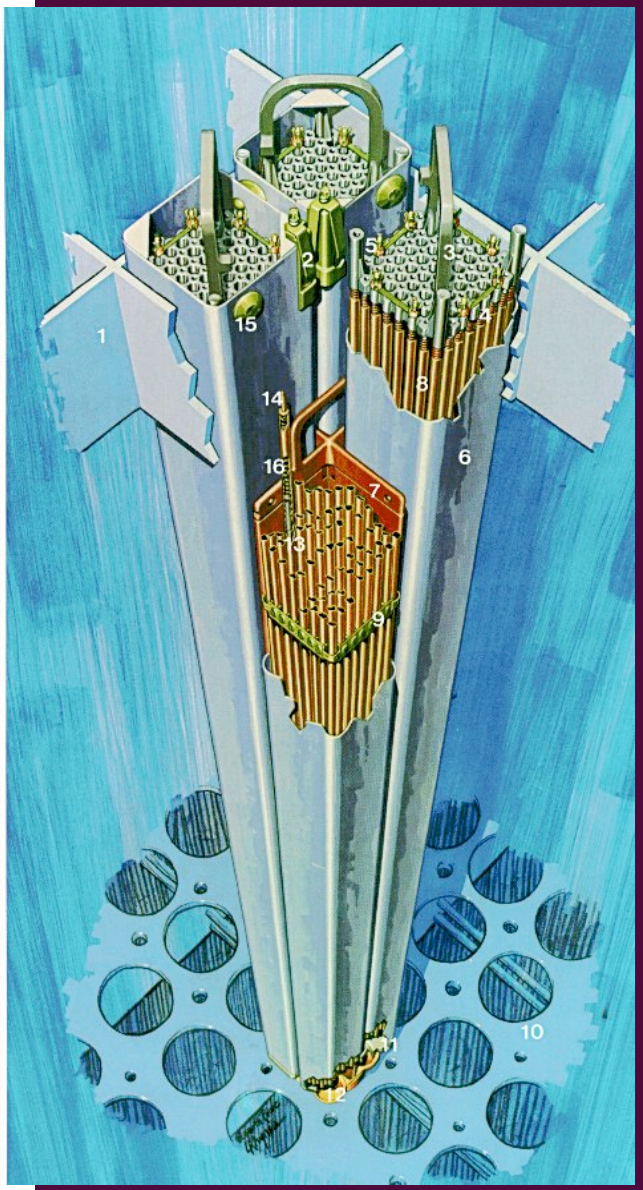
- Example: Iran
  - Member of Nuclear Non-proliferation Treaty (NPT).
  - Legally allowed to enrich uranium.
  - Acquisition another story.

Nuclear Fuel Cycle Problem #1

Dual Use Nature of Enrichment Technology

- Example: Iran
  - Approximately 3,800 centrifuges in 23 cascades.
  - 9,750 kilograms of UF6 into 630 Kilograms of LEU (5%).
  - Break Out Capability - No Way to Judge Intent.

Back to Nuclear Fuel Cycle

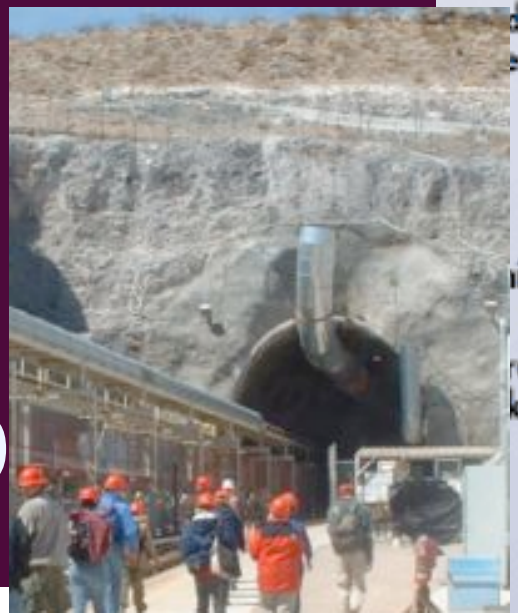


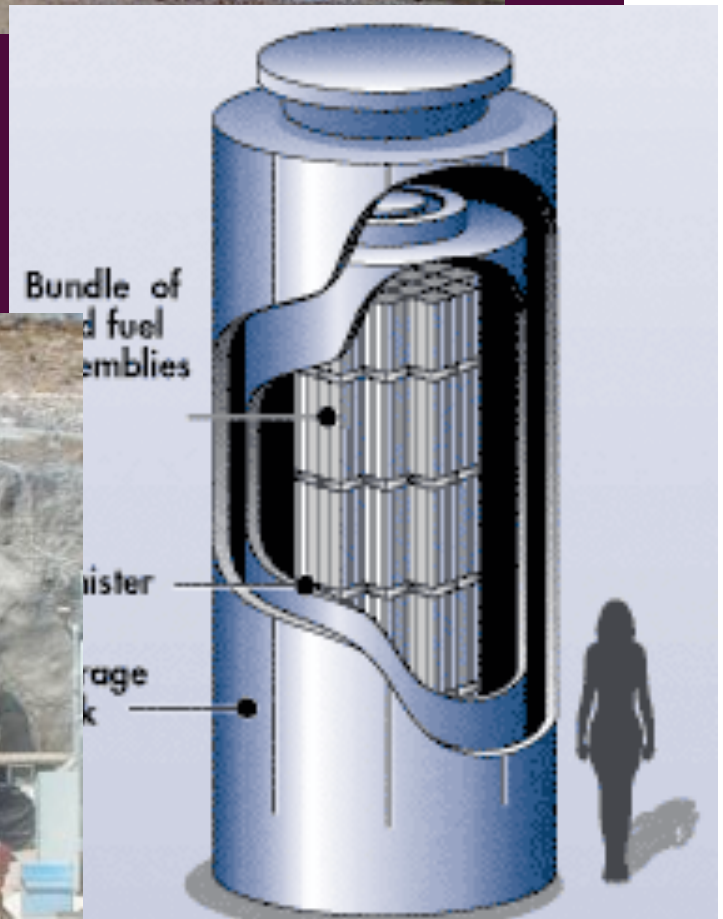
- LEU(UF6) to fuel & fuel pellets
- Fuel pellets to fuel rods.
- Rods to fuel assemblies.
- Fuel assemblies to core of reactor.
- Fuel burned to Spent Nuclear Fuel (Nuclear Waste).
  - Into cooling pools.

