TENORM Waste/Radiation Safety

David Stradinger
ND Department of Health
Radiation Control Program
TENORM radioactive materials of concern:

- Radium-226 (Ra-226)
- Radium-228 (Ra-228)
Why are they a concern?

These materials emit radiation:

- Alpha radiation:
  - Internal hazard (e.g., swallowed, inhaled, absorbed through wounds)
  - Not an external hazard
- Beta radiation:
  - Short range particle
- Gamma radiation:
  - Penetrating, external hazard
Radiation Safety

- Ra-226 emits alpha and gamma radiation (186 keV gamma)
  - Not much of an external exposure concern
  - Concern with inhalation (breathing in), ingestion (eating), and absorption (open wounds, etc.)
Radiation Safety

- Ra-228 emits beta radiation
  - Not much of an external exposure concern
  - Moderate internal exposure concern
Radiation Safety

Radioactive Decay in Thorium and Uranium Series

THORIUM SERIES
- Po-212 (0.3 μsec)
- Bi-212 (61 min)
- Po-216 (0.15 sec)
- Pb-212 (10.6 hr)
- Bi-212 (3 min)
- Ti-208 (stable)

URANIUM SERIES
- Po-210 (138 day)
- Bi-210 (160 μsec)
- Po-214 (19.7 min)
- Pb-210 (22 yr)
- Bi-214 (3 min)
- Rn-222 (3.8 day)

Th-228 (1.9 yr)
Ra-224 (3.6 day)
Ac-228 (6.1 hr)
Ra-228 (5.8 yr)
Th-232 (1.4 x 10^10 yr)
U-234 (250,000 yr)
Th-230 (80,000 yr)
Pa-234 (1.17 min)
Th-234 (24 day)
U-238 (4.5 x 10^9 yr)

Alpha Decay
Beta Decay
Gamma Emission
THE PENETRATING POWER OF ALPHA AND BETA PARTICLES, AND GAMMA RAYS

**ALPHA PARTICLES**
Stopped by a sheet of paper

**BETA PARTICLES**
Stopped by a layer of clothing or by a few millimeters of a substance such as Lucite (plastic) or aluminum

**GAMMA RAYS**
Stopped by several feet of concrete or a few inches of lead

RADIATION SOURCE

ORGANIC TISSUE
Radiation Safety

- External exposure protection factors
  - Time
  - Distance
  - Shielding
Minimizing Exposure - Time

- Minimize the amount of time spent near sources of radiation
As the distance from a radioactive source doubles, the exposure rate decreases by a factor of four.

Moving back just a couple of feet makes a big difference.
Use of proper personnel protection equipment (PPE)

- Protective clothing (i.e., coveralls, Tyvek suits)
- Gloves
- Masks
- Respirators
Minimize Exposure - Shielding

- Practicing good personnel hygiene
  - Do not take dirty clothing, etc. home
  - Wash hands thoroughly
  - Survey hands and feet prior to leaving restricted areas
Use of Survey Meters (detection)
- Essential for detection and measurement of radiation in the workplace
- Calibrated at least annually
- Users must be trained
Minimize Exposure - Other

Labels, Signs & Warnings
- Warning signs should be used on:
  - TENORM storage/transport containers
  - TENORM storage areas
  - TENORM use areas

“Notice to Employees”

Posting of location of ND Radiological Health Rules, operating and emergency manual, radioactive material license, etc.
Minimize Exposure - Other

- **TENORM Storage & Security**
  - Limit access
  - Use properly lined storage containers
  - Perform regular area surveys

- **TENORM Waste Management**
  - Use proper waste transport containers
  - Proper labeling of waste containers
  - Manifests
How do we determine external exposure?

- Ring and/or whole-body badges
- Monitoring devices include:
  - Film badges
  - TLDs (thermoluminescent dosimeters)
  - Luxel+® OSL (optically stimulated luminescence) dosimeters
  - Pocket-type dosimeters
- Exchanged monthly or quarterly
What are the permissible limits for external exposure?

- Public dose limit = 100 mrem/year
- Occupational dose limit = 5000 mrem/year
What is occupation dose?

- The dose received by an individual in the course of employment in which the individual’s assigned duties involve exposure to radiation or to radioactive material.
What is public dose?

- The dose received by everyone else.
How do the dose limits compare?

- Average individual dose from normal background radiation (not including medical) = 360 mrem/year

- Average individual dose from background radiation including medical = 620 mrem/year
The three cardinal rules for radiation protection are time, distance and shielding.

Use common sense.
Questions?

David Stradinger
Radiation Control Program
North Dakota Department of Health
918 E. Divide Avenue, Second Floor
Bismarck, ND 58501
701-328-5188
dstradinger@nd.gov