



MICHIGAN DEPARTMENT OF  
ENVIRONMENT, GREAT LAKES, AND ENERGY

# TENORM & RAM

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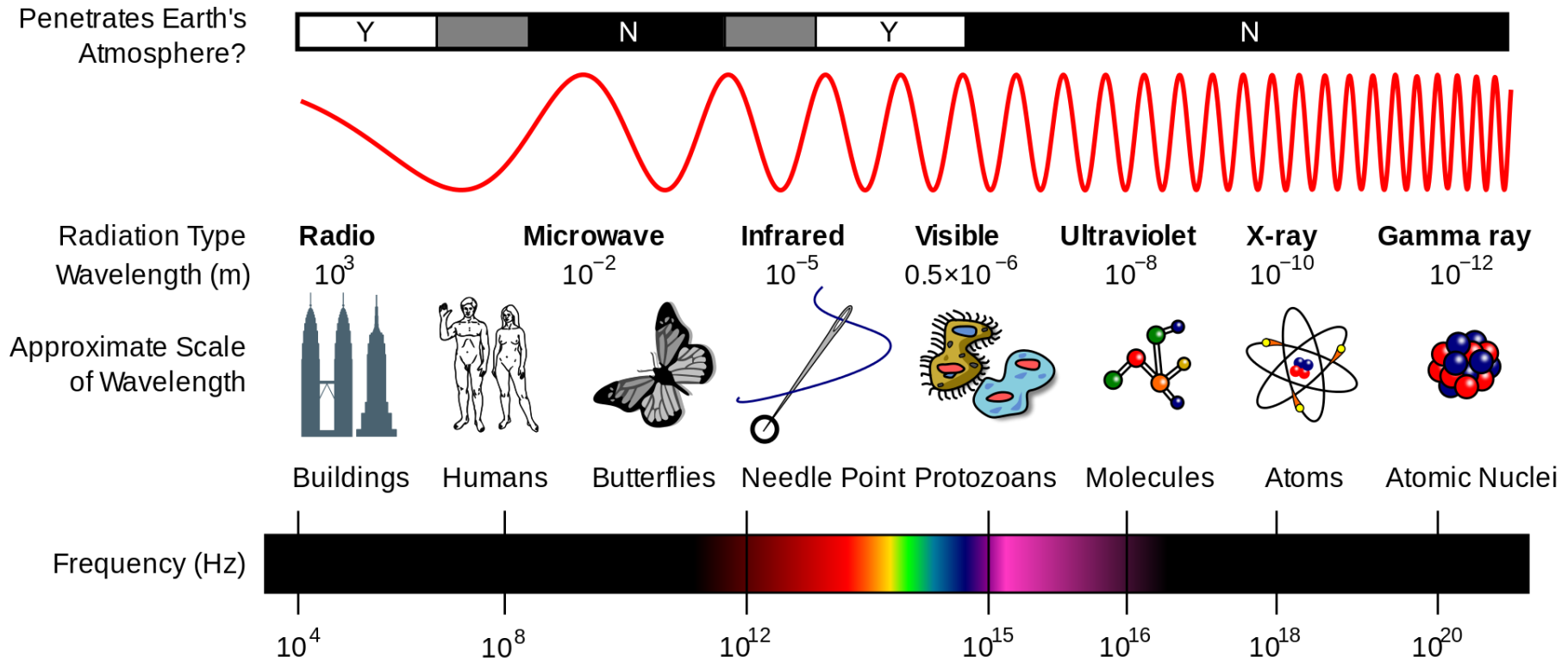
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# TENORM & RAM

