

# Oregon Rulemaking Meeting

April 24, 2023

# Key program elements

- Easy to understand system that ensures Oregonians are protected
  - Based in current science
  - Limited to NORM/TENORM wastes
  - Wastes exceeding maximum concentration limits (Table D) cannot be disposed in Oregon
- Exemptions for specific wastes, supported by current science
- Disposal model for wastes included in certain waste classes (Table B)
  - Incorporates worker 100 mrem/year dose limit (reduced from 500 mrem/year)
  - Incorporates future resident 25 mrem/year dose limit
  - Generic landfill model designed to recognize current science
  - Site specific landfill model optional to recognize site specific conditions
  - Inventory tracking required
  - Annual Report to ODOE
- Individual Oregon landfills may elect to NOT accept wastes requiring inventory tracking
  - ODOE reviewed program required

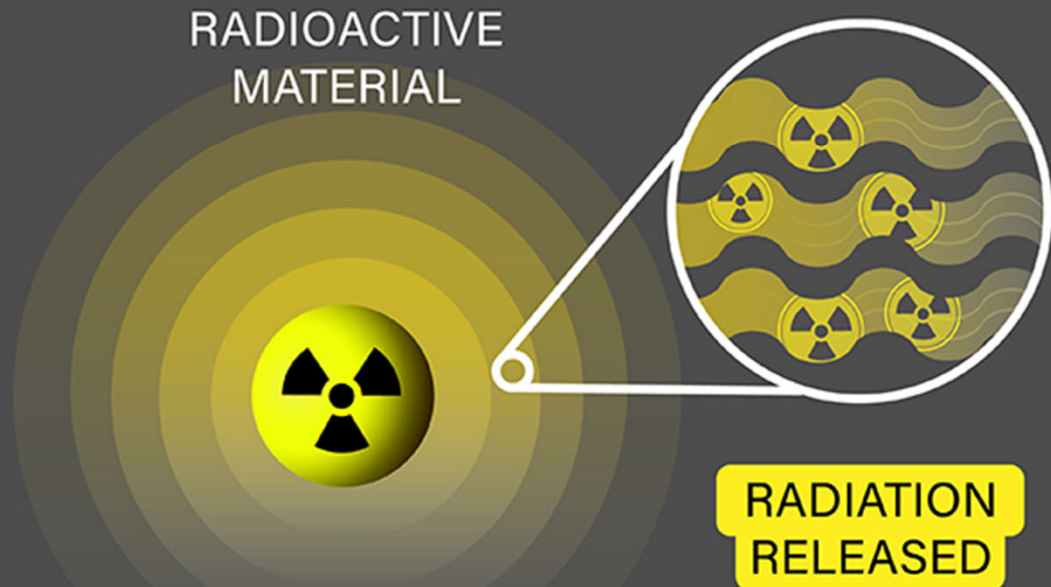
# Agenda

- Radiation fundamentals
- Brief review of current rules and issues
- Proposed Rules and modeling
- Next steps

# Radiation Fundamentals: Radioactivity

## Radioactivity

Radioactivity is a measure of the **radiation released** by a material.



