CHALLENGES IN REGULATING NORM – THE VIEW FROM THE UNITED STATES OF AMERICA STATE PROGRAMS

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Conference of Radiation Control Program Directors, Inc. (CRCPD)

- A Partnership Dedicated to Radiation Protection
Organization

The Conference of Radiation Control Program Directors was established in 1968 and is identified as a nonprofit, nongovernmental professional organization.

The CRCPD is managed by Executive Director, Ruth McBurney

The Board of Directors is the governing body, which consists of seven State or local members from across the United States.
Organization

Partnerships with Experts from Federal Agencies

- Centers for Disease Control and Prevention
- Department of Energy/ National Nuclear Security Administration
- Department of Homeland Security/ Federal Emergency Management Agency
- Environmental Protection Agency
- Food and Drug Administration- Center for Devices and Radiological Health
- Nuclear Regulatory Commission
- Department of Transportation

A Partnership Dedicated to Radiation Protection
Mission

- To promote nationwide consistency in addressing and resolving radiation protection issues
- To encourage high standards of quality in radiation protection programs
- To provide leadership in radiation safety and education
Purpose

➢ To provide a common forum for the exchange of information among State and local radiation control programs.

➢ To provide a mechanism for States to communicate with the federal government on radiation protection issues.
Goal and Objectives

- Keep radiation exposure of the patient, worker, and general public to the lowest practical level, while not restricting the beneficial use of this valuable energy source.

- Four Major Objectives
  - Promote consistency in radiation protection practices
  - Provide leadership in radiation issues
  - Improve efficiency in radiation protection
  - Enhance relationships with members
Practical Arrangements with IAEA Under Development

CRCPD and IAEA are working toward Practical Arrangements for working collaboratively in the development and sharing of information in the areas of:

– Naturally Occurring Radioactive Materials impacting the environment, public and occupational workers
– Reduction of radiation exposure from radon
– Radiation protection and safety of patients in new emerging technologies used in medicine
NORM VS. TENORM

Naturally Occurring Radioactive Materials (NORM) describes materials that contain radionuclides that exist in the natural environment. There are natural long-lived radionuclides and their decay products that have always been present in the earth’s crust and within the tissues of all living species.

Australian Department of Industry, Innovation and Science
Definition of TENORM in Current CRCPD Suggested State Regulations - Part N

TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVE MATERIAL

Describes NORM where radionuclide concentrations are increased by or as a result of past or present human practices. TENORM does not include background radiation or the natural radioactivity of rocks or soils. TENORM does not include "source material" and "byproduct material" as both are defined in the Atomic Energy Act of 1954, as amended (AEA 42 USC §2011 et seq.) and relevant regulations implemented by the NRC.
NORM VS. TENORM

What does “human practices” mean?

- Mining and Extraction
- Drill cuttings from oil and gas production
- Industrial/Chemical Processes
Source Terms that Enhance NORM

- Oil and Gas Production
  - Scales
  - Sludge
  - Flowback or Produce Water

- Phosphate fertilizer production and phosphogypsum
  - Tailings
  - Filters

- Water treatment facilities
  - Filters and Resin Beds
Early concerns from:
- Contaminated pipe in scrap yards and for recycling into other uses
- Contaminated soil in pipe cleaning and storage yards

Concentrations
Average: 3.7 kBq/g (radium)
Upward range to: 3.7 MBq/g (radium)
Pipe Scale

- June 9, 2016 Western Arkansas
- Survey Readings
  - 1.0 – 1.5 μSv/hr
Contaminated Oil and Natural Gas Production Equipment

Worker awareness and protection issues involved in cleaning and maintenance.

Phosphogypsum

Large areas of diffuse material
Average concentration of radium:
1.1 Bq/g (30 pCi/g)
Water Treatment Systems

- Filtration systems concentrate radionuclides from drinking water

- Example: Average Illinois municipal sludge concentration: Approx. 1kBq/kg combined radium (50% Ra-226, 50% Ra-228)

- Average 56,000 tons per year
Other Sources of TENORM

**Additional Industries:**
- Chemical production facilities
- Geothermal wastes
- Paper/pulp industry
- Rare earth mining

**Other Waste Forms:**
- Flowback/Formation Waters
- Radon from landfill gas systems
- Pb-210/Po-210 airborne particulates

**Varying State Limits:**
- Fly Ash
- Municipal wastewater sludges
- Drill cuttings
- Refractory material
Features of CRCPD Model Regulations for NORM