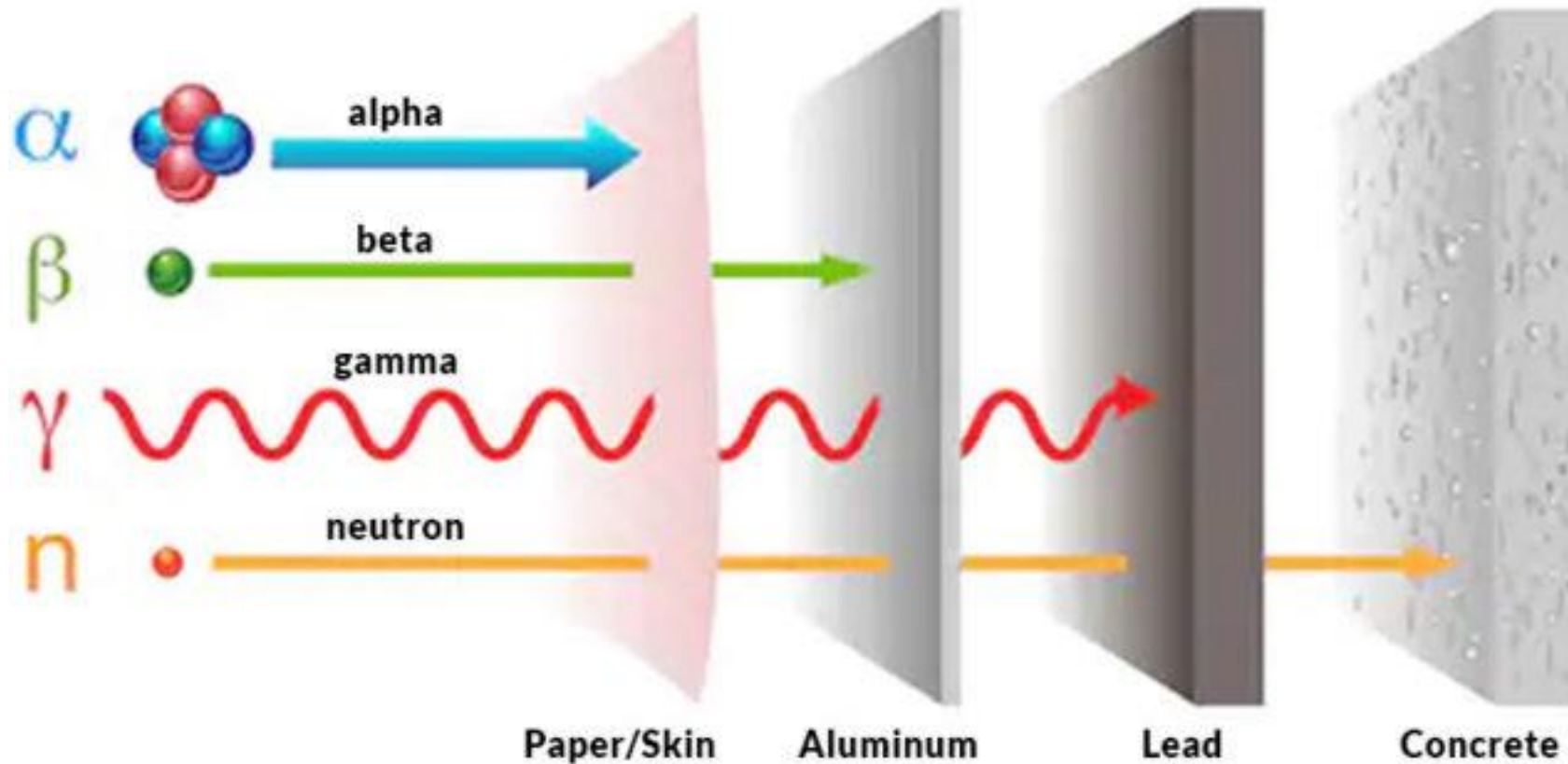
- Radiation: What is it?
- NORM & TENORM
  - Definition
  - Origins, Processing, and Disposal
  - [PA 688](#) and [PA 689](#)
- Other Radioactive Material
  - Medical Radionuclides
  - [Unimportant Quantities of Source Material \(Th and U\)](#)
  - Exempt Quantities
  - LLRW
  - General and Specific Licensed Radioactive Material
- DOT Special Permits

