



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION



Bureau of Radiation Protection

Update on DEP's Guidance for Dealing With Radioactivity in Solid Waste

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December 12, 2018

Tom Wolf, Governor

Patrick McDonnell, Secretary

Disclaimer

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Legislative Authority

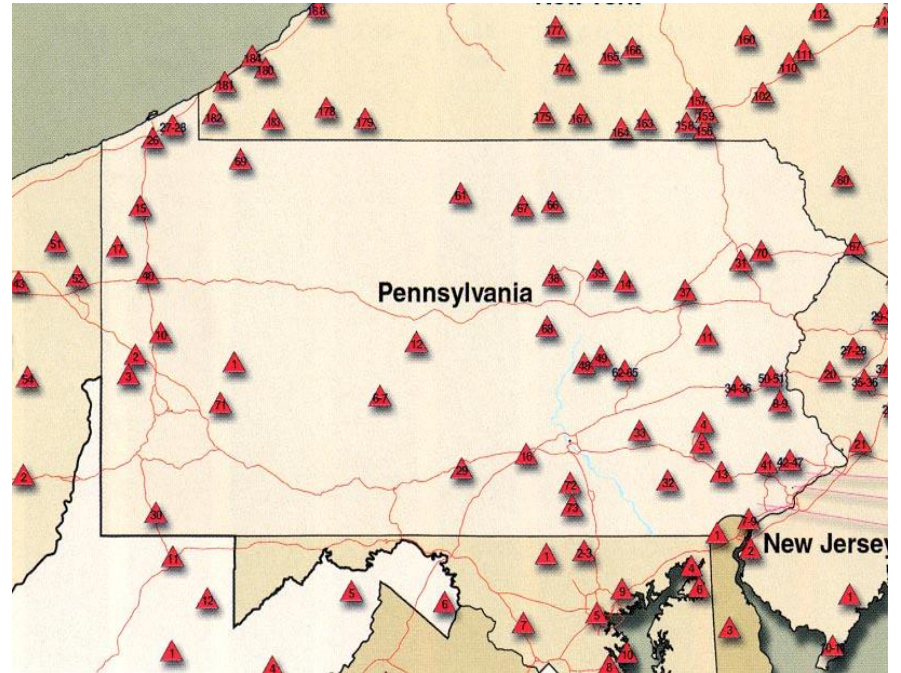
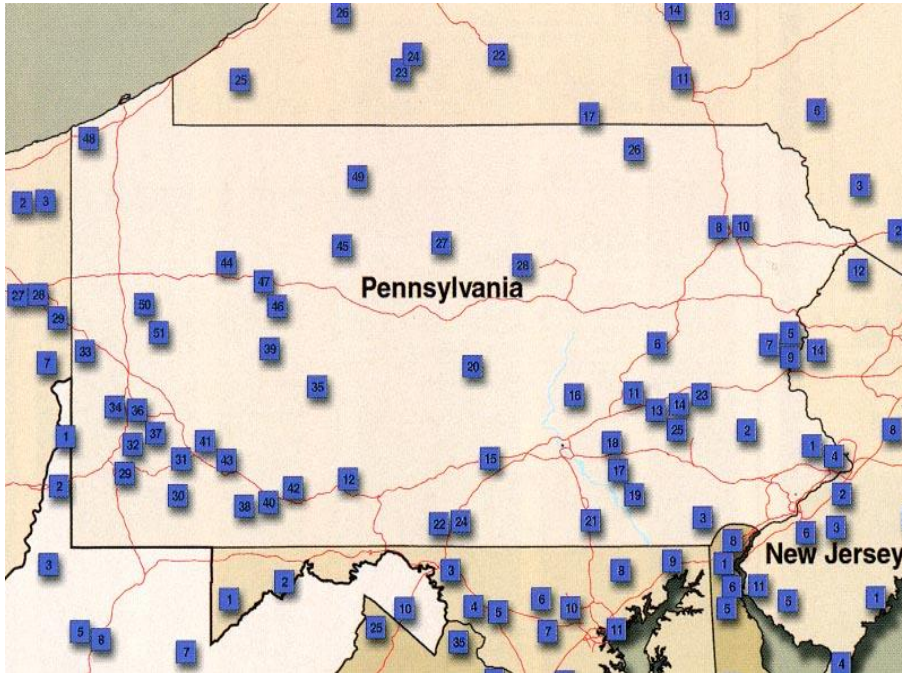
- Solid Waste Management Act (Act 1980-97)
- Radiation Protection Act (Act 1984-147)
- Appalachian States LLRW Compact Act (Act 1985-120)
- LLRW Disposal Act (Act 1988-12)
- LLRW Disposal Regional Facility Act (Act 1990-107)

