Background

- Naturally Occurring Radioactive Material - NORM (Technologically Enhanced - TENORM)
  - Uranium and Thorium natural decay chains
  - Potassium-40, Beryllium-7
- Extraction of material from the ground will always contain some amount of NORM
- Extraction method and processing will determine what isotopes are in your waste
- Oil & Gas/Petrochemical and Mining
  - Radium and its decay products in Oil/Gas/Petrochemical
  - Uranium, Thorium and everything else in mining
Background

The Uranium-238 Decay Chain

Atomic Number
82 83 84 85 86 87 88 89 90 91 92

Only main decays are shown
Gamma emitters are not indicated

Element Names
U - uranium
Th - thorium
Ra - radium
Pa - protactinium
Rn - radon
Po - polonium
Bi - bismuth
Pb - lead

Half-life units
a - years
d - days
h - hours
m - minutes
s - seconds

The Thorium-232 Decay Chain

Atomic Number
81 82 83 84 85 86 87 88 89 90

Only main decays are shown
Gamma emitters are not indicated

Element Names
Th - thorium
Ra - radium
Ac - actinium
Rn - radon
Po - polonium
Bi - bismuth
Pb - lead
Tl - thallium

Half-life units
a - years
d - days
h - hours
m - minutes
s - seconds
Where can you find guidelines and regulations?

- No federal NORM-specific regulations
- 19 states have specific NORM regulations
  - Just because you don’t have NORM specific regs, doesn’t mean you aren’t regulated!
  - Not much consistency between states
  - Often lacking in detail
- Other Agencies
  - CRCPD-Part N
  - OGP-412
General Flow for Waste Management

- Classify your waste
- Characterize your waste
- Determine Best Disposal option
- Profile, Package and Ship
Classify Your Waste

- Who regulates me?
  - What industry are you in?
    - Oil & Gas
    - Petrochemical
    - Power production (Coal Fired Plants)
    - Mining
    - Other
  - What process within an industry?
    - Oil vs Gas
    - Ore production vs Ore processing

Can I claim an Exemption?

What facilities are an option?
Characterization

- Off-site sample analysis
  - Gamma Spectroscopy (pCi/g, µCi/ml)
    - Broad spectrum NORM
    - Ra-226 via ingrowth or 187 keV peak
    - GLEPS for Lead-210
  - Alpha Spectroscopy
  - You **MUST** analyze for Pb-210 if your waste is derived from natural gas products (including crude distillates)

- On-Site Screening
  - Exposure Rate surveys of oilfield equipment (µR/hr)
Characterization

- Understand how your lab is reporting activities!
  - Some isotopes assumed to be in equilibrium and are reported as surrogate activities
  - Radium-226 has three options
    - Assumed equilibrium
    - 21-day hold for ingrowth
    - Direct count of low energy peak
  - Lead-210 has a very weak gamma, a special low-energy analysis is required for accurate results
- Are these samples being homogenized?
- Are these wet or dry weights?
Disposal Options

- Landfill
  - Exempt disposals in TX & LA (30 pCi/g Ra-226 or 228, 150 pCi/g all other NORM isotopes)
  - Special Permit disposal in WCS-Andrews, TX (Special permitted disposal cells for all levels of activity. May get reclassed to Class-A LLRW)
  - Special Permit disposal for regulated Radium and Lead in Michigan (on-site downblending)
  - High activity NORM in ID (500 pCi/g Ra-226+228, 1500 pCi/g Pb-210)
  - High activity NORM in WA (High activity limits for Ra or Pb, but may be reclassed to Class-A LLRW waste)
  - Several other Waste Compact facilities with varying limits
Disposal Options

- If you can claim Exploration and Production Exemption, Injection wells become an option.
- Three commercial wells permitted for NORM, all in TX.
- No activity limits.
- ONLY Radium and its decay products.
- Still must meet physical requirements (processed into slurry).
Disposal Options

- What about liquids?
  - Disposal limits are typically in pCi/g
  - Often have to refer back to general effluent release criteria in general radioactive material regulations
  - If it meets the above criteria it can be managed through on-site wastewater systems
  - Filter solids and analyze if suspended particulate
  - May have to solidify for landfill disposal
  - Texas does not allow dilution for purposes of meeting limit (i.e., you can’t take credit for the mass of the solidifying agent)
Case Study

Gas Fractionation Plant in TX has 10 drums of cartridge filters from the feed lines with 1100 pCi/g Pb-210, six drums of cartridge filters from the depropanizer unit with 250 pCi/g Pb-210, and two frac tanks full of flush water with 7x10E-9 µCi/ml Pb-210, six used valves off an exchanger unit with exposure rates of 10 µR/hr.
Feedstock lines are prior to first point of fractionation, so the E&P exemption applies. These can be disposed of at Lotus LLC in Andrews, TX via injection well. The other facilities will not take filters due to type of wells.

Deopropanizer unit is post first point of fractionation – no EPA exemption. Waste exceeds 150 pCi/g Pb-210, no state exemption. Waste is not of a type that can be blended for disposal in MI, so it either goes to ID for landfill, or WCS-Andrews, TX for a special permitted waste cell. Now it becomes basic economics.

Water is less than the general unrestricted effluent release for Pb-210 and can go to a commercial wastewater well or through on-site treatment.

50 µR/hr exposure rate exemption does NOT apply to natural gas lines in TX, but these can still go for exempt disposal with lab analysis of scale and TCEQ concurrence letter.
Case Study

Audience requests?
The first step is knowing what you have via surveying and sampling.

Figure out if you can claim an exemption!

Determine the available disposal options and compare the costs.

NORM regs are often vague, complex, inconsistent....

- Make sure your employees are properly trained.
- Utilized competent contractors...the dollar you save today may cost you millions in litigation in the future!!!