No Time to Waste

EFFECTIVE MANAGEMENT OF OIL AND GAS FIELD RADIOACTIVE WASTE

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WESTERN ORGANIZATION OF RESOURCE COUNCILS

This report is a publication of the Western Organization of Resource Councils (WORC). WORC is a regional network of grassroots community organizations that include 12,200 members and 40 local chapters. WORC's network includes: Dakota Resource Council (North Dakota); Dakota Rural Action (South Dakota); Idaho Organization of Resource Councils; Northern Plains Resource Council (Montana); Oregon Rural Action; Powder River Basin Resource Council (Wyoming); Western Colorado Congress; and Western Native Voice.

WORC's mission is to advance the vision of a democratic, sustainable, and just society through community action. WORC is committed to building sustainable environmental and economic communities that balance economic growth with the health of people and stewardship of their land, air, and water.

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Front cover photo:
A worker at a wastewater recovery facility in Keane, North Dakota, disposes of radioactive filter socks in a common household garbage can.

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The Blue Earth Society (Seattle) provides charitable 501(c)(3) status to Bruce Farnsworth's ongoing documentary project. All donations made at Fracking: Forgotten on the Bakken are secure and tax-deductible. Support his efforts to illustrate the environmental and cultural issues of this industry, now underway in 20 states. Farnsworth is working closely with local Tribal members, ranchers, and farmers to help them tell their stories. For more of Bruce's work, visit www.brucefarnsworth.com

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Executive Summary

Since the advent of horizontal drilling, hydraulic fracturing, and other advances in drilling technologies, the oil and gas industry has been linked to a rising number of health and environmental concerns: the contamination of drinking water aquifers, the flaring, venting, and leaking of methane, the proliferation of oil and saltwater spills, and the degradation of local roads and other infrastructure from overuse and misuse.[1][2][3][4]

The list of negative impacts from oil and gas production is already lengthy. In recent years, though, yet another issue has surfaced. Many of the waste byproducts produced during the oil and gas extraction and production process are radioactive. They contain varying concentrations of naturally occurring radioactive materials (NORM), or technologically enhanced naturally occurring radioactive materials (TENORM), which originate deep in the earth and can be mobilized upwards by the liquids involved in the hydraulic fracturing (fracking) process. Such materials give off radiation, which can travel through air, water, and even some solid materials, and pose serious risks to both human and environmental health.

Despite posing such risks, wastes from the oil and gas industry are not regulated under federal law. In 1978, the EPA exempted the oil and gas industry from the Resource Conservation and Recovery Act, despite its finding that oil and gas-field wastes "contain various hazardous constituents."[5] As a result, oversight and management of the storage, transport, and disposal of oil and gas-field wastes has been left up to state agencies, many of which have yet to institute any formal regulations.

This report considers the current status of radioactive oil and gas-field waste regulations and disposal practices in six states: Colorado, Idaho, Montana, North Dakota, South Dakota, and Wyoming. It finds that state regulatory frameworks remain sparse, where they exist at all. Colorado, Wyoming, and Montana all lack formal regulations around radioactive oil and gas-field waste; of these three states, only Montana has initiated rulemaking around the issue. South Dakota has a formally regulated disposal limit, but no other oil and gas field waste-specific regulations, while Idaho has a handful of regulations, but no formal limit. Of the states examined, only North Dakota has a relatively comprehensive regulatory framework in place to address the waste stream.

The consequences of these regulatory gaps are well-documented. In 2013, a

An abandoned gas station in Noonan, North Dakota, where a stash of filter socks were discovered illegally dumped in 2014. © BruceFarnsworth.com.

municipal landfill operator in McKenzie County, North Dakota, reported discovering 954 filter socks—large, sock-shaped bags used to filter radioactive materials out of fracking wastewater—at his facility, all of which had been snuck through the landfill's inspection and waste acceptance protocols.[6] In 2014, thousands of pounds of filter socks were discovered abandoned on truck beds in Watford City, North Dakota.[7] Later in the same year, 200 garbage bags filled with filter socks were found in an abandoned gas station in Noonan.[8] This last incident garnered national media attention, and became a source of outrage for many in North Dakota.

