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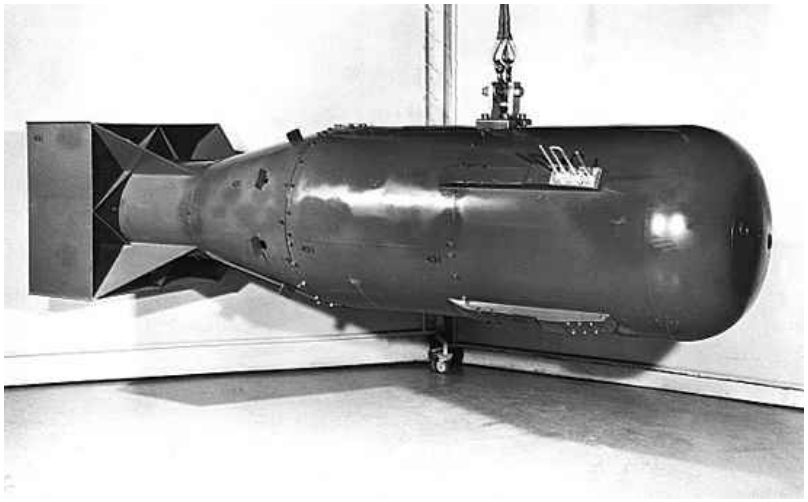
Uranium Properties

- 48^{th} most abundant element found in natural rock
- 19g/cm^3 density (1.6 times lead)
- 3818 degrees C melting point
- 0.7 % 235 U naturally occuring

Enriched Uranium Classes

- Low Enriched Uranium (LEU) 0.72-20% 235 U
  - LEU is primary fuel for nuclear reactors
- High Enriched Uranium (HEU) >20% 235 U.
  - HEU is used primarily in weapons.
  - Atomic weapons of WWII used HEU of about 93.5% 235 U



Yellowcake

- 60-80% U
- Two main commercial processes to produce usable U compound:
  - Solvent Extraction/flourination (wet)
  - Flourination/fractionation (dry)

Solvent Extraction/Flourination

- Yellowcake ($Na_2U_2O_7$) dissolved in nitric acid (HNO_3)
- Impurities removed by filter or centrifuge
- Undergoes thermal denitration to UO_2.
- UO_2 treated with HF gas – UF_4
- UF_4 reacted with generated Flourine gas (F_2) produces UF_6

Flourination/Fractionation

- Yellowcake is treated with sulfuric acid.
- Precipitating the ammonia(NH4) from the remaining compound gives (NH4)2U2O7
- Heat application yields UO3
- Exposure to hydrogen yields UO2
- Similar to wet process, UO2 is transformed into UF6

Electromagnetic Isotope Separation

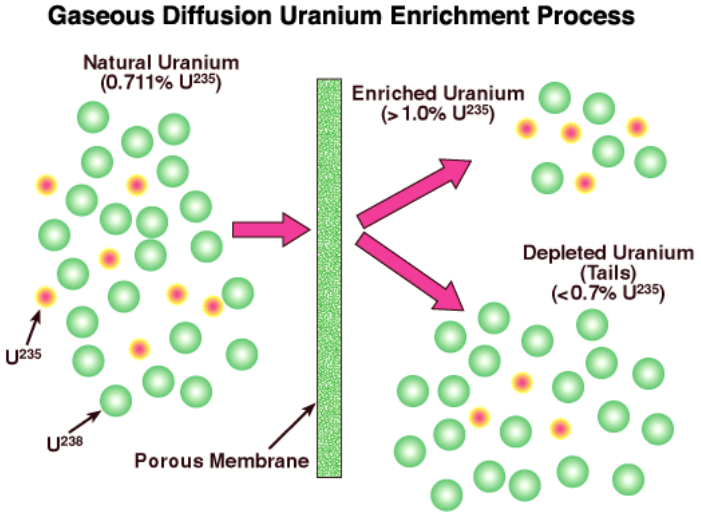
- Based on principles of mass spectrometer: chraged particles follow a circular path in unified magnetic field.
- As sample U is ionized with the magnetic field, isotopes separate.
- UCl4
- U.S. EMIS plant during 1940s used 2 stages: A and B
  - ‘A’ stage, 12-20% 235 U
  - ‘B’ stage, 93.5% 235 U
- Arranged in tracks to allow multiple a-b cycles
- Highly innefficient but relatively simple and inexpensive.

Thermal Diffusion

- Thin film of UF6
- Heat applied to top side of film
- Bottom side cooled
- Convection currents
- 235 collects at top of film
- 238 collects at bottom
- Also used for weapons production in WWII

Gaseous Diffusion

- UF6 at 135 F becomes gas
- Porous membranes separate the lighter 235 U (effusion)
- 0.4% difference in velocity between 235 U and 238 U
- Inefficient



Gaseous Diffusion Setup

- Primary Pieces of Equiptment:
  - Diffuser
  - Compressor
  - Electric Motor
  - Cooling system
  - Various Piping
- UF6 is highly corrosive
- Nickel or aluminum oxide