## Using Radioactivity

**Common Use** Measuring soil, water and air samples

**Units** Becquerel (Bq), Curie (Ci)

### Examples

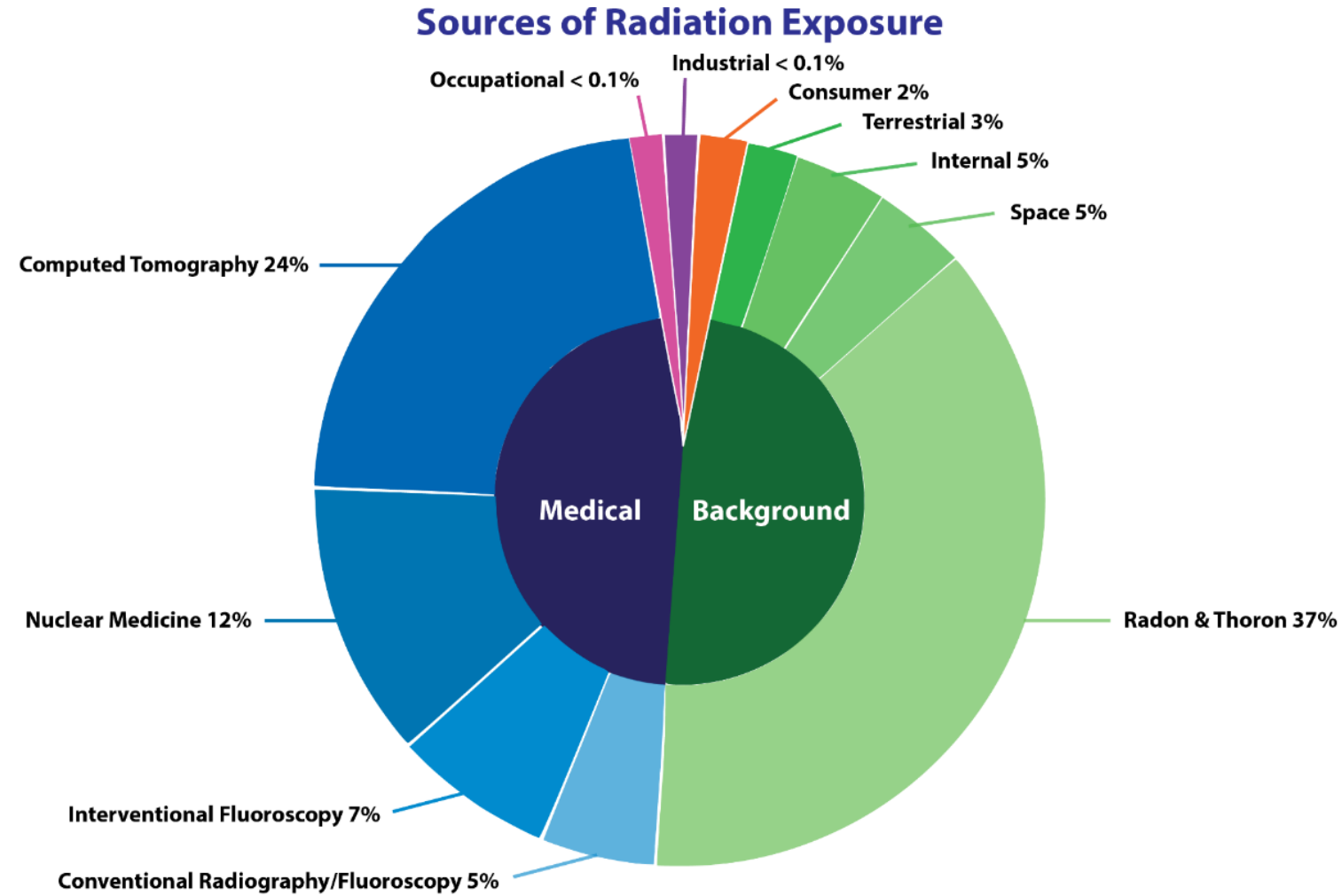


**Surface water**  
Natural radium-226 levels:  
0.0037 – 0.0185 Bq/L  
or 0.1 – 0.5 pCi/L



**Drinking water**  
Radium limit for daily  
consumption:  
0.185 Bq/L or 5.0 pCi/L

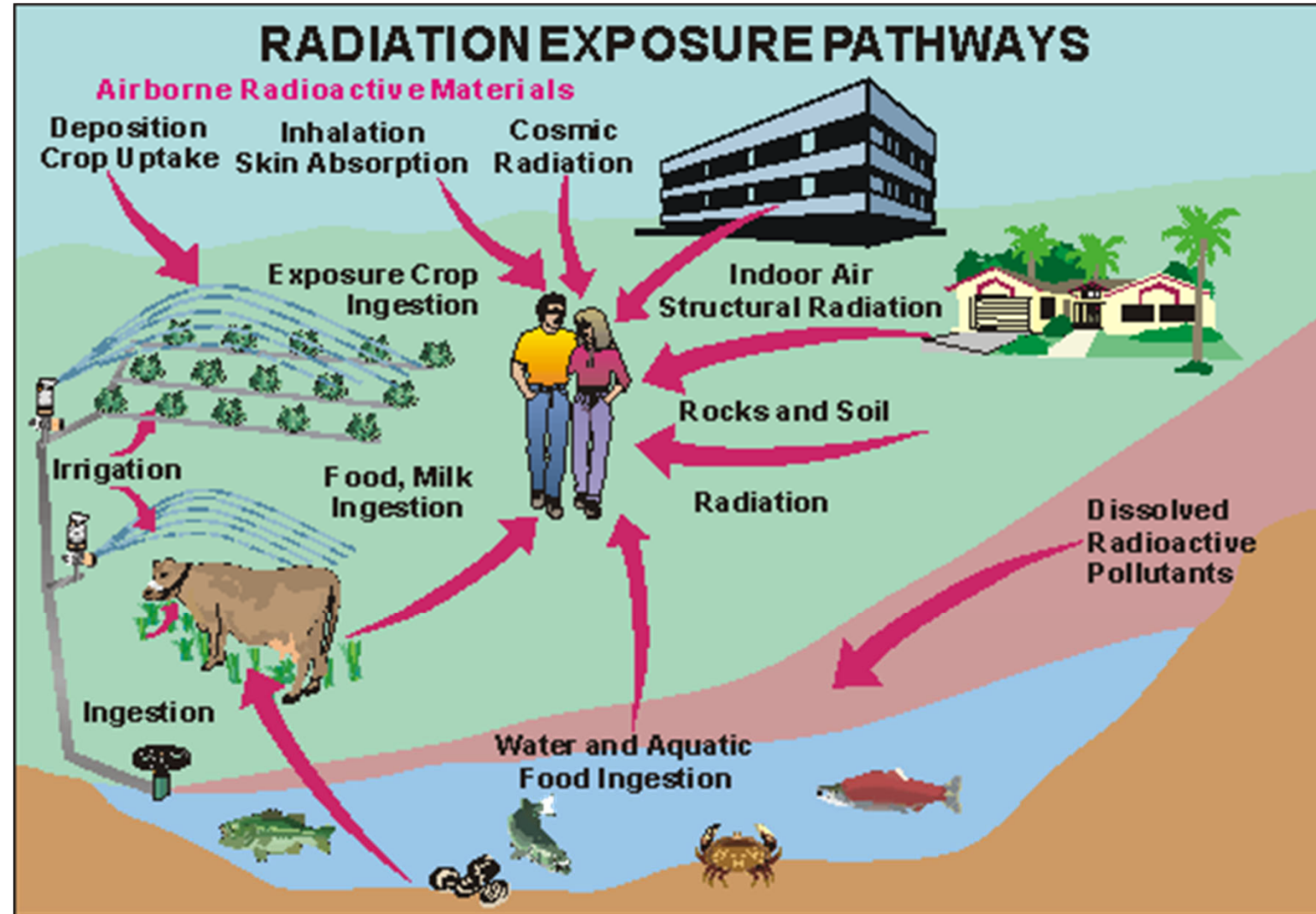
# Radiation Fundamentals: Background Radiation



Average Annual Radiation Dose											
Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
<b>Units</b>											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33 mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

From NCRP Report No. 160 (2006): *Ionizing Radiation Exposure of the Population of the United States*

# Radiation Fundamentals: Exposure Pathways



# NORM and TENORM

- **NORM – Naturally Occurring Radioactive Material**
  - Typically refers to "unrefined" materials from the uranium and thorium decay chains, although in some scenarios is only applicable to materials in place
- **TENORM – Technologically Enhanced Naturally Occurring Radioactive Material**
  - NORM that has been processed such that it becomes more radioactive or to increase the likelihood of human exposure