# Radiation



www.wikiversity.org

# Radiation - Ionizing



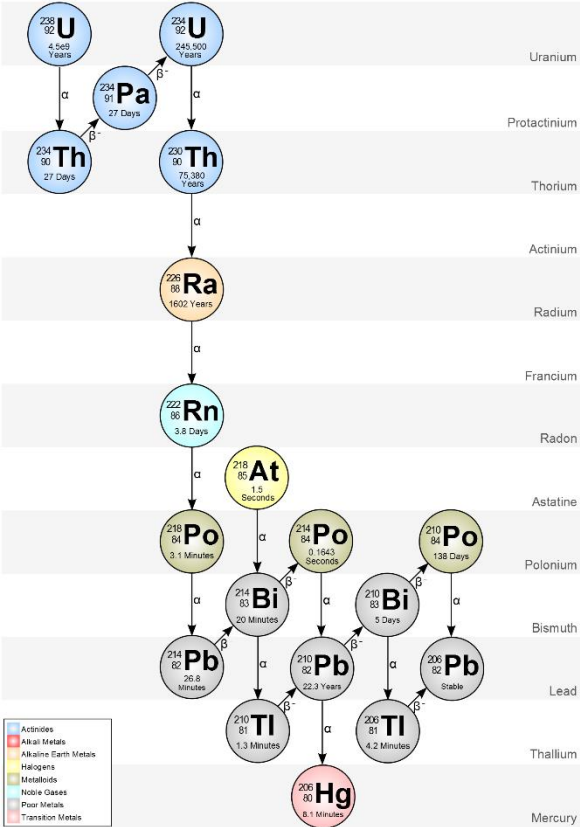
marshield.com

# NORM Origins

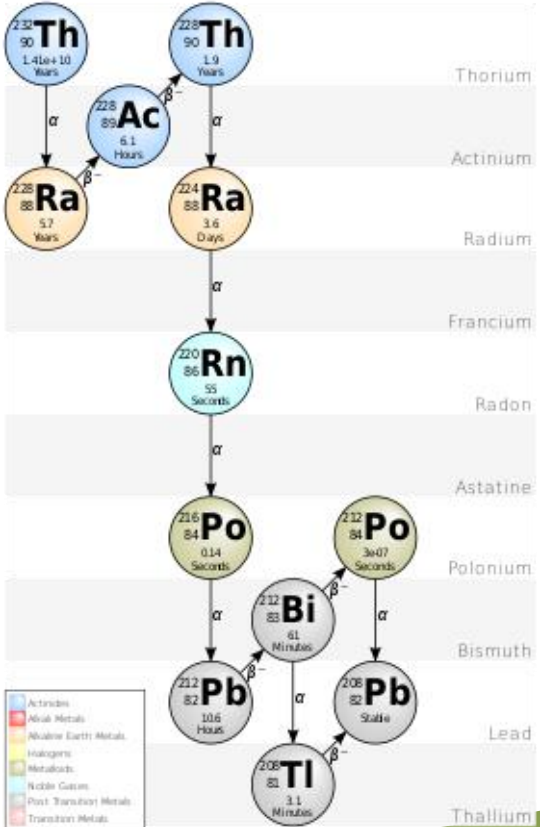
- NORM is material found in the environment that contains radioactive elements of nature's origin. These elements originate from natural Uranium and Thorium, which decay to other radionuclides including Radium, Lead, and Radon.
- Rocks
- Soil
- Clay
- Ores
- Coal
- Groundwater with dissolved radionuclides

# NORM

U-238 Decay Chain (99.2% nat. ab.)



Th-232 Decay Chain (99.98% nat. ab.)



metadata.berkeley.edu



# TENORM

- Technologically Enhanced Naturally Occurring Radioactive Material
  - No national definition
  - Defined in Michigan under [Public Act 688 of 2018](#) (For Disposal Purposes)
    - Any NORM whose radionuclide concentrations have been increased as a result of human practices
    - Explicitly does not include source material as defined by the atomic energy act of 1954 (Uranium and Thorium). Federally regulated.
    - Material with Radium-226, Radium-228, and/or Lead-210 concentrations exceeding 5 pCi/g

