SAND2008-4302P

Munitions Issues

Environmental Considerations Seminar with Military Operations

Amman, Jordan

July 14-17, 2008

Hosted by Jordanian Armed Forces and US Central Command

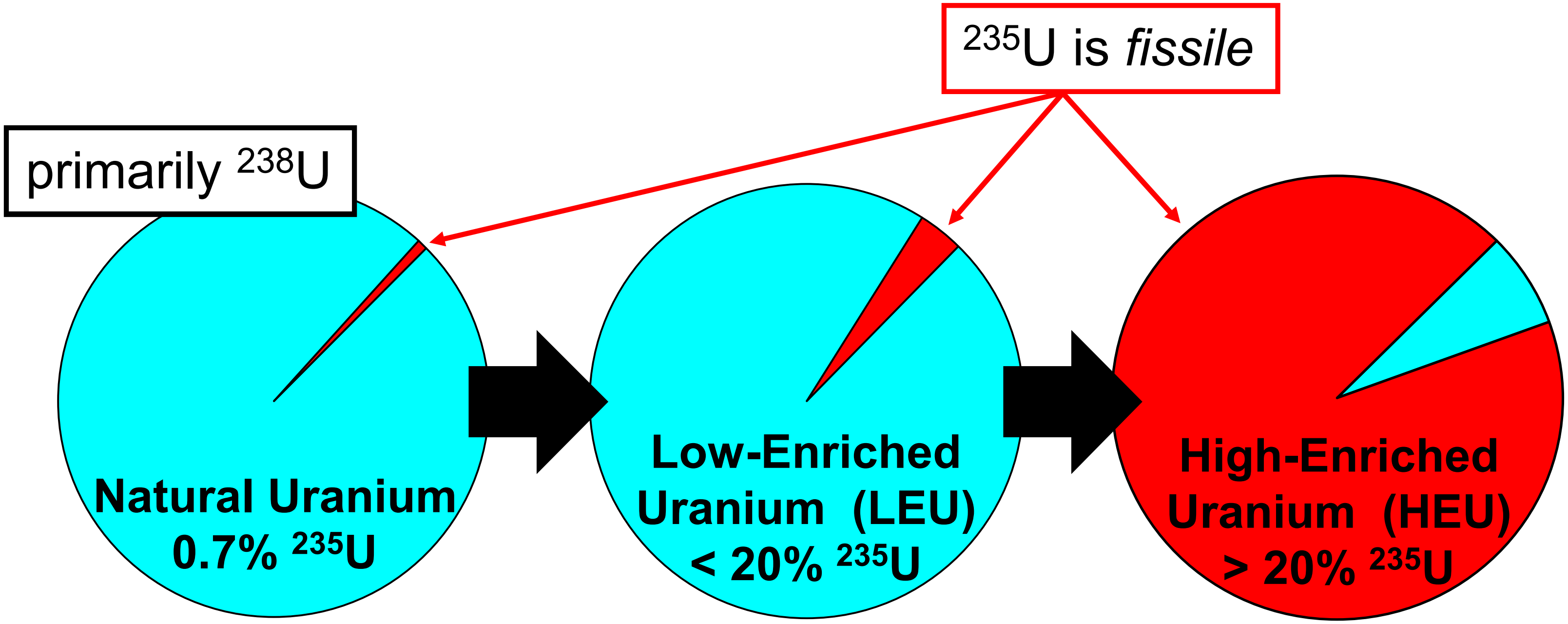
Dr. Amir H. Mohagheghi
Physicist/Program Manager, Middle East Programs
Sandia National Laboratories
Phone: +1-505-844-6910 Fax: +1-505-284-5055
Email: ahmohag@sandia.gov

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Munitions Issues

- Unexploded Ordinance
- Lead Contamination
- Depleted Uranium
  - What is Uranium
  - Physical, Chemical, Radiological properties
  - Exposure and health effects
  - Monitoring Techniques
- Conclusions

Uranium



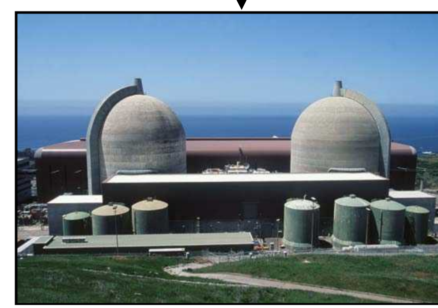
- Natural uranium, LEU and HEU are all useful in reactors.
- Only HEU is useful for making a nuclear explosive.
- Depleted uranium (<0.7% ^{235}U) is a byproduct of enrichment.