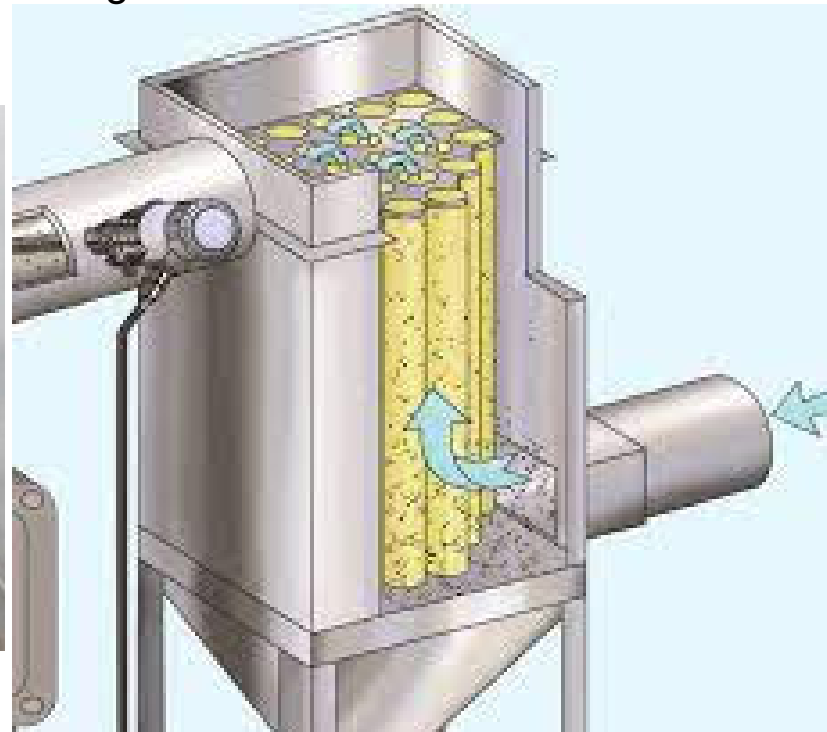


# Examples of TENORM

Sandblast Grit



Baghouse Dust



Pipe Scale



Portland Cement



Filter Socks



Foundry Shell



Water Heater Scale

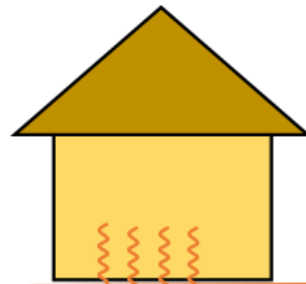


# Current Oregon Rules

## ***ORS 469.525: Radioactive waste disposal facilities prohibited***

*("Radioactive waste" is defined by its risk properties)*

- Assume a person builds a house on the waste
- No credit for burial shielding
- No credit for land use controls
- No credit for caps and liners



*Waste must pass leach testing – demonstrate inherently low migration*

- Material is determined to be NOT radioactive waste
  - If concentrations are lower than specified limits or quantities (current Tables 1 & 2)
  - Specific exemptions in OAR 345-050-0030 (e.g. Ra-226 < 5 pCi/g)
  - If concentrations are over these limits, must demonstrate:
    - External gamma exposures less than 500 mrem/year
    - Leachate concentrations less than Table 3 values
    - Radon in a hypothetical house is less than 3 pCi/L of air

# Current Oregon Rules: An Incomplete List of Issues Related to the Pathway Exemption Process

- Current 500 mrem/year dose limit for pathway exemption is not consistent with the current Federal exposure threshold of 100 mrem/year for the general public
- Rules do not account for protections modern disposal facilities provide
- Lab detection limits are frequently not sufficient, resulting in costly and time consuming additional testing
- Pathway process is arduous and open to interpretation

# Big picture recommendations for new Rules

- EFSC/ODOE may identify materials as not radioactive waste that do not present significant danger to public health or safety
- Any new Rules must ensure that workers, the public, and future residents of Oregon are protected, while allowing businesses to operate in the state
  - Safety: use model that ensures doses aren't underestimated
  - Consistency: update dose limits to match Federal standards
  - Science: use latest dose coefficients
- Specific Oregon landfills may elect to NOT accept wastes requiring inventory tracking
  - Characterization of certain wastes for radiation
  - Acceptable plan for ODOE review

