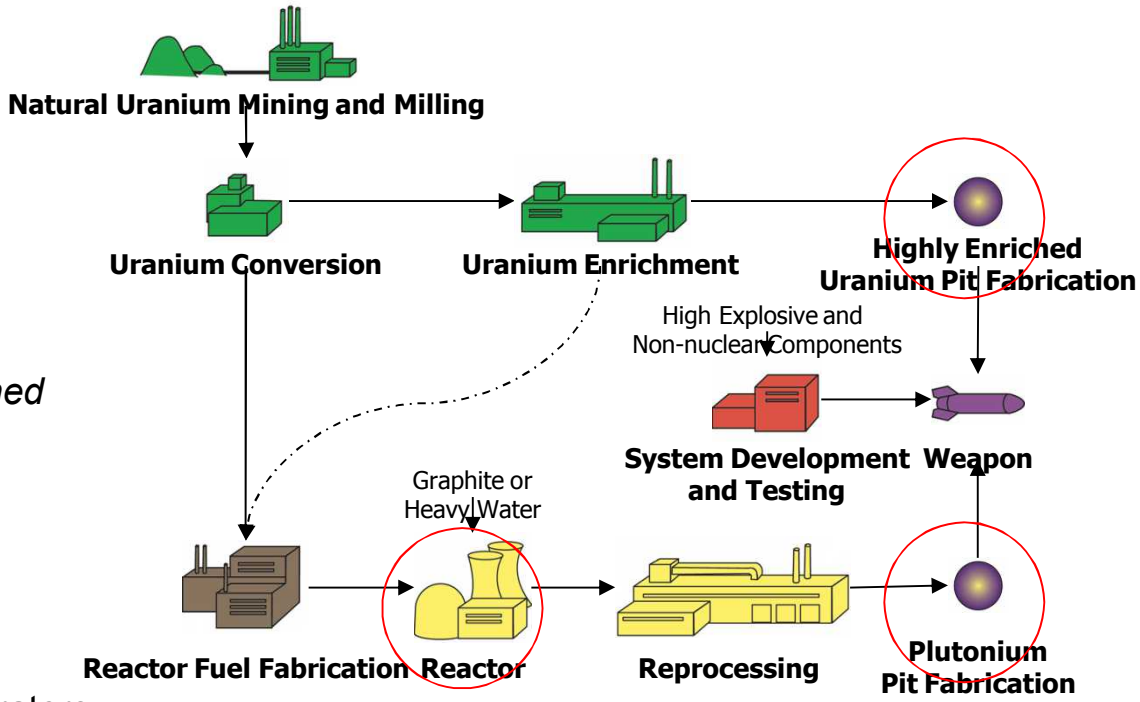
Alpha Emitting Radionuclides

SAND2011-0050P

- **Controls**
  - HS 2844, 9022.21, 9022.29, 9022.90
  - NSG DUL 2.C.19
  - EU 1C236
- **Nuclear Uses**
  - Neutron source component for nuclear weapons
    - *Alpha emitters, when combined with beryllium*
- **Other Uses**
  - Radiation treatment for cancer
  - Radiography
  - Electrical static eliminators
  - Explosives detection equipment
  - Radioisotope thermoelectric generators
  - Well logging sources
  - Smoke detectors



Alpha-emitting radionuclides having a alpha half-life of 10 days or greater but less than 200 years, in the following forms:

a. Elemental;
b. Compounds having a total alpha activity of 37 GBq (1 Ci) per kg or greater;
c. Mixtures having a total alpha activity of 37 GBq (1 Ci) per kg or greater;
d. Products or devices containing any of the foregoing.

Note: Does not control a product or device containing less than 3.7 GBq (0.1 Ci) of alpha activity.

Alpha Emitting Radionuclides – Controlled Isotopes ($t_{1/2}$ of 10 days - 200 yrs)

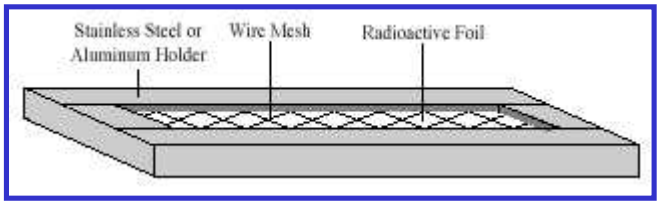
Isotope	Half-life	Isotope	Half-life
Gadolinium-148	75 years	Curium -241	32.8 days
Polonium -208	2.9 years	Curium -242	162.8 days
Polonium -209	102 years	Curium -243	29.1 years
Polonium -210	138.4 days	Curium -244	18.1 years
Radium -223	11.4 days	Californium -248	334 days
Actinium -225	10.0 days	Californium -250	13.1 years
Actinium -227	21.8 years	Californium -252*	2.6 years
Thorium -227	18.7 days	Californium -253	17.8 days
Thorium -228	1.9 years	Californium -254	60.5 days
Uranium -230	20.8 days	Einsteinium -252	1.3 years
Uranium -232	70 years	Einsteinium -253	20.5 days
Neptunium -235	1.1 years	Einsteinium -254	276 days
Plutonium -236	2.9 years	Einsteinium -255	40 days
Plutonium -238	87.7 years	Fermium -257	100.5 days
Plutonium -241	14.4 years	Mendelevium -258	51.5 days
Curium -240	27 days		