Pennsylvania Code

- Title 25 Environmental Protection
 - > Articles VIII and IX, Municipal and Residual Waste
 - 271. Municipal Waste Management – General Provisions
 - 273. Municipal Waste Landfills
 - 277. Construction/Demolition Waste Landfills
 - 279. Transfer Facilities
 - 281. Composting Facilities
 - 283. Resource Recovery Facilities (RRF)

LANDFILLS

TRANSFER STATIONS



There are six RRFs in Central and Southeastern PA

The Problem

Almost everything in the world contains some radioactivity, mostly of natural origins, but:

- There is no accepted *legal* definition of what is detectable as “radioactive,” but rather an acceptable public dose impact (i.e., health risk);
- Patients who have nuclear medicine procedures can be the source of contaminated solid waste (SW);
- The U.S. NRC tabled action on a “clearance” level;
- All PA SW facilities now have radiation monitors; and
- Oil & Gas operations now have to develop an “Action Plan” if they process O&G waste on a well pad.

Need for Regulations and Guidance for Rad. in SW

- Permits at SW facilities used to say “no radioactivity.”
- Some SW facilities had installed radiation / radioactive materials (RAM) monitors.
- Differences between monitors, policies, alarm set point, sensitivity, modes of use, etc.
- Alarms required response by facilities and BRP.
- BRP staff respond to several alarms a week.
- A “quagmire” of national regulations and standards regarding RAM involve follow-up.
- Nuclear medicine (NM) – a major cause of alarms.

DOT Regulations May Apply

- DOT regulations in 49 CFR §173.401 Scope -
 - (b) This subpart does not apply to:
 - (3) Class 7 (radioactive) materials that have been injected into, ingested by, or are otherwise placed into, and are still in, human beings or live animals.
- CRCPD / DOT Special Permit issued for detected RAM in scrap or waste.
- DOT interpretation as “household waste.”

Sources of Radioactivity - Industry

- Lost radiation sources can be a major hazard.
- Discarded NRC General License (GL) RAM, e.g., static eliminators, thickness or level gauges.
- Stolen or lost sources:
 - Well logging devices
 - Moisture / density gauges
- Some RAM are not gamma emitters and can't be detected by usual radiation monitors (e.g., GL tritium EXIT signs).



Ra-226 Sources Found in SW



Incinerated Sources in PA or MD

**One of four 3 mCi Cs-137 sources that were incinerated
in PA or MD**



“Consumer products”

The ASTSWMO petitioned the NRC to revise regs on tritium EXIT signs... it was denied.



< GL tritium EXIT sign



Sources of Radiation

Items that may contain naturally occurring radioactive materials (NORM) or Technologically Enhanced (TENORM)

- Coke slags
- Metal processing slags
- Media from water purification – U & Ra
- Fire brick – w/ zircon
- Mineral Sands
- Soils high in Ra
- K compounds
- Rocks
- Minerals
- Fertilizer
- Gypsum
- Sheet rock
- Oil & gas brines and frac sludges

Objectives of PA Regs and Guidance on RAM in SW

- To protect environment, public and workers from unnecessary exposure.
- To protect SW facility property from RAM contamination and costly decontamination.
- To help prevent unlawful disposal of specific or generally licensed RAM.
- To assist facility operators in complying with revised regulations and permits.
- To conserve DEP / RP Program resources by reducing unnecessary response activity.

SW Regulations – Basic Limitations

The following radioactive material controlled under specific or general license or order authorized by any federal, state or other government agency shall not be processed at the facility, unless specifically exempted from disposal restrictions by an applicable Pennsylvania or federal statute or regulation:

- Naturally occurring and accelerator-produced radioactive materials (NARM)
- Byproduct material
- Source material
- Special nuclear material
- Transuranic radioactive material
- Low-level radioactive waste

➤ SW Regulations – Basic Limitations (cont.)