# Proposed Rules: Modeling

- RESRAD model

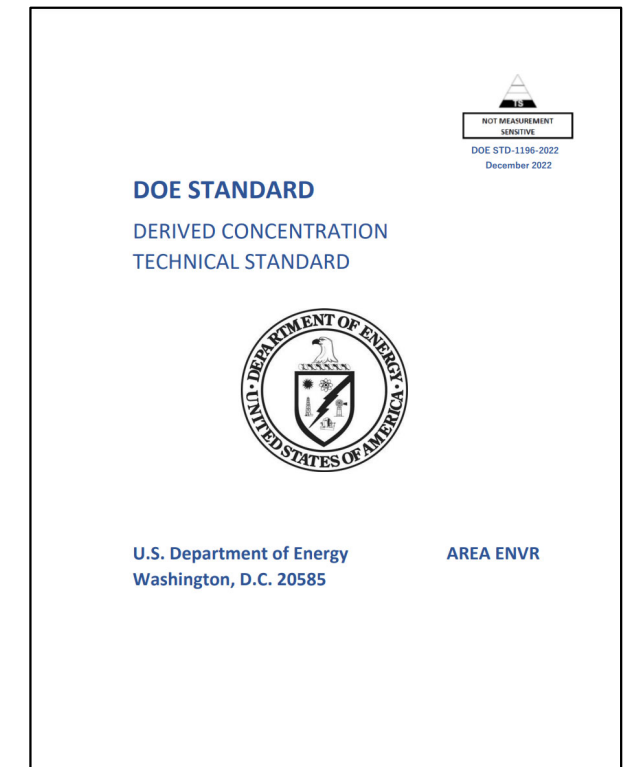
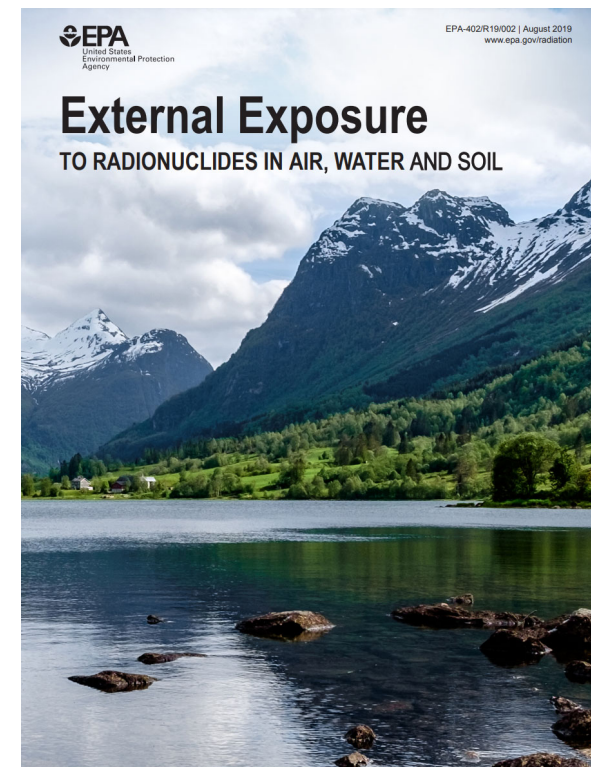


## RESRAD-ONSITE

For assessing radiation exposures of a human receptor located on top of soils contaminated with radioactive materials

- Conservative input values to ensure doses are not underestimated (more later)
- Inventory accounts for cumulative effects

- Most current dose coefficients



Both published in 2022!