*** Cf-252 emits neutrons spontaneously; does not need to be combined with beryllium**

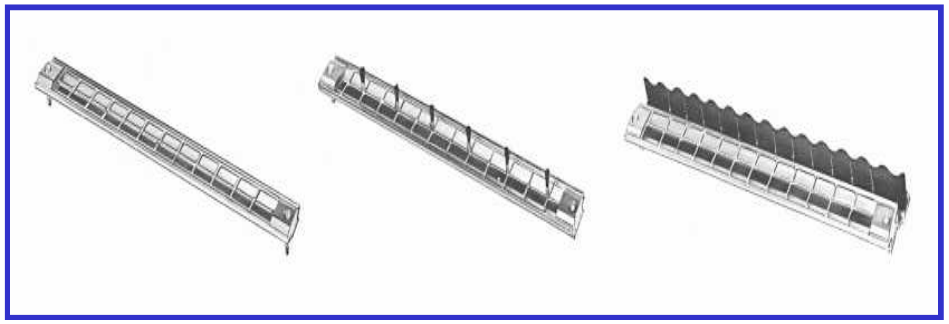
There are many alpha emitting isotopes with half-lives ranging from milliseconds to 1E15 years. However, the list of the isotopes that meet the NSG ‘s half-life specification (10 days to 200 years) is much shorter and is shown.

Alpha Emitting Radionuclides: Appearance

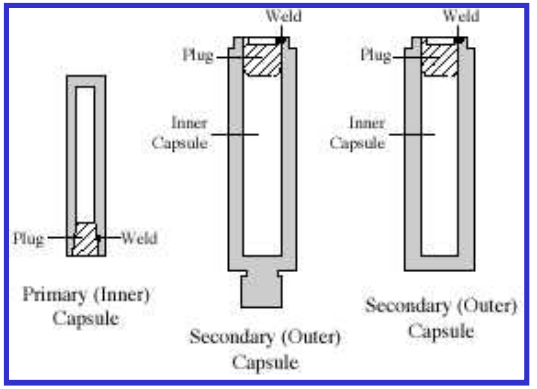
- **Appearance**
  - Often are incorporated into foils mounted in stainless steel or aluminum holders
  - Cf-252 is a neutron, gamma, and alpha emitter-stored in a typical capsule
  - Po-210 is used in electrical static eliminators
    - *radiation labels and the words "Caution" and "Radioactive" on bars*



Typical alpha source holder



Electrical static eliminators



Cf-252 source holder

NRD, LLC
Model P-2021 In-line alpha ionizer
Contains 10 mCi (370 MBq) of polonium-210

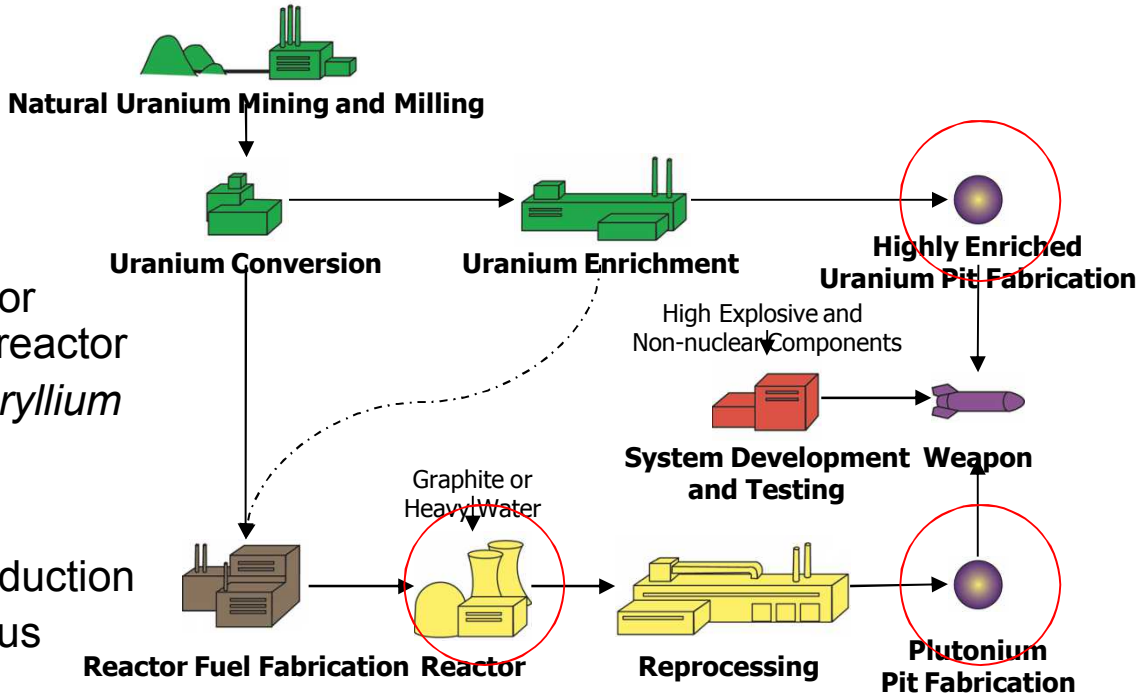
Alpha Emitting Radionuclides: Packaging and Handling