Depleted Uranium is:

Natural uranium

Enriched and Processed

Yellowcake



Armor piercing rounds

Shielding

Etc.

Armor

A useful by-product from the enrichment process

Physical Properties of Uranium

In purest form is a silvery, gray metal and is the heaviest naturally occurring element

<u>Physical</u> – Can be a solid, liquid, or gas uranium

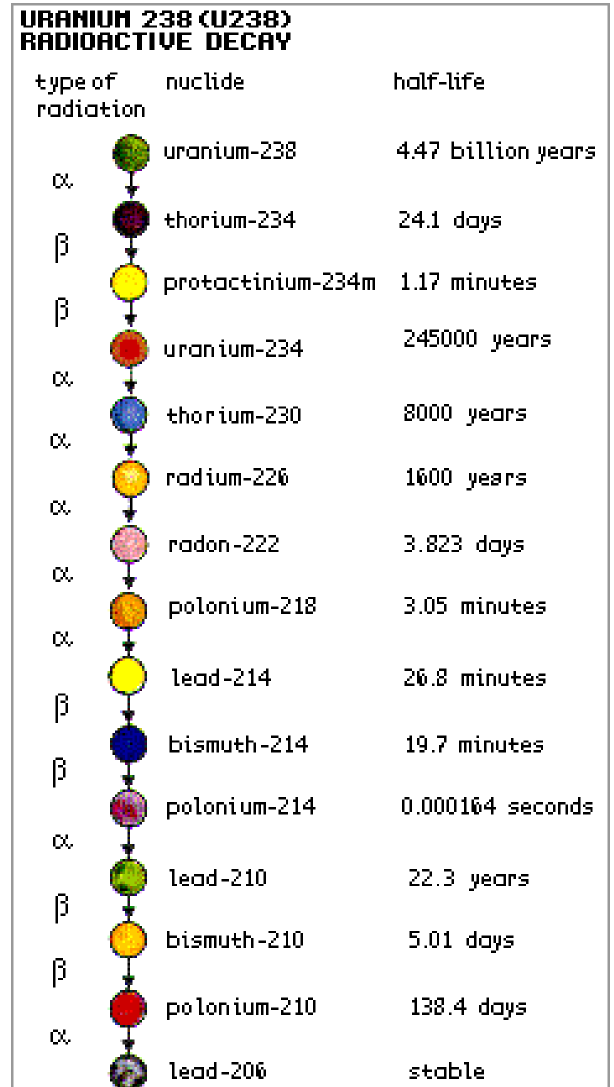
- Solid - most stable and most probable - shiny metal easily oxidizes
- Liquid - molten uranium is unlikely; however, uranium may be dissolved in a solution
- Gas - only in process facilities

Uranium yellowcake – after enriching and processing

Sandia National Laboratories

Radiological Properties of Uranium

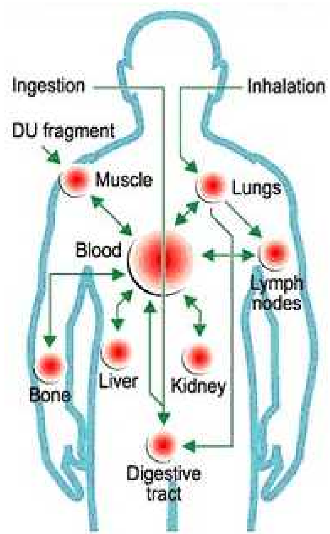
- Eighteen isotopes of Uranium, 3 exist naturally
- Principally an alpha emitter; however, gamma and beta as well from daughter products
- Radiological properties change with enrichment
- Long radiological half-lives
- Uranium is fissionable