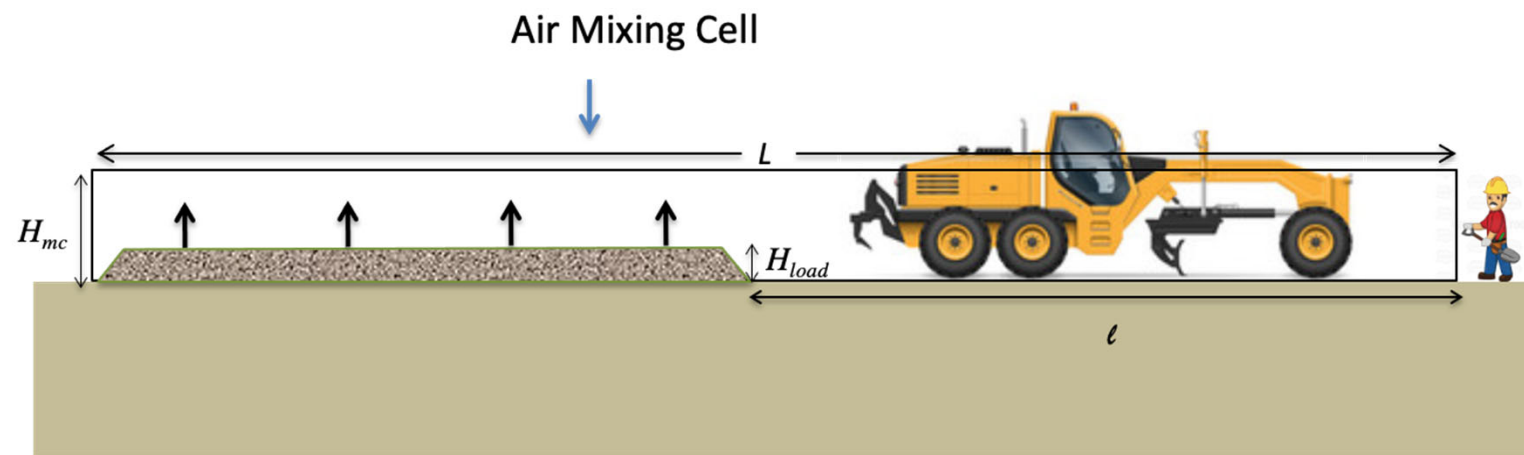
# Proposed Rules: Current disposal facility worker

- **Exposure pathways**

- External exposure
- Incidental ingestion of soils
- Inhalation of particulates

- **Dose limit – current worker**

- 100 mrem per year
- Consistent with current Federal regulations and guidance from the International Atomic Energy Agency, the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, and the American National Standards Institute





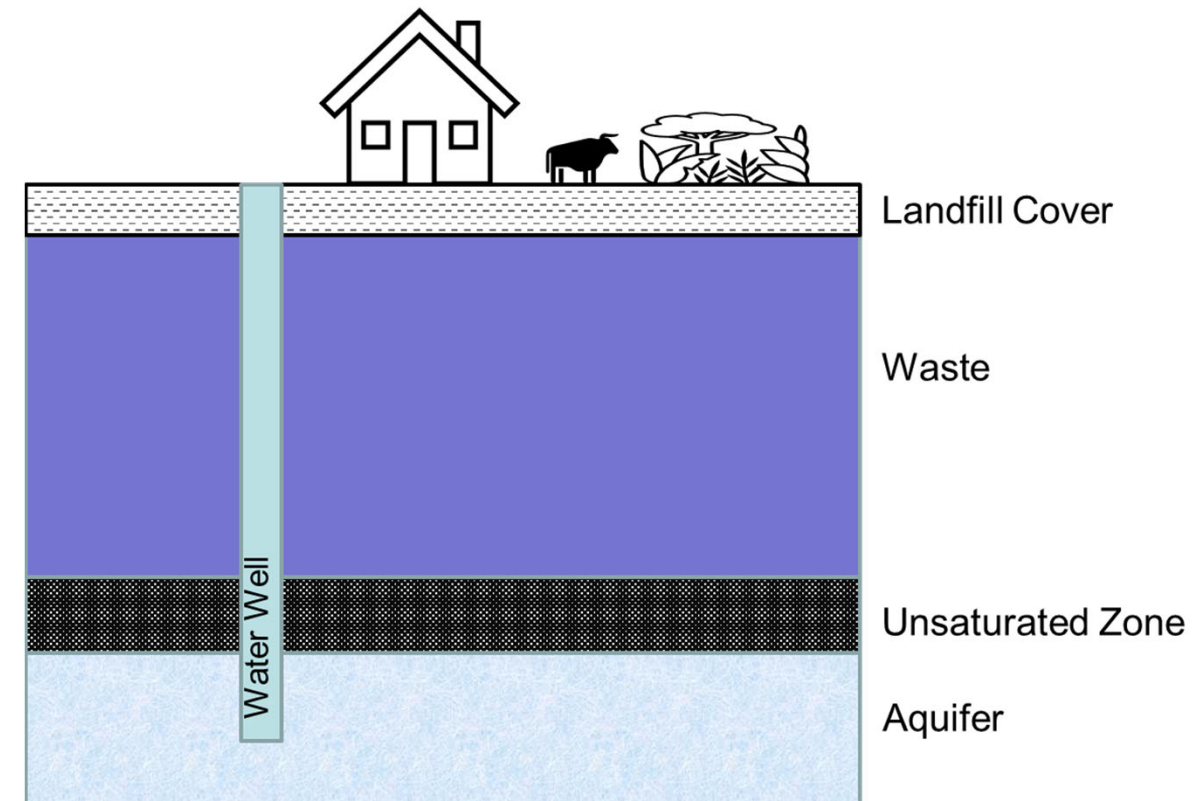
# Proposed Rules: Future hypothetical resident