# TENORM Origins - Water

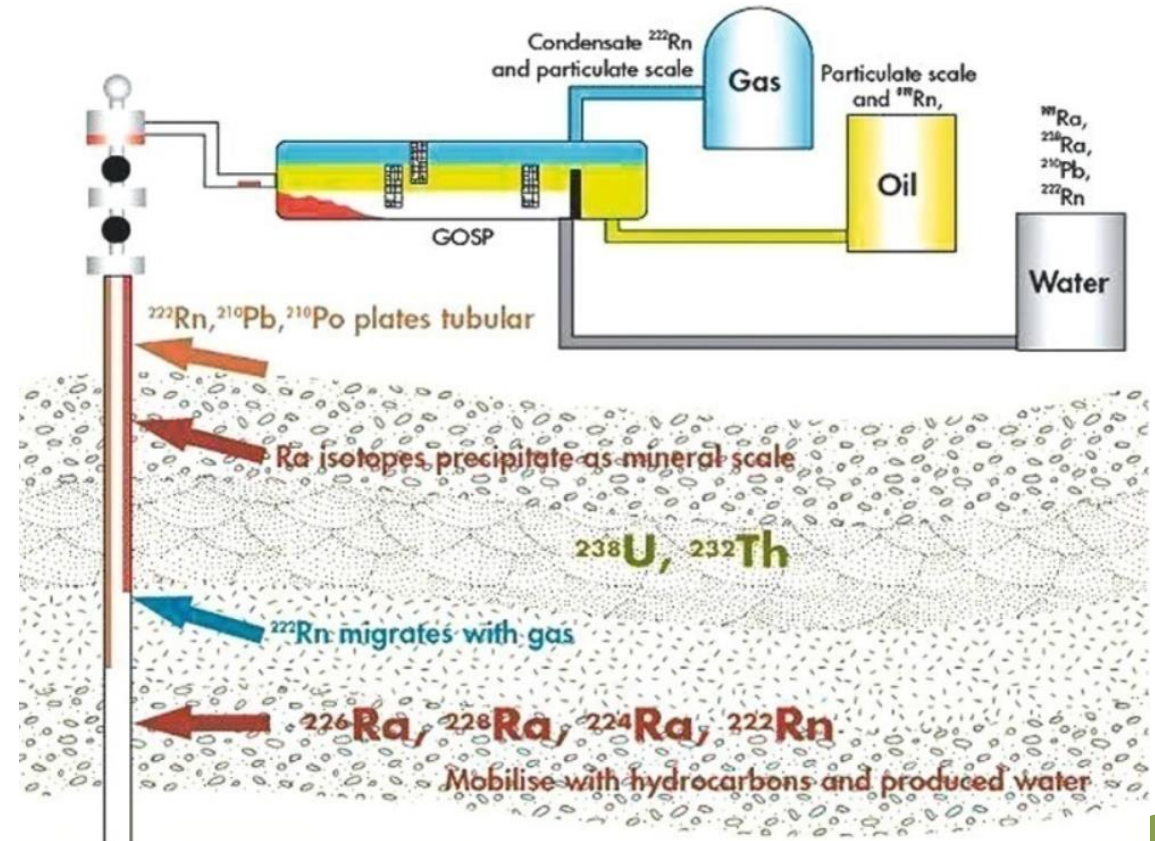
- Drinking Water Systems
  - TENORM is more likely in facilities processing large quantities of water.
  - Heavy metal removed by filtration, which can accumulate radium
  - Dependent on geology
- Wastewater Treatment
  - Drinking water Plants often back flush filters and send effluent to Waste-Water Plants.
  - Not a major concern at WWTP as there is not sufficient time for accumulation.