Other Properties of Uranium

Chemically Reactive

- Reacts readily with air and water
- Finely divided particles can burn in air



Short Term Exposure

- Toxicity is the concern
- May result in kidney damage

Long Term Exposure

- Radiological effects become the primary concern
- Increased risk of cancer - bones, kidneys and lungs

Uranium Uses

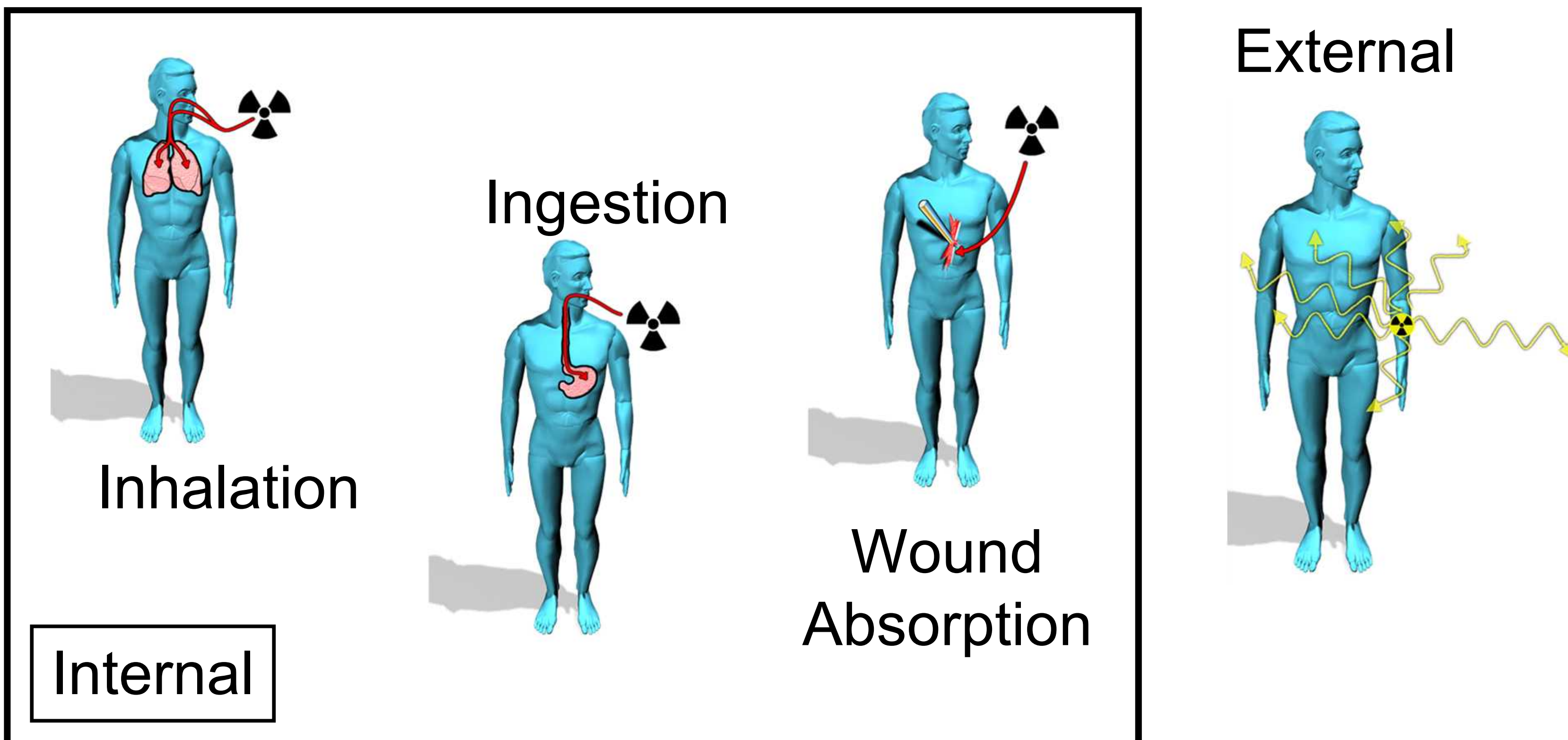
- Nuclear reactor fuel
- Developing nuclear weapons
- Coloring glass
- Depleted Uranium - armor plating, radiation shielding, counterweights, armor piercing rounds