- **Exposure pathways**

- External exposure
- Incidental ingestion of soils
- Inhalation of particulates
- Water ingestion
- Plant ingestion

- **Modeled limits**

- 25 mrem per year, consistent with newest guidance from the Health Physics Society and American National Standards Institute (2016)
- Radon flux and air concentration limited



# Disposal model options: Generic facility

- **Generic disposal facility model option**
  - Standard Oregon landfill
    - Averages used for: precipitation, thickness of waste, waste cover
    - Standard reference parameters (default) used for: solubility, ingestion/inhalation parameters, plant/animal uptake, etc.
    - All parameters are conservative, e.g. high-sided to ensure doses are not underestimated
  - Disposal model determines maximum NORM/TENORM activity inventory allowed per landfill (in Curies or Bq)
    - NORM/TENORM mass and activity inventory for Ra-226, Th-232, U-238 tracked by each facility

# Disposal model options: Site-specific facility

- **Site-specific model option**
  - Department-approved model of a specific landfill
    - Thickness of cover
    - Environmental setting (e.g. annual average precipitation)
    - Disposal facility dimensions, total volume
  - Disposal model determines maximum NORM/TENORM activity inventory allowed per landfill (in Curies or Bq)
    - NORM/TENORM mass and activity inventory for Ra-226, Th-232, U-238 tracked by each facility

# Table A: Exclusions List

- Medical wastes, regulated by Oregon Health Authority<sup>1</sup>
- Waste from residential sources (cat litter, chemo diapers)
- Phosphate or potash ore-based fertilizer products<sup>2, 3, 6</sup>
- Zirconia/zircon containing NORM/TENORM, unless manufactured from ore or processing increased mobility<sup>2, 3, 6</sup>; exemptions include:
  - Industrial grinding/cutting discs (Norton 143, Radiac, or similar)
  - Zircon-based insulating blankets (Kaowool or similar)
  - Zircon materials that have been made less environmentally mobile (hardened slurry, brown fused alumina, bricks, or similar)
- Mine drill cuttings, rocks, overburden<sup>3, 4, 5</sup>
- Oil and gas exploration and production drill cuttings, fluids<sup>3, 4</sup>
- Coal combustion residuals (i.e., fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste) from energy conversion<sup>3, 6</sup>
- Cement of all types and cement kiln dusts from industrial processes<sup>7</sup>
- Municipal wastewater treatment wastes<sup>8</sup>
- Sandblasting wastes (includes filters)<sup>9</sup>
- Mixtures of these wastes with other non-NORM/TENORM wastes
- Materials currently exempted under Table 1, Table 2, or specific exemptions
- Materials previously legally disposed of or ongoing disposal of materials which have been approved as pathway exempt

# Table B: Waste classes requiring isotopic review

<b>Waste classification</b>	<b>Examples (not exhaustive)</b>
Mining	Mine water residuals – sludges, resins, spent filters/media/membranes, equipment cleanout
Petroleum refining and production	Filter socks, pipe scale, tank bottoms, refinery sediments, stratum water
Geothermal	Filter socks, pipe scale, tank bottoms, stratum water
Metal casting	Baghouse dusts
Others	Ceramic, refractory, baghouse dusts with refractory, mag-thor metals, off-spec zircon products not used in manufacturing



# Generator Requirements

Proper characterization of wastes, whether NORM/TENORM or not, is the responsibility of the **generator**