• Applies to all sources of TENORM, except that which is defined as byproduct or source material by Atomic Energy Act of 1954

• Definition of TENORM constrains the scope of the regulations

• Radon excluded from dose calculation

• Limited to increases in NORM Concentrations
Features of CRCPD Model Regulations for NORM

- Industry specific exemptions (*fertilizer, zircon*)
- Dose-based exemptions (0.185 Bq/g)
- Land application up to 370 Bq/kg
- 0.5 μSv/hr release limit for scrap and equipment
Consistent Regulatory Framework Needed

Inconsistencies in handling TENORM and varying thresholds at which TENORM becomes regulated licensed material.

- Unclear regulatory picture for industry
  - Regulatory oversight of wastes vary State to State
  - Inconsistent protective standards for the environment and the public
- No clear and consistent disposal guidance for Solid Waste Disposal
- Worker protection standards and training requirements range from non-existent to required for essential licensed personnel
- NORM sometimes disposed at Low Level Radioactive Waste (LLRW) sites and results in differences in waste acceptance criteria at disposal sites.
E-42 CRCPD Task Force Report

REVIEW OF TENORM IN THE OIL & GAS INDUSTRY

Report completed in June 2015

The emphasis of this report is on the need for nationwide scientific consistency in a more standard regulatory framework to ensure public health and protection of the environment.

www.crcpd.org/Pubs/TENORM/E-42_Report_Review%20of%20TENORM.pdf
E-42 Task Force Recommendations

1. Establish a more consistent definition of TENORM
2. Review the acceptance criteria in Suggested State Regulations- Part N for adequacy, using a consistent dose and regulatory approach
3. Partner with National Council on Radiation Protection (NCRP) on the criteria to develop trigger levels
4. Further evaluate the extent and quantification of Lead-210 (Pb-210) and Polonium-210 (Po-210) contamination and exposure to radon for radiation protection of oil and gas workers
5. Incorporate TENORM assessment in the early phases of oil and gas permitting
TENORM REGULATORY FRAMEWORK

How is TENORM regulated in the U.S.?

*It’s complicated….*

It’s complicated because:

• TENORM is many things.
• TENORM has many possible regulators.
• TENORM has many *actual* regulators.
TENORM REGULATORY FRAMEWORK

• TENORM has a wide range of characteristics.
  – The principal radiological concerns are uranium and thorium series isotopes. Polonium-210 and Lead-210 in natural gas operations are becoming problematic.
  – A wide range of physical forms: liquid, sludge, ash, scale, air emissions.
  – A wide range of chemical characteristics that affect management needs.

• There is not a consistent definition, even within the U.S.
  – NORM vs. TENORM
  – Concentration vs. relocation
TENORM REGULATORY FRAMEWORK

It’s complicated because TENORM has many possible regulators.

• Different management stages have different possible regulators.
  – Workers are typically not considered “radiation” workers, so hazards are covered under general occupational regulations or even under “public” exposure limits.
  – Specific facilities may be covered by different regulators: mines, fuel cycle facilities.
  – Transportation authorities cover shipping or movement of materials.
  – Storage, disposal and legacy site clean-up may be overseen by nuclear or environmental authorities, or both.
  – The material may not be regulated at all until it exits an industrial process, so controls are not in place at all stages.
TENORM REGULATORY FRAMEWORK

It’s complicated because TENORM has many possible regulators.

• Waste with different characteristics and forms may be regulated under different legal authorities.
  – The non-radiological characteristics may determine how it can be regulated.
  – In the U.S., solid and hazardous waste is regulated separately from air emissions, which are regulated separately from drinking water and water treatment, which are regulated separately from underground injection...

• There are gaps in national regulatory coverage.
  – Some industries and materials may be exempt.
  – If legal authority to regulate is not given specifically to a national agency, then it automatically falls to the states to regulate...
  – And states may to not choose to regulate it
TENORM REGULATORY FRAMEWORK

It’s complicated because TENORM has many actual regulators.