# TENORM Origins – Oil and Gas

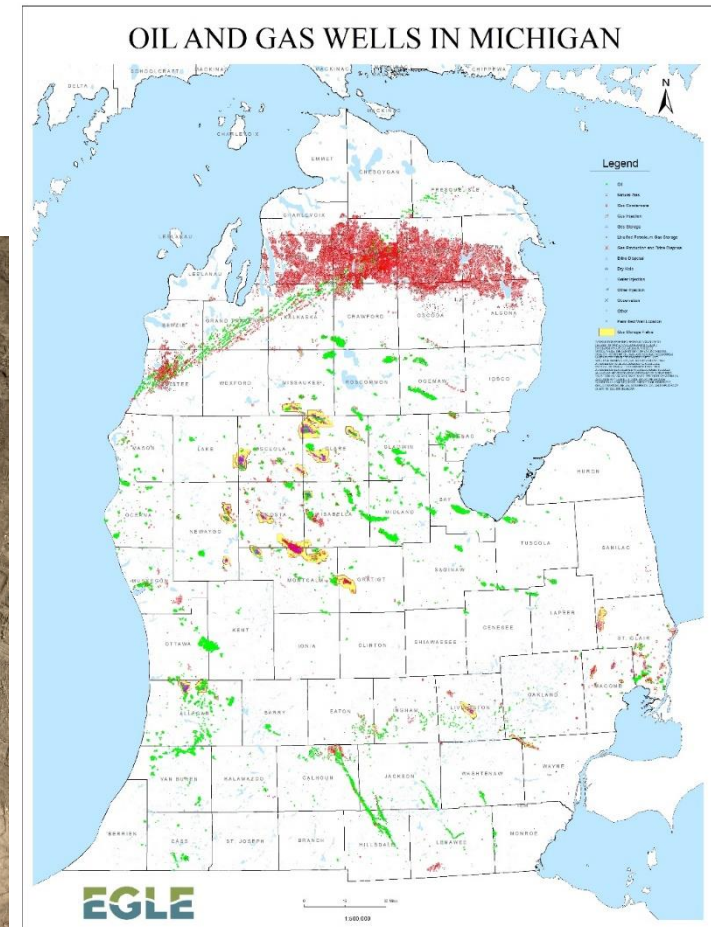
- Oil and Gas Industry
  - Drill Cuttings
  - Flowback and Produced Water (brine)
  - Pipe Scale
  - Sludges, Sediments, and Filters
- Radium is carried up in chloride rich brines
- Radium plates out as temperature and pressure reduce
- Radon will pass through filters and plate out as Pb-210 (gas lines)



International Assoc. of Oil & Gas Producers, Report No. 412 (2008)

# TENORM Origins – Oil and Gas

- ~4,100 Oil Wells (green)
  - Ra-226, Ra-228, and Pb-210
- ~10,400 Gas Wells (Red)
  - Pb-210



# TENORM Processing & Disposal

- Materials with Ra-226, Ra-228, and Pb-210 concentrations under 5 pCi/g are not considered TENORM and is unregulated as radioactive material.
- Materials exceeding 5 pCi/g can be processed by a TENORM contractor.
  - Scale can be physically removed
  - TENORM is downblended with clean material
- Some material with high concentrations of TENORM are not easily downblended and will require disposal at a LLRW facility

# TENORM Site Cleanup Guidelines

- General Site Contamination
  - Follow [EQC-1602](#)
  - 10  $\mu\text{R}/\text{h}$  above background at 1m above any surface
- Brine Contaminated Soils
  - Unlikely to be an issue if simply a spill
  - Leak locations with continual exposure can produce elevated TENORM concentrations
  - Initial soil survey with portable meter per [EQC-1602](#)