Military Uses of DU

- ★ First used in combat by US -- 1991 Gulf War
- ★ DU armor-piercing munitions are highly effective
  - – Used in several US weapons systems
  - – High-density/self-sharpening qualities ideal for use against enemy armored vehicles
- ★ DU armor used in Abrams tanks for enhanced protection
- ★ Personnel may be exposed to DU through friendly fire accidents or other situations

Potential Exposure Pathways

Uranium could present internal and/or external exposure hazards



DU Internal Exposures

★ When DU projectiles penetrate armor, the projectiles self-sharpen and produce small shards which
  - Can kill or wound
    - In the wounded, can result in internal exposure to DU due to embedded DU fragments
  - Can burn and create airborne DU dust (particulates) which can be inhaled, ingested, and contaminate wounds by those wounded or others exposed to the particulates resulting in internal DU exposures

Uranium Exposure
- Potential Health Effects -

Chemical Toxicity Effects

Filtered by the kidneys causing kidney damage

- High exposure (50 to 150 mg) can result in acute kidney failure – even death
- Damage is detected by protein and dead cells in the urine

Radiological Toxicity Effects

- Mainly alpha exposure from internal exposure
- External exposure (gamma and beta) when around larger quantities
- Results in an increase in cancer rates

Environmental Monitoring for Uranium

- In-Vitro Techniques: Representative air, soil, and water samples are obtained and analyzed to determine uranium concentrations
- In-Situ Techniques: Field measurements are made using a variety of instruments

Sandia National Laboratories

Personnel Monitoring for Uranium

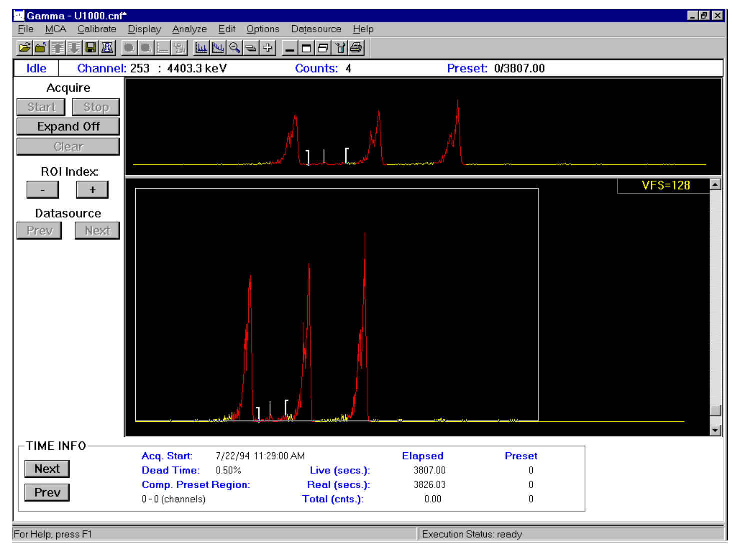
- In-Vitro Techniques:
  - Urine samples is the most common method for quantifying internal exposure to uranium
    - 24 hour sample
    - Dose reconstruction
  - Personnel dosimetry is used to quantify external exposure to uranium
  - A new assay under investigation is to take hair samples
- In-Vivo Techniques
    - Whole Body Counting

Sandia National Laboratories

Monitoring for Uranium

Laboratory Instruments

- **Gamma Spectroscopy**
  - analyze sample with minimal preparation
- **Alpha Spectroscopy**
  - requires radiochemistry
- **Mass Spectrometry**
  - requires some sample preparation



Questions?