Sources of Radiation

Kristen Schwab, MS
Health Physicist
Office of Radiation Protection
Department of Health
Radiation Emitting Device vs radioactive Material

Radiation emitting device - only gives off radiation when on

Radioactive material - always radioactive (until it decays)
Sources of Natural Background Radiation

Naturally Occurring Radioactive Material (NORM)
Cosmic Radiation

Charged particles from the sun and stars interact with the earth’s atmosphere and magnetic field to produce a shower of radiation.

Super Novas produce much of the cosmic radiation that reaches the Earth.

Radiation from our own Sun

A cross country flight - about 5 mrem.
Terrestrial Radiation

When the Earth was formed, radioactive elements Naturally Occurring Radioactive Material (NORM) were present.

Important radioactive elements include uranium, thorium, radium, and their radioactive decay products (e.g. radon) are found in the earths crust and soils

The Earth is Naturally radioactive
Radon Gas

• Formed from the radioactive decay of uranium and radium in the soil.

• As radium decays, it becomes radon gas, which then seeps up from the ground, and potentially into basements.

• Radon emits alpha radiation, which is not a hazard if it's not inhaled, but if inhaled is considered the second leading cause of lung cancer, after tobacco smoking.

Radon gas can seep through cracks and other openings in buildings.
Naturally Radioactive

Bananas contain potassium-40

Some Granite emits Radon

Brazil Nuts contain Radium-226

Tobacco polonium-210 and lead-210.
Internal Radiation

Within the Human Body

• Potassium-40 and carbon-14

• To a lesser extent uranium and thorium
Sources of Man Made Radiation
Sources of Alpha Radiation

- Plutonium Pacemaker
- Polonium-210 Static Eliminator
- Americium-241 Smoke Detector
Sources of Beta Radiation

- Strontium powered space vehicles and weather stations
- Tritium in glow-in-the-dark EXIT signs, watch dials, and night-sights on firearms
- Radioactive nickel in chemical agent detectors
Sources of Gamma Radiation

- Technetium-99m for diagnostic medical testing
- Iodine-131 for treating hyperthyroidism in cats
- Iridium-92 Industrial radiography pipe weld inspection
- Cobalt-60 medical sterilizer
Historical Medical Uses

Radioactive Toothpaste

Radium Bath Salts

Radium Bromide Tablets
Reportedly for Gout, Rheumatism, Glandular swellings, Nephritis, menstrual disturbances
Marie Curie
Fuel Assembly and Fuel Pellet

Fuel Assembly

Fuel Pellet
Uses of
Radioactive Material
Medical Uses

One-third of the 30 million hospitalized Americans are diagnosed or treated with radionuclides (e.g., $^{99m}$Tc, $^{67}$Ga, $^{111}$In and $^{131}$I)

Normal Bone Scan

Bone Metastases
Medical Uses

Radioactive materials are used to sterilize medical bandages and implements as well as foodstuffs to kill pathogens.

Radioactive materials are used in 100 million lab tests on tissue specimens and body fluids.
Scientific Research

Archaeologists use $^{14}{\text{C}}$ to date artifacts containing plant or animal material.

Criminal investigators use radiation to examine evidence.

Museums rely on radioactive materials to verify authenticity of art objects and paintings.
Industrial Uses

Construction crews use radioactive materials to gauge soil moisture content and asphalt density.

Industrial gauges are used to measure fill, flow and thickness.
<table>
<thead>
<tr>
<th>ISOTOPE</th>
<th>½ Life</th>
<th>APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium</td>
<td>billions of years</td>
<td>Natural uranium is comprised of several different isotopes. When enriched in the isotope of U-235, it’s used to power nuclear reactor or nuclear weapons.</td>
</tr>
<tr>
<td>Carbon-14</td>
<td>5730 y</td>
<td>Found in nature from cosmic interactions, used to “carbon date” items and as radiolabel for detection of tumors.</td>
</tr>
<tr>
<td>Cesium-137</td>
<td>30.2 y</td>
<td>Blood irradiators, tumor treatment through external exposure. Also used for industrial radiography.</td>
</tr>
<tr>
<td>Hydrogen-3</td>
<td>12.3 y</td>
<td>Labeling biological tracers.</td>
</tr>
<tr>
<td>Irridium-192</td>
<td>74 d</td>
<td>Implants or &quot;seeds&quot; for treatment of cancer. Also used for industrial radiography.</td>
</tr>
<tr>
<td>Molybdenum-99</td>
<td>66 h</td>
<td>Parent for Tc-99m generator.</td>
</tr>
<tr>
<td>Technicium-99m</td>
<td>6 h</td>
<td>Brain, heart, liver (gastroenterology), lungs, bones, thyroid, and kidney imaging, regional cerebral blood flow, etc.</td>
</tr>
</tbody>
</table>
Regulatory Categories
Radioactive Material

Licensed Material
• Unlikely to Encounter

Unlicensed Material
• Likely to Encounter
Unlikely to Encounter
Licensed Material

• Specifically Licensed Material
  • Possession and use of certain quantities and types of radioactive material require a Radioactive Materials License
  • Specific License issued to facility/entity (e.g. university, hospital)
  • Material may only be transferred to another Specific Licensee
  • Material must be disposed at Low-Level Radioactive Waste Site

• Generally Licensed Material
  • General license is “issued” when the object is purchased (e.g. tritium exit signs, portable gauges, static eliminators)
  • Material may only be transferred to a Specific Licensee
  • Material must be disposed at Low-Level Radioactive Waste Site
Likely to Encounter Unlicensed Material

• Exempt Material
  • No license required to possess or use (e.g. smoke detectors)
  • Material must be disposed at facility that can accept this material in accordance with state and Compact laws.

• Naturally Occurring Radioactive Material “NORM” and Technologically Enhanced Naturally Occurring Radioactive Material “TENORM”
  • e.g. refractory bricks, granite, ores, pipe scale
  • Disposed of at a facility licensed to accept this material
Household Hazard Waste Collection Center

How Do You Encounter?

• Believed To Be or Is Radioactive Material
  • Either have a radioactive material symbol/caution label (e.g. smoke detector)
  • Oral history (e.g. glass jars of rocks, revigators)
  • Cleaning out Dad’s garage
    » static brushes, military artifacts, chemistry kits
Radioactive Labels and Markings
Radioactive Items
Household Hazard Waste Collection Center
Worker Safety

- Implement universal precautions
- Limit handling of the item
- Do not open the item
- Do not take item apart
- Store item in a safe location
- Call Your State Radiation Control Program Manager
How Do You Encounter?

• **Surprise!**

• Alarming Portal Monitor
  – Vintage/Antique Objects
  – Exempt Material
  – Medical Waste
  – Diffuse Material (NORM/TENORM)/ Construction Debris

• Member of the Public

• Industry

• In a Truck/Vehicle
SW Landfill
What Do You Do?

- Do you have protocols in place for responding to alarming portal monitors?
- Verify the source of the alarm (driver or truck)
- Call Your State Radiation Control Program Manager
SW Landfill
Worker Safety

- Implement universal precautions
- Isolate the truck
- Secure the load
- Do not empty the truck without a survey meter
Thank You