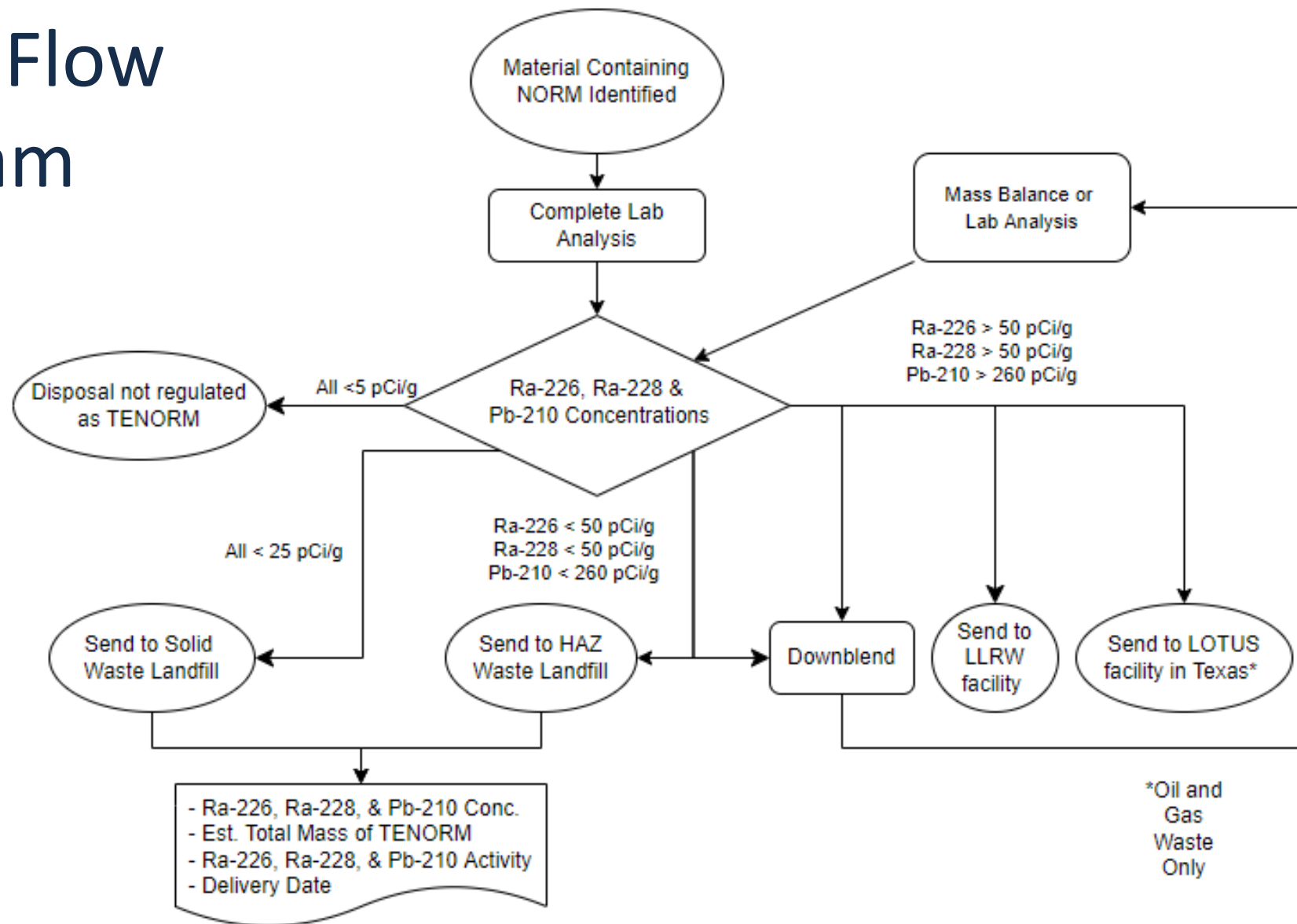
# TENORM PIGGING Waste

- Treated the same as all other TENORM waste
- When surveying material from natural gas processing/cleaning use a pancake meter or other detector capable of detecting  $\alpha$  &  $\beta$ -particles
- Ra-226 and Ra-228 would be present in upstream equipment



[www.ludlum.com](http://www.ludlum.com)

# Disposal Flow Diagram



Suggested Disposal Diagram for Michigan Feb-2022

# PA 688 & PA 689 Highlights

- [PA688](#) (Part 111 & Part 115)
  - Sets disposal concentration limits
  - Defines reporting requirements for generators
  - Conditional employee and environmental monitoring requirements for increased concentration disposal
  - Requires monitoring and capping requirements for increased concentration disposal
  - Sets annual reporting requirement for operator's summary of TENORM collection
- [PA689](#)
  - Set tipping fee for TENORM waste at \$5/ton
  - Only applies to hazardous waste landfills

# Medical Radionuclides

- Not regulated by the state of Michigan
- Regulated by the United States Nuclear Regulator Commission (NRC)
- Release of patients administered with radioactive materials falls under [10 CFR 35.75](#)
- Some radionuclide residuals in patient excreta can be detected
  - If discovered in residential trash, can be buried in landfill
  - If discovered from a site-specific container, the container should be returned to the customer. Licensees authorized to administer these materials have license restrictions for material release & disposal.