- **Packaging and Handling**
  - "Radioactive" label required when shipping
    - *Isotope*
    - *Quantity*
    - *Form*
    - *Surface dose rate*
  - Since isotopes are radioactive, take following precautions if packaging is damaged:
    - *provide proper shielding*
    - *avoid inhalation or ingestion of the material*
  - Shipping Information
    - *vendor name and address*
    - *isotope name and activity*
    - *device identification*
    - *serial and model numbers*

Shipping container for Cf-252

Radium-226

- **Controls**
  - HTS 2844
  - NSG DUL 2.C.12
  - EU 1C237
- **Nuclear Uses**
  - Neutron source component for nuclear weapons or nuclear reactor
    - *When combined with beryllium*
    - *1,602-year half-life*
- **Other Uses**
  - Precursor for Radon gas production
  - Formerly used in self-luminous paints, radiography, gas chromatography and calibration sources



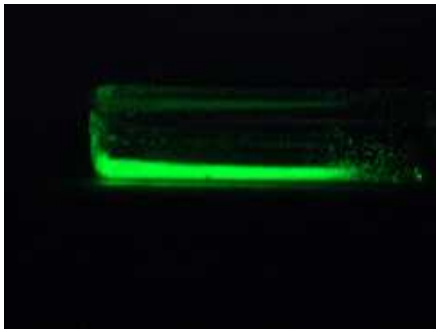
All materials and devices containing Radium-226 in a quantity greater than 0.37 GBq (10 millicuries), with the exception of Medical Applicators

Note: Radium-tipped medical applicators used for Nasopharyngeal radium irradiation (stick down patient's nostril and leave for 10 – 12 minutes, occurred during the 1950s – 1960s and has been almost completely discontinued)

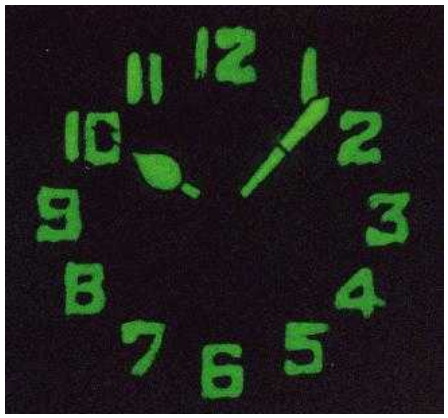
Radium-226: Appearance

- **Notable Features**

  - Radium metal is brilliant white, turns black when exposed to air
  - Most radium compounds are white
  - In contact with air, radium has characteristic pale-blue luminescence
  - Radium can be stored in stainless steal capsules (5-38mm long and diameter is 1.5 – 9.5mm)



Radium Salt

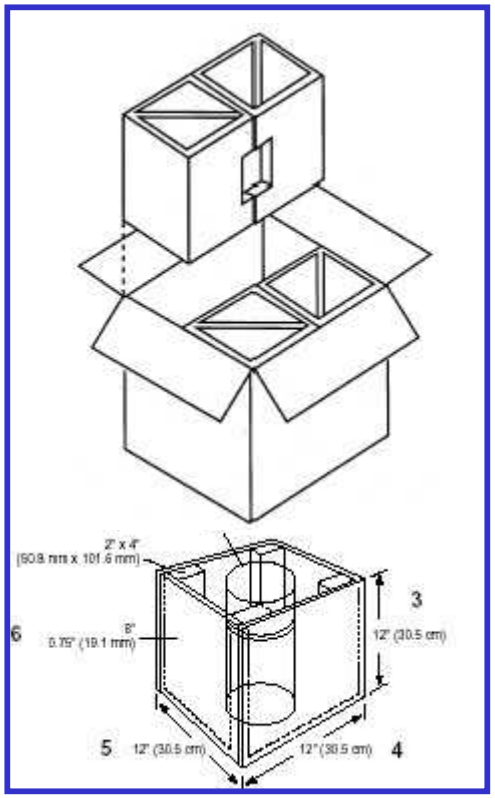


Radium Luminescent Dial

Stainless Steel Capsules w/Radium

Radium-226: Packaging and Handling

- **Packaging and handling**
  - **Warning sign "Radioactivity"**
  - **Packaging depends on quantity, shape and surface doze rate**



Transport container, type A

Transport container, type B

Caution!

All Radium isotopes are radioactive

Radioactive gas inside (Radon)!