The following radioactive material shall not be disposed of or processed at the facility, unless approved in writing by DEP the disposal / processing does not endanger the health and safety of the public and the environment:

- Short-lived radioactive material from a patient having undergone a medical procedure
- TENORM
- Consumer products containing radioactive material

The limitations in the above regulatory citations do not apply to radioactive material as found in the undisturbed natural environment of the Commonwealth.

General Guidance for Action Plans

Definitions (RAM, NARM, NORM, TENORM, etc.)

- Background; reg. drivers, sources, past events
- General Considerations
 - Personnel Training
 - Monitoring and detection of radiation
 - Awareness of items containing RAM
 - Initial response to detection
 - Notifications; internal/external (DEP)
 - Characterization
 - Disposition; reject, dispose / process onsite
 - Record keeping

Trucks being monitored



PA's SW Regs – Action Levels

- Below, average background* + 10 $\mu\text{R h}^{-1}$ (max) NO ACTION REQUIRED - treat waste in normal manner.

ACTION LEVEL 1

- Above average background + 10 $\mu\text{R h}^{-1}$ (alarm set point) shall cause an alarm, facility INVESTIGATES!

ACTION LEVEL 2

- Above 2 mR h^{-1} in vehicle cab, 50 mR h^{-1} on any other surface, or contamination – NOTIFY DEP / BRP and isolate waste and / or vehicle.

*Note: 10 $\mu\text{R h}^{-1}$ limit on instrument background.

PA SW Regs and TENORM

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Radiation Protection and
Bureau of Land Recycling and Waste Management

- DOCUMENT NUMBER:** 250-3100-001
- TITLE:** Final Guidance Document on Radioactivity Monitoring at Solid Waste Processing and Disposal Facilities.
- EFFECTIVE DATE:** January 2, 2004
- AUTHORITY:** Solid Waste Management, Act of July 7, 1980, P.L., No. 97, as amended, 35 P.S. Sections 6018.101-6018.1003; Radiation Protection Act, Act of July 10, 1984, P.L. 688, No. 147, 35 P.S. Sections 7110.101-7131.1101; The Administrative Code of 1929, Section 1917-A, 71 P.S. Section 510-17; Solid Waste Regulations, 25 Pa. Code Chapters 273, 277, 279, 281, 283, 284, 288, 289, 293, 295 and 297; Radiological Health Regulations, 25 Pa. Code Chapters 215-240.
- POLICY:** To protect the environment and the public health, safety and welfare from the possible dangers of radioactive material that is delivered to solid waste processing and disposal facilities.
- APPLICABILITY:** This guidance document applies to all owners and operators of solid waste processing and disposal facilities that are required by regulation to monitor for radiation from incoming loads of waste, and to those facilities that choose to monitor even though not required. This guidance document also applies to all Department personnel and activities involved with waste facility permitting, operations and enforcement, radiation protection, grants, monitoring, administration and emergency response.
- DISCLAIMER:** The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

Guidance-Detection & Initial Response

- Facility must have a Rad. Monitoring Action Plan.
- Initial measurements below Action Level 2, $T_{1/2} < 65$ days and NM RAM, facility may have DEP blanket approval for a disposal or process option.
- If $> 2 \text{ mR h}^{-1}$ cab, $> 50 \text{ mR h}^{-1}$ on surface, or $> 22 \text{ dpm/cm}^2$ removable contamination - isolate and call DEP / BRP.
- DO NOT send driver back on road until proper action determined, and if needed, DOT Special Permit obtained from DEP/BRP.
- If waste is to be rejected, DEP will need to know destination to notify other state agencies.

MCA's Used For Characterization



Guidance - Disposition

- OK to dispose or process NM RAM with half life less than 65 days (if determined by DEP not to endanger health and safety of site staff, public and environment).
- Small quantity TENORM and consumer products can be pre-approved, too.
- Most facilities wanted blanket approval for Nuclear Medicine RAM in Action Plan.
- DEP can approve TENORM case by case.
- RAM disposed of as 'LLRW' at a licensed facility.
- DEP Fact Sheet on LLRW disposal options.
- RAM returned to point of origin (with DOT special permit (SP) manifest from DEP / BRP).