Though North Dakota has occupied much of the spotlight on this issue, other states have begun to see a rising tide of radioactive waste, as well. In Montana, residents near the state's largest (and, for now, only) special oilfield waste facility, Oaks Disposal, have experienced an inundation of oil and gas field waste transporters into their quiet, rural community; residents' list of grievances includes noise and dust from the near-constant truck traffic, frequent spills from trucks turning corners too quickly, and the facility's proximity to an important source of groundwater. Despite these concerns, however, the Montana Department of Enviromental Quality has yet to create formal rules around oil and gas-field waste disposal, and continues to permit new facilities.

In Wyoming, where the state allows all solid waste facilities to self-determine what wastes to accept, landfill operators have been left to enact their own protocols around radioactive waste disposal. In light of this, some landfills have chosen not to accept the waste stream, determining it too risky. Others, like the Campbell County public works department, have stepped in to conduct their own research, hiring private contractors to help them establish protocols and standards for radioactive waste management. Despite efforts

by individual stakeholders to move the process forward, however, the Wyoming Department of Environmental Quality has resisted initiating a formal rulemaking, and maintains that radioactive oil and gas-field waste does not pose an issue in the state.

Colorado, Idaho, and South Dakota each face a unique set of concerns around this issue, as well. Like Wyoming and Montana, none of the three aforementioned states has a comprehensive regulatory framework in place to address the storage, transport, and disposal of radioactive oil and gas-field waste.

In 2014, oil prices plummeted. Since then, oil companies throughout the West have struggled to maintain their original profit margins, and many now seek new ways to cut costs. Now, more than ever, we need to regulate radioactive oil and gas field waste, in order to minimize the impacts of oil and gas development on the environment and the health and safety of local communities.

This report highlights the imminent need to:

- *Eliminate the federal exemption* for oil and gas-field wastes from the Resource Conservation and Recovery Act.
- *Establish comprehensive state-based regulatory programs* for the oversight and management of oil and gas-field wastes that are sufficiently protective of environmental and human health.
- *Set the lowest practical disposal limit* for combined radium and other relevant radionuclides in each state.
- *Limit the disposal of radioactive oilfield waste* to facilities that meet the most stringent and thorough design standards and operating protocols, and prohibit them from being disposed of at municipal solid waste facilities.
- *Provide ample opportunities for public participation* in the siting and permitting of radioactive oil and gas-field waste facilities.
- *Require "cradle-to-grave" tracking and reporting* for all oil and gas-field waste storage, transport, and disposal.
- *Require regular, unannounced inspections* of all oil and gas operators, waste transporters, and disposal facilities, and enforce any violations with appropriate swiftness and severity.

What are NORM and TENORM?

Radioactivity

Radioactivity is the natural process by which some atoms spontaneously disintegrate, in order to move from instability to a more stable state.[9] Generally, materials undergoing this process (also called radioactive decay) emit radiation in the form of a subatomic particle, such as an alpha or beta particle. This emission is the mechanism by which atoms transform from unstable to stable.

Some radioactive materials also emit gamma radiation, which is not a mode of radioactive decay, unlike alpha or beta particles. Rather, it is the release of excess energy in the form of an electromagnetic wave.[10]

All three forms of radiation (alpha, beta, and gamma) can pose risks to human health. Alpha radiation cannot penetrate skin, clothing, or other materials, but can be dangerous if inhaled, swallowed, or absorbed. Beta radiation can partially penetrate human skin, but can be stopped by many materials; it can cause skin injury, or be harmful if deposited internally. Gamma radiation, meanwhile, can readily penetrate most materials, and can cause harm via direct external exposure. As the most powerful form of radiation, gamma rays are considered the primary hazard to human health.

NORM & TENORM

Two categories of radioactive materials exist: man-made radioactive materials, and naturally occurring radioactive materials (NORM). The first category refers to anything produced within nuclear reactors, accelerators, or other devices, either by splitting atoms or bombarding them with subatomic particles.[11] Materials of this kind are licensed and regulated by the U.S. Nuclear Regulatory Commission (NRC).[12]

The second category, NORM, refers to primordial radionuclides that exist naturally in the earth's crust. Among them are uranium, thorium, and radium, and their associated decay products. Typically present in very low concentrations, NORM can appear in greater density in the geologic formations surrounding oil and gas deposits.[13]

NORM can be brought to the earth's surface through various extraction processes, such as uranium mining, or oil and gas exploration. Often, these processes concentrate the original primordial radionuclides, resulting in slightly elevated levels of radioactivity. Materials that have been concentrated in this way are often defined as technologically enhanced naturally occurring radioactive materials (TENORM).