• **There are no comprehensive Federal regulations for TENORM.**
• **National regulations exist for some specific materials... but they do not use consistent approaches.**
  – Radioactivity in drinking water: judged “at the tap” and includes naturally-occurring radioactive materials which protects the aquifers.
  – Air emissions from phosphogypsum stacks: judged based on public exposures at the site boundary, and gamma radiation is excluded.
  – Clean-up of uranium mill tailings: soil concentration (over background) derived from radon risk to residents in homes built on top of contaminated materials.
  – Injection wells: brine disposal requires permits, but radioactivity is not the hazard of concern AND hydraulic fracturing is exempt.
  – Solid waste treatment and disposal: some TENORM may be regulated as hazardous waste based on non-radiological aspects, but oil and gas exploration and production waste are exempt.
TENORM REGULATORY FRAMEWORK

It’s complicated because TENORM has many actual regulators.

- National regulations may be implemented differently at the state/regional level.
  - Environmental Protection Agency (EPA) Regions are delegated to implement regulations in some jurisdictions.
  - Some states take responsibility to implement national regulations.
  - This is possible for both environmental and radiological protection programs.
  - States must use national regulations at a minimum if they exist, but can be more restrictive.
  - Some activities associated with TENORM are exempt in a number of national regulations.
TENORM REGULATORY FRAMEWORK

• Some state/regional regulations exist... but they are not consistent.
  
  – About 15 states (out of 50) have specific regulations: generally states with active industries that generate TENORM.
    • “Model” regulations exist, but states differ on approaches.

  – Authority over TENORM-related activities and materials is often divided:
    • Environment: broad authority to address environmental releases and public exposures.
    • Worker and public exposures maybe of concern
    • Oil and gas, mining, etc.: authority on location at sites varies.
TENORM Disposal Issues

- **TENORM is not disposed of as radioactive waste.**
  - Disposal is restricted for “radioactive waste,” which is usually defined as material licensed by the nuclear regulator (i.e., NRC or an Agreement State).
  - Under that interpretation, TENORM is not “radioactive waste.” It is waste that contains some radioactivity.
  - Disposal in a designated radioactive waste disposal facility (even for low-level waste) is not required.
  - Higher activity radium waste may be disposed in licensed disposal facilities based on potential dose or risk.

- **It is most often disposed of in a municipal (solid waste) landfill or an industrial (hazardous waste) landfill** (which has more design requirements per US Environmental Protection Agency).
  - Permission from the local authorities may be required to accept TENORM.
  - It is growing practice for landfills to have portal monitors in order to detect materials with elevated radioactivity.
  - Limits may be imposed on the level of radioactivity or the type of material accepted at a facility.
  - State regulations, if they exist, may also apply to disposal.
TENORM Disposal Issues

Issues related to disposal:

• **Worker protection:** landfill workers not treated as radiation workers, so limits for “members of the public” apply in principle.

• **Radon releases:** barriers not required, methane capture systems can increase releases.

• **Monitoring:** Post-closure monitoring at landfills required for shorter times than typical for radioactive waste disposal.

• **Waste acceptance criteria:** often derived from uranium mill tailings clean-up limits, which are not an accurate reflection of TENORM disposal risks.

• **Inconsistencies:** Waste can be moved to other locations with less restrictive disposal situations.

• **Voluntary efforts are limited:** landfill guidance doesn’t address radioactivity; oil industry efforts don’t address disposal.

• **Liability:** the “standard of care” exists even if regulations do not exist.
What is the Approach?

Nahhhh...I don't think it will work. Let's do something different...something smarter...something cooler!
What can be done for Consistent TENORM Regulations?

- Expand and define training and procedures to enhance worker protection.
- Expanded monitoring to document and assess radioactivity.
- Engineering and administrative controls to limit radon releases: restrict volumes of TENORM, limit placement to certain depths.
- Establishment of waste acceptance criteria based on applicable exposures scenarios to address realistic risks.
What can be done for Consistent TENORM Regulations?

- Institutional controls during operations and post-closure to limit public exposures.
- Additional financial surety to address longer-term liabilities.
- Guidance and voluntary efforts to provide more consistent approaches.
- More study is needed to understand the scope and risks of TENORM.
What can be done for Consistent TENORM Regulations?

• Collaborative efforts to update and expand guidance are useful.
  – National Council on Radiation Protection & Measurements (NRCP; U.S.) is examining and addressing dose management approaches of TENORM from hydraulic fracturing.
  – The Conference of Radiation Control Program Directors (CRCPD; U.S. states) is updating its regulatory “model” for TENORM, taking account of current technical information.

• National leadership and broader guidance on TENORM can encourage consistency and good practices. In the meantime, the States will continue to have the lead in TENORM regulations.
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Questions?