1. Generators fill out form describing waste and certifying its contents (see [Table A](#) & [Table B](#))
2. If waste is *not* on [Table A](#) and *is* on [Table B](#), generator is required to provide representative composite sample(s) to certified lab for gamma spectroscopy (via EPA method 901.1) and provide the results to disposal facility operator

# Waste acceptance – generator side

Generator, disposal facility, or third party contractor:

1. Reviews analysis from representative sample(s) for Ra-226, Ra-228, and U-238
2. Compares results against new **Table C: Exempt NORM/TENORM Concentrations** (similar to the current Table 1) and **Table D: Maximum Concentration Limits** (new)
  - a. If *less* than new **Table C** values, wastes are exempt from the radioactive waste definition and disposal prohibition
  - b. If *greater* than new **Table C** values AND *less* than **Table D** values, wastes may be disposed of in Oregon with disposal facility approval (see next slide)
  - c. If *greater* than new **Table C** values AND *greater* than **Table D** values, wastes are prohibited from disposal in Oregon and must be shipped out of state

# Waste acceptance – disposal facility side

Individual Oregon landfills may elect to NOT accept wastes requiring inventory tracking.

→ ODOE reviewed program expected

Disposal facilities can accept or reject NORM/TENORM materials:

- If waste is rejected by the disposal facility
  - Waste must go to alternative facility or be shipped out of state
- If waste is accepted by the disposal facility, the operator must:
  1. Check inventory limits (prior to disposal physically occurring)
  2. Record Ra-226, Th-232, and U-238 concentrations (from gamma spectroscopy results)
  3. Record total waste mass accepted
    - This information goes into annual report (see later slide)

# Generic Disposal Facility Requirements

- Adapted from the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) guidance report for solid waste managers (2011)<sup>1</sup>
  - NORM/TENORM should be limited to 10% or less of the volume in a given cell or total disposal facility
  - NORM/TENORM waste should be covered with at least 6 inches of clean soil (or other non-NORM/TENORM wastes) by the end of each working day
  - NORM/TENORM wastes should be covered with at least 6 ft of a combination of the disposal facility cover materials and clean wastes that do not contain radionuclides prior to closure
  - Workers should receive appropriate education and training
  - Dust control should be implemented
  - Disposal facility should have a liner and leachate collection and recovery system
  - Disposal facility should have the ability to sample groundwater
  - Annual reporting requirement (specifics discussed later)
  - Follow requirements of closure permit

# Disposal Facility Annual Reporting

- Annual reporting
  - Inventory limits for disposal facility and YTD quantities (mass and activity) of Ra-226, Th-232, and U-238 (based on waste manifests)
    - Inventory tracked for wastes with concentrations above new [Table C: Exempt NORM/TENORM Concentrations](#)
  - Monitoring of leachate and groundwater
    - Solids analyzed using EPA method 901.1
    - Liquids analyzed using methods in §40 CFR 141.25
    - Leachate sampling: Results compared to new [Table E: Maximum Contaminant Levels for Leachate](#)
    - Groundwater samples: Results compared to new [Table F: Maximum Contaminant Levels for Groundwater](#)

## Analysis methods for liquids per §40 CFR 141.25

Radionuclide	Acceptable Analytical Method for Liquids
Uranium	EPA 200.8
Ra-226	SM 7500-Ra B
Ra-228	EPA 904.0
Th-232	EPA 200.8



# Next steps

- Agree on general modeling concept and decision-making process
- Finish draft RESRAD modeling and parameter documentation
- Schedule follow up RAC meeting to review modeling and parameters in detail
- Agree on parameter values with ODOE

Then...

- Rerun RESRAD model with accepted parameter values and produce draft documentation for review
- Produce draft Rules incorporating new methodology and provisions
- Produce draft [Table C: Exempt NORM/TENORM Concentrations](#) (revision of part of current Table 1)
- Produce draft [Table D: Maximum Concentration Limits](#) (new)
- Produce draft [Table E: Maximum Contaminant Levels for Leachate](#) (new, replaces current Table 3 column 2)
- Produce draft [Table F: Maximum Contaminant Levels for Groundwater](#) (new, EPA MCLs)