Nuclear Fuel Cycle

<u>Storage Options</u>

- Dry Casks : Interim Storage
- Geologic Repository:Long-term
- Reprocess Waste





Nuclear Fuel Cycle Problem #2

TABLE 4.3.4-1—*Aqueous Separation Processes*

Process	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6	Product 7
UREX+1	U	Tc	Cs/Sr	TRU+Ln	F.P.		
UREX+1a	U	Tc	Cs/Sr	TRU	All F.P.		
UREX+2	U	Tc	Cs/Sr	Pu+Np	Am+Cm+Ln	F.P.	
UREX+3	U	Tc	Cs/Sr	Pu+Np	Am+Cm	All F.P.	
UREX+4	U	Tc	Cs/Sr	Pu+Np	Am	Cm	All F.P.

Notes: U = uranium; Tc = technetium; Cs/Sr = cesium/strontium; TRU = transuranics; Pu = plutonium; Np = neptunium; F.P. = fission

Source: WSRC 2008a- GNEP PEIS, US Department of Energy, Chapter 4.

Dual Use Nature of Reprocessing Technology

- Reprocessing = separating waste.
- Spent fuel: 1% Plutonium.
- More vulnerable to theft and attack.
- Fabricate into fuel for power or fabricate into weapon components.

Nuclear Fuel Cycle Problem #3

Nuclear Waste Storage

- Highly Radioactive Waste
- U.S. - 50,000 metric tons commercially generated waste
- 63,000 metric tons by 2014= Yucca Mountain Legal Capacity
- Yucca delayed to 2020- will it open?

Global Nuclear Energy Partnership (GNEP)

The Global Nuclear Energy Partnership (GNEP): A U.S. policy developed to solve these 3 problems

<u>Two Components</u>

1. International Component
   - -Curb spread of dual-use technology
   - -Promote proliferation resistant UREX
2. Domestic Component
   - -Restart reprocessing to manage waste
   - -Develop proliferation resistant UREX + Fast Reactors

Global Nuclear Energy Partnership (GNEP)
International Component

Establish group of supplier & receiver states

Supplier States:

- Sell nuclear reactors and fuel
- Take back waste
- Reprocess using UREX

Receiver States:

- Receive good price on nuclear reactors and fuel- with supply assurances
- Forgo future enrichment and reprocessing

Global Nuclear Energy Partnership (GNEP)

Failure of **International Component**

- Original suppliers (France, Japan & Russia):
  - No to UREX.
  - U.S. less experience due to 30 year freeze.
  - Not going to store another nations waste.
- Potential Receivers:
  - Do not want to be “have-nots.”
  - South Africa & Argentina revive enrichment.

Global Nuclear Energy Partnership (GNEP)
Domestic Component
Program to Close the Fuel Cycle in United States

- Restart reprocessing to manage waste
  - Less highly radioactive waste for repository.
- Develop proliferation resistant reprocessing method.
- Develop new fuel and fast burner reactors.

Global Nuclear Energy Partnership (GNEP) Failure of **Domestic Component**

- Experts (Dr. von Hippel) testify:
  - Proliferation resistant reprocessing is a farce.
  - Reprocessing facility = $35 billion.
  - 40-75 fast reactors cost $40-$150 billion.
- National Academies against it:
  - Program should be replaced by research only.
- Congress cuts program in half-$179 million:
  - No construction, only research.
  - “rushed, poorly-defined, expensive and expansive.”

Next Steps Under Obama?

- Yes to nuclear, "if we can make it safe" and cost efficient."
- Continue to uphold Article IV commitments
  - Evaluating nations' readiness for nuclear power - grid appropriate reactors.
- Radioactive waste working group good, but Congress skeptical.
- Congressional oversight needed.

Next Steps Under Obama?

Renewables & green revolution will not take away desire to go nuclear

- Not just an economic decision.
- Nuclear fuel cycle capabilities sought for power & prestige.

Until Nuclear Weapon states find ways to devalue nuclear weapons and the dual-use fuel cycle technology associated with them, their policies to better manage the fuel cycle will fail.

Needed:

-Steps to Zero: CTBT, START, FMCT, Dramatic cuts, improved relations that reduce tension and decrease the need for security assurances.

Q & A

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