Nuclide	~ Half-Life	Procedure
Ga-67	3.3 Days	SPECT Diagnostic
Cu-67	2.6 Days	Cancer Treatment
I-131	8 Days	Thyroid Cancer Treatment & Diagnostic
T-99m	6 Hours	SPECT Diagnostic
F-18	2 Hours	PET Diagnostic
Lu-177	6.7 Days	PSMA (Prostate)



# Unimportant Quantities of Source Material

- Regulated by the NRC under [10 CFR 40.13](#)
  - Source material is defined as any combination of U or Th in any physical or chemical form exceeding concentrations of 0.05% by weight.
  - How does this translate to laboratory analysis, which is typically reported in pCi/g?
    - Natural U = 335 pCi/g
    - U-238 = 165 pCi/g
    - Th-232 = 55 pCi/g
- If  $<0.05\%$   $\rightarrow$  can be handled without regard to its radiological component



# Examples: Unimportant Quantities of Source Material

Non-Regulated Materials	Provided
Unrefined and unprocessed ores	Not getting refined/processed
Incandescent Gas Mantles, Vacuum Tubes, Welding Rods, Electric Lamps	Less than 50 milligrams Th
Germicidal lamps, Sun Lamps, & Lamps for outdoor/industrial Lighting	Less than 2 grams Th
Rare earth metals and compounds	0.25% weight Th, U, or Combo.
Personnel Neutron Dosimeters	Less than 50 milligrams Th
Glazed Ceramic Tableware (Fiesta)	Made before 8-27-13 & <20% by weight
Piezoelectric Ceramic	<2% by weight
Coal and Fly Ash	<500 ppm Th and U

# Exempt Material - Smoke Detectors

- Do not dismantle
- Can contain Am-241 or Ra-226
- Disposal (Am-241)
  - Return to manufacturer
  - If a return program does not exist, they can go in residential waste
- Disposal (Ra-226) - Rare
  - Return to manufacturer
  - If a return program does not exist, these should go to a LLRW facility
- Seek guidance from the NRC prior to large volume disposals efforts. EGLE-RPS can often serve as a sounding board for guidance.

# LLRW

## Low-Level Radioactive Waste

- Contaminated materials
- Activated material
  - Accelerators
  - Reactor components
- Disposal Options
  - Securely store on site
  - Decay on site ( $t_{1/2} < 120$  days) → trash
  - Ship to LLRW disposal site
- No Disposal sites in MI
- LLRW from MI → Clive or WCS



Page Last Reviewed/Updated Thursday, March 12, 2020

# General & Specific Licensed Material

- General licenses are under [10 CFR 31](#)
  - A few Examples
    - Luminous Aircraft dials
    - Antique time pieces with Ra-226 (some, not all)
    - XRF equipment with source material
    - Gauge equipment
  - Cannot dispose of in general waste
  - Can return to MFG
  - Dispose of in LLRW
  - Transfer of material is restricted and consultation with the NRC is recommended
- Specific licenses are issued by the NRC (in MI) to authorize specific use of radioactive material that is otherwise not exempt or under a general license provision.
- When in doubt, reach out. Call ELGE-RPS or NRC Region III office for guidance.



www.epa.gov

# DOT Special Permits

- Granted authority to EGLE RPS by the US DOT
- [DOT SP 10656 – Scrap Loads](#)
- [DOT SP 11406 – Waste Loads](#)
- One way permit restrictions
  - Rail or Road
  - Must be shortest route to location
  - Can be back to the originator, or intermediate location for identification purposes
  - Allows temporary exemption from certain DOT requirements for carriers
  - Radiation cannot exceed 50 mrem/h at external surface or 2 mrem/h in any occupied space (Cab)

# Contact

- For assistance with Radioactive Materials or DOT permits
  - EGLE Radiological Protection Section –RAM Unit
    - [RadioactiveMaterial@michigan.gov](mailto:RadioactiveMaterial@michigan.gov)
    - 517-284-6581
  - Jay Paquette – RAM Unit Supervisor
    - [PaquetteJ3@michigan.gov](mailto:PaquetteJ3@michigan.gov)
    - 517-243-7197
  - EGLE
    - [www.Michigan.gov/EGLE](http://www.Michigan.gov/EGLE)
    - 800-662-9278