Guidance – Disposal Option

Examples of Common NM RAM *

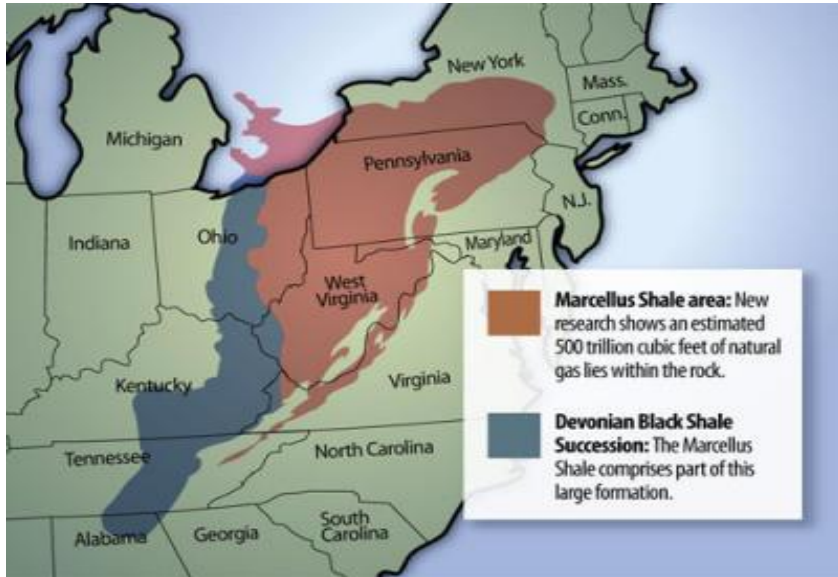
<u>Isotope</u>	<u>T-1/2</u>
I-131	8 days
Tc-99m	6 hours
Tl-201	3.0 days
Ga-67	3.3 days

* Over 90% of alarms to date are from NM RAM and patient-contaminated solid waste.

Guidance – Disposal Option (cont.)

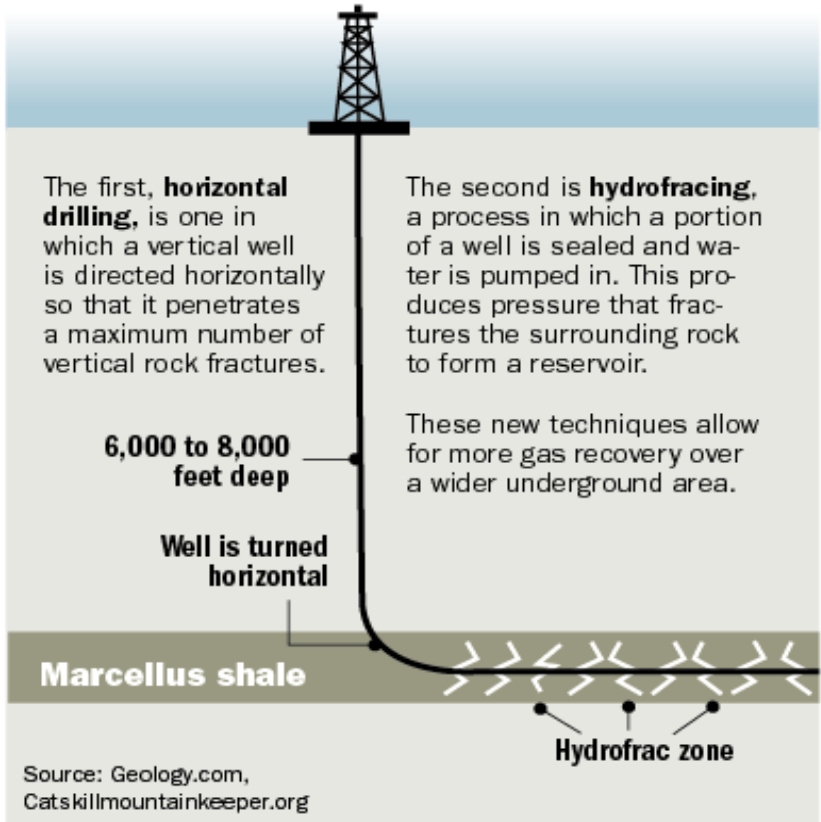
- TENORM, surface dose rate $< 50 \mu\text{R h}^{-1}$
@ 5 cm, combined radium activity $< 5.0 \text{ pCi/g}$,
and below 1 m^3 ... small quantity and facility can
dispose / process without DEP approval.
- Higher levels permitted with DEP approval if
pathways analysis demonstrates dose to
maximum exposed person is less than 25
mrem/yr from all exposure pathways (i.e., using
“resident farmer” and RESRAD code).

Marcellus Shale



New techniques, better recovery

Two technologies relatively new to the Appalachian Basin are employed in wells drilled into the Marcellus formation.

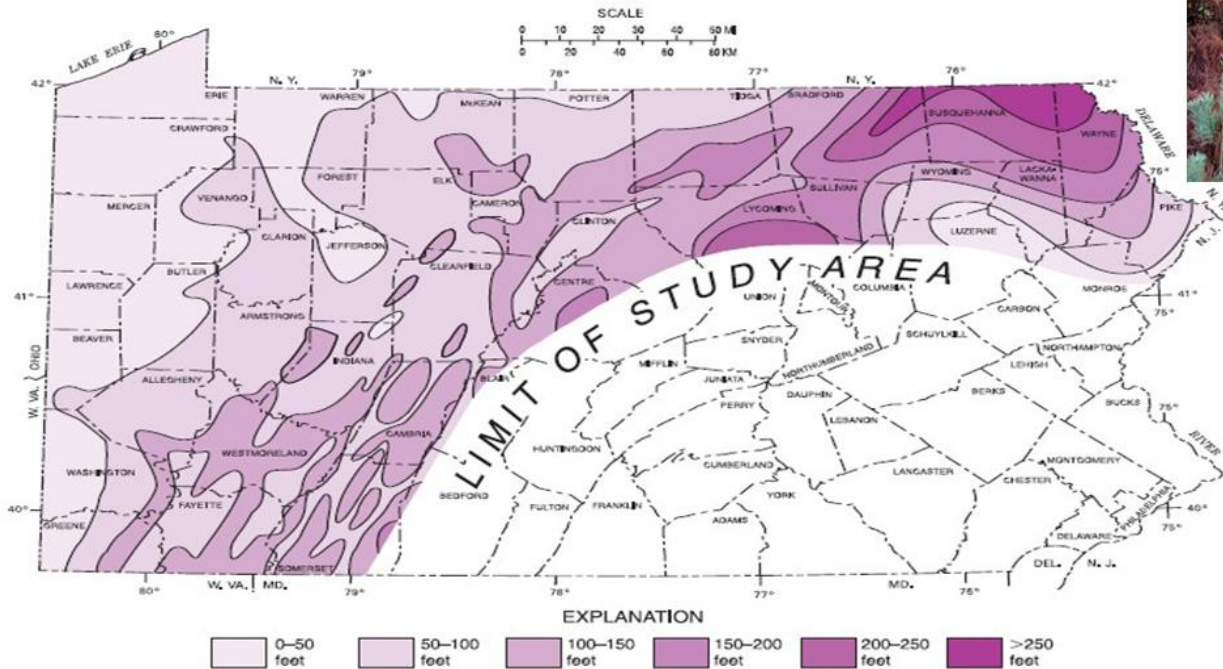


Post-Gazette

Marcellus Shale

NET FEET OF ORGANIC-RICH SHALE IN THE MARCELLUS FORMATION

(Modified from Piotrowski and Harper, 1979, Plate 4)
(See article on page 2.)



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Department of Conservation and Natural Resources
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Middletown, PA 17057-3534

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Marcellus Shale

URANIUM 238 (U238) RADIOACTIVE DECAY

type of radiation	nuclide	half-life
α	uranium-238	4.47 billion years
β	thorium-234	24.1 days
β	protactinium-234m	1.17 minutes
α	uranium-234	245000 years
α	thorium-230	8000 years
α	radium-226	1600 years
α	radon-222	3.823 days
α	polonium-218	3.05 minutes
α	lead-214	26.8 minutes
β	bismuth-214	19.7 minutes
β	polonium-214	0.000164 seconds
α	lead-210	22.3 years
β	bismuth-210	5.01 days
β	polonium-210	138.4 days
α	lead-206	stable

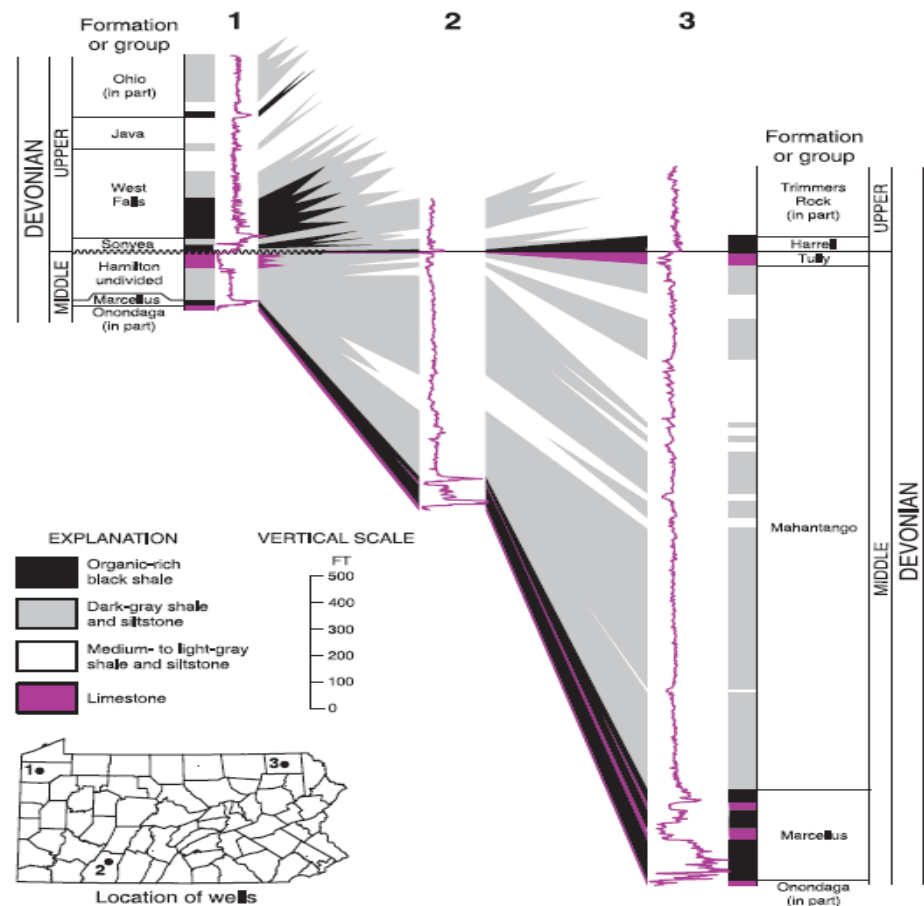


Figure 2. Correlation of Middle and Upper Devonian organic-rich shale facies and interbedded strata in three wells in Pennsylvania, based on gamma-ray log signatures (the jagged purple lines) and descriptions of well cuttings. Note that the black shales correspond in large part to higher-than-normal gamma-ray readings (radioactivity increases to the right in all log signatures).

Marcellus Shale

- MS uranium content: 10-100 ppm
- MS U-238 content: $\sim 3.4 - 34$ pCi/g
- MS Ra-226 content: $\sim 3.4 - 34$ pCi/g
- MS Frac H₂O Ra-226: 300 – 25,000 pCi/L
- DW MCL Ra-226/gross *a*: 5/15 pCi/L
- Treated Frac H₂O sludge: 6 – 250 μ R/h

Implementation

- Over 170 SW facility permit modifications for RP Action Plans.
- Hundreds of onsite inspections.
- Annual Reports reviewed.
- Hundreds of DOT Exemptions issued.
- Official DOT “interpretation” on RAM in “household waste” in 2004 - not subject to hazmat regs in 49 CFR.

Implementation Update (cont.)

Thousands of onsite radiation alarm responses

- ~ 90% NM RAM in household waste
- ~ 9% NORM or TENORM
- ~ 1% NM RAM in driver
- < 1% Regulated or controlled RAM

DEP has Fact Sheets on tritium EXIT signs, “orphan sources,” and LLRW disposal.

