



TENORM Radiation Safety From Oil and Gas Production

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Just To Be Clear

- We're talking about this NORM:



- Not talking about this Norm:



**Corner stool at
Cheers; loves beer**

Outline

- **Definitions**
- **Sources and types of NORM/TENORM**
- **NORM/TENORM Regulations**
- **TENORM Radiation Safety**

NORM: Naturally Occurring Radioactive Material – U, Th, Ra, Rn, Po

- **We live on a radioactive planet**
- **Radioactivity is found everywhere**
 - **Soil**
 - **Rock**
 - **Plant**
 - **Animal**
- **We are exposed 24/7**

TENORM – Technologically Enhanced NORM

- **Natural material whose radioactive concentrations have been enhanced by human activities including:**
 - **Oil & gas pipe scale**
 - **Oil & gas sludges**
 - **Water treatment filter media**
 - **Natural gas processing equipment**

Ionizing Radiation – Why Worry?

- **Ionizing radiation health risks:**
 - **Acute effects – high levels of radiation produce effects such as blood chemistry changes, nausea, fatigue, various skin effects, cataracts, and death**
 - **Delayed effects – at some lower level of radiation, can increase risk of some cancers**
- **Radiation is a weak carcinogen compared to other materials (beryllium, asbestos, tobacco smoke...)**
- **What about at typical environmental and occupational dose levels? No risk? Hormesis? What are the implications?**

TENORM Exposure Pathways

- **Radon gas, external exposure, internal exposure**
- **Potential:**
 - **Worker exposure**
 - **General public exposure (and associated litigation risks)**
 - **Environmental impact**

Oil & Gas Industry

- **NORM/TENORM present in all phases**
- **Concentrations depend on geology**
 - **Higher concentrations in production phase (scale/sludge)**
 - **Drill cuttings**
 - **Produced water/flowback water**
 - **Radon decay products in gas production equipment**

Which Regulations Govern My Operation?

- **Some Federal regulations ‘touch’ on NORM**
 - EPA
 - OSHA
 - DOT
- **It really boils down to what State(s) do I operate in**

Regulations Overview

- **EPA – sets federal radiation standards for the public**
- **OSHA – has authority over hazardous materials in the workplace**
- **DOT – transportation of hazardous materials, including radioactivity, such as NORM**
- **States**
 - **NORM-specific regulations**
 - **Workplace dose rates; concentration limits in soil**
 - **Waste management**

Federal Agencies - EPA

- Airborne releases from phosphate industry and uranium mines under CAA
- Liquid discharges of TENORM from U mines and mills under CWA
- Superfund site cleanups
- Office of Water published proposed pretreatment standards prohibiting discharges of unconventional O&G extraction wastewater to publically owned wastewater treatment plants – April 7, 2015

Federal Agencies - OSHA

- **The regulator when workers are not covered under a materials license and are not Federal employees**
 - **Why? Because radiation is defined as a workplace hazard under OSHA regulations**
 - **The Reality – not actively regulating this or any radiation hazards**

Federal Agencies - DOT

- **Generators have the responsibility to know about their waste and appropriate management**
- **Waste characterization**
 - **Can be done through analytical testing, or**
 - **Through generator knowledge of a waste based on defensible and demonstrated factors**
 - **If uncertain, generators have the responsibility to perform analytical testing**

Oil Field Waste: Example Radionuclide Content

| <u>Radionuclide</u> | <u>Average Sludge</u> <u>pCi/g*</u> | <u>Average Scale</u> <u>pCi/g*</u> |
|---------------------|--|---------------------------------------|
| ^{210}Po | 56 | 360 |
| ^{210}Pb | 56 | 360 |
| ^{226}Ra | 56 | 360 |
| ^{228}Th | 19 | 120 |
| ^{228}Ra | 19 | 120 |
| Total | 206 | 1,320 |

270 pCi/g Ra-226, Ra-228 subject to DOT regulation.
Typical background radium-226 in soil is ~1 pCi/g

* EPA Data

States

- **16 states have regulations covering TENORM**
- **Another 9 have regulations and/or guidance addressing NORM**
- **CRCPD Part N suggested TENORM regulations**
- **Check your State regs!**

Some Common Threads In Determining If Exempt

- More robust regulatory programs in traditional oil producing States across the south; much less so in the newer gas regions
- 50 $\mu\text{R}/\text{h}$ (sometimes including background, sometimes not) from surface of equipment
- 5 pCi/g radium (usually above background); not easy to determine with hand-held instrument

Do We Need A License?

- It depends on
 - What State you're in
 - What you do

Where To Send Waste For Disposal

- Some waste acceptance criteria examples (5 states have landfills that can accept > 50 pCi/g)

- **Texas:**

- Radium-226: 30 pCi/g
- Pb-210: 150 pCi/g
- Equipment: <50 μ R/hr

- **Michigan:**

- Radium-226: 50 pCi/g
- Pb-210: 260 pCi/g

- **Idaho:**

- Radium (Ra-226 + Ra-228)
- Bulk: 500 pCi/g
- IP-1 package: 1,500 pCi/g

- **Washington:**

- Radium-226: 10,000 pCi/g
- Pb-210: no upper limit

What About Injection Well Disposal For O&G NORM Wastewater?

- **Maybe**
- **Injection wells in Ohio, Louisiana, Texas, Alaska, N.D.**
- **Elsewhere – wastewater treatment plant followed by landfill disposal of filter cake**

Oilfield NORM/TENORM – Workers Exposed?

- **Maintenance personnel – cutting, grinding, welding, scraping, dismantling pipes (scale/sludge)**
- **Pipe/equipment recyclers**
- **Personnel involved in remediation and decontamination operations**
- **Waste handlers/transporters**

Oilfield NORM/TENORM – Who Else Could be Exposed?

- **Members of the public**
 - **Landowners who have leased mineral rights**
 - **Transportation of wastes containing radioactive materials**
 - **Water treatment plant workers – they are members of the public with respect to radiation regulations**
- **Legal Implications?**

TENORM Radiation Safety

- **Written Radiation Safety Protocols**
- **Training**
- **Survey Activities:**
 - **Instrument surveys for dose rate, contamination**
 - **Air monitoring?**
 - **PPE – air filter, gloves, other**

TENORM Radiation Safety (continued)

- **Dose Monitoring**
- **Record-keeping – if there's no record, then it wasn't done**
 - **Can you defend your program if challenged?**
 - **We live in a very litigious society so this can't be stressed enough**

Common Sense Radiation Safety In An Uneven Regulatory Environment

- **Be familiar with your State's regulations**
- **Develop radiation safety procedures**
- **Provide radiation safety training**
- **Generate and maintain radiation safety records, including dosimetry**
- **KEEP IT REAL!!!**

Questions?

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