The delineations between NORM and TENORM are not always clear, however. The Conference of Radiation Control Protection Directors (CRCPD) defines TENORM as any naturally occurring radioactive materials that have been concentrated or condensed in some way by human activities.[14] According to this definition, TENORM does not include materials that have merely been exposed by human activities. The U.S. Environmental Protection Agency (EPA), by contrast, recently clarified its definition to include both exposed and condensed materials. In their words, TENORM involves any materials that have been "disturbed in such ways that they can be misused by humans, or affect the environment."[15] Any of the wastes from oil and gas exploration, by this definition, would be categorized as TENORM, even if they did not undergo a change in radioactivity concentration.

The confusion between these terms is emphasized by the inconsistencies with which state agencies use them. For instance: North Dakota considers drill cuttings NORM (because they are exposed but not concentrated) and other radioactive oil and gas wastes like sludge or pipe scale TENORM (because they are both exposed and concentrated).[16] Wyoming considers the two terms interchangeable, but uses NORM in state documents.[17] Montana makes a distinction between them, but then abandons that distinction, and uses NORM throughout its policy document.[18] Colorado also makes a distinction between them, but only regulates TENORM.[19] South Dakota uses the joint term of "NORM/NARM"—the latter being an older acronym for "naturally occurring or accelerator produced radioactive material"—while making no mention of TENORM at all.

For the sake of consistency, this report will use the broader definition of TENORM provided by the EPA, and will refer to all radioactive waste exposed or concentrated during the oil and gas exploration and production process as TENORM. Any radioactive materials brought to the earth's surface pose a potential risk to humans and the environment; as such, it seems most useful to consider them all part of the same category.

NORM TENORM

FIGURE 1

FIGURE 2

FIGURE 3

FIGURE 4

Oil & Gas TENORM Wastes

The oil and gas exploration and production process results in a number of specific waste byproducts, many of which contain elevated levels of TENORM. These include produced water, pipe scale, sludge, filter cake, disposal filter socks, contaminated production and processing equipment, and some synthetic proppants.[20]

Produced water (Figure 1), or water trapped in underground formations brought to the surface during oil and gas exploration and production, is one of the primary vehicles for bringing radionuclides to the surface during the oil and gas production process. Radium in particular is highly soluble, and can be easily mobilized within liquid waste streams. As a result, produced water most frequently contains radium-226, radium-228, and various decay products.[21]

As produced water moves from the formation to the surface, radionuclides often precipitate out along the way. These materials can get deposited along the inside of pipes, where they accumulate as hard and insoluble deposits called **pipe scale** (Figure 2). They can also settle to the bottom of vessels that are used in the storage or management of produced water, including water storage tanks, separators, and heater treaters. There, they accumulate as solid debris products called **sludge** (Figure 3).

Any remaining radionuclides in produced water typically get filtered out via a **filter sock** (Figure 4), prior to transport or disposal of the water. Filter socks collect and condense sludges and scales over multiple uses, resulting in a highly concentrated radioactivity level. Filter socks have received more media attention than other TENORM waste byproducts, likely because they have frequently been mishandled or disposed of improperly.

Production and processing equipment can be coated with a layer of residual TENORM, even when cleaned regularly. Some equipment may also retain higher quantities of TENORM, if it is something particularly hard to clean, such as a wellhead filter, valve or screen.[22]

Finally, some **synthetic proppants**, used for hydraulic fracturing, have been found to contain low levels of radioactivity. Proppants that are spilled or discarded should be handled similarly to other oil and gas TENORM wastes.[23]

Federal Regulations

Despite posing risks to both human and environmental health, TENORM waste is currently exempt from federal regulation. Here is a brief look at the history behind that exemption.

In October 1976, Congress passed the Resource Conservation and Recovery Act (RCRA), which sought to institute a national regulatory framework around solid and hazardous waste disposal. The act amended the Solid