*Guidance – Records & Notification

- Daily Operational Records
 - Date / time / location w/ brief narrative
 - Any info on origin
 - Isotope ID if known
 - Name, address, tel.# of hauler / supplier / driver ID
 - Final deposition (dispose / reject)
- DEP Notification
 - For DOT Exemption
 - For disposal NM RAM w/ $T_{1/2} < 65$ days
 - If identify RAM w/ $T_{1/2} > 65$ days
 - Immediate if Action Level 2 exceeded
 - Annual report of detected RAM

**** Note: O&G regs now reference this guidance.***

Guidance - Disposition

T $\frac{1}{2}$ >65 days days, except NORM / TENORM

- Above ACTION LEVEL 1 - reject and return to point of origin (with DOT SP Form from BRP), or arrange for proper recovery and disposal as LLRW.
- Above ACTION LEVEL 2 - respond in consultation with DEP / BRP, and perhaps U.S. NRC or EPA.
- DEP Fact Sheet available noting LLRW brokers.
- PA - CRCPD orphan source disposal Agreement may provide funding.

PA O&G Regs and TENORM



DEP > Businesses > Energy > Oil and Gas Programs > Office of Oil and Gas Management > I Regulations

OIL AND GAS SURFACE REGULATIONS

On October 8, 2016, Pennsylvania's [Environmental Quality Board \(EQB\)](#) published a final-form rulemaking in the Pennsylvania Bulletin regarding surface activities related to unconventional gas well development. The Pennsylvania Bulletin publication includes the final-form rulemaking language in plain text (Annex A) and an Order describing the regulations. The publication document is available as an html document [here](#) and as a pdf document [here](#).

PA O&G Regs and TENORM

RULES AND REGULATIONS

Title 25—ENVIRONMENTAL PROTECTION

ENVIRONMENTAL QUALITY BOARD

[25 PA. CODE CHS. 78 AND 78a]

Environmental Protection Performance Standards
at Oil and Gas Well Sites

§ 78a.58. Onsite processing

The amendments establish provisions regarding wastewater processing at well sites, codifying the Department's current approval process for onsite oil and gas waste processing. Subsection (a) allows operators to process fluids generated by oil and gas wells at the well site when the fluids were generated or at the well site when all of the fluid is intended to be beneficially used to develop, drill or stimulate a well upon Department approval. Subsection (b) lists specific activities that do not require Department approval, including mixing fluids with fresh-water, aerating fluids or filtering solids from fluids. These activities shall be conducted within secondary containment. Subsection (d) requires an operator processing oil and gas fluids onsite to develop a radiation protection action plan which specifies procedures for monitoring and responding to radioactive material or technologically enhanced naturally occurring radioactive materials (TENORM) produced by the treatment process. This subsection also requires procedures for training, notification, recordkeeping and reporting to be implemented. Subsection (e) specifies that drill cuttings may only be processed at the well site where those drill cuttings were generated, if approved by the Department. Subsection (g) allows for using approved processing facilities at subsequent well sites.

PENNSYLVANIA BULLETIN, VOL. 46, NO. 41, OCTOBER 8, 2016

PA O&G Regs and TENORM

(c) Activities described in subsection (b) shall be conducted within secondary containment.

(d) An operator processing fluids or drill cuttings generated by the development, drilling, stimulation, alteration, operation or plugging of oil or gas wells shall develop an action plan specifying procedures for monitoring for and responding to radioactive material produced by the treatment processes, as well as related procedures for training, notification, recordkeeping and reporting. The action plan shall be prepared in accordance with the Department's *Guidance Document on Radioactivity Monitoring at Solid Waste Processing and Disposal Facilities*, Commonwealth of Pennsylvania, Department of Environmental Protection, No. 250-3100-001, as amended and updated, or in a manner at least as protective of the environment, facility staff and public health and safety and which meets all statutory and regulatory requirements.

Purpose of SW Guidance Update

- Cover Oil & Gas operations
- Disposition of TENORM waste
- Capture 20 years of lessons learned
- Reduce duplicate content in guidance
- Provide for non-SW recycler operations
- Improve guidance on environmental monitoring
- Compile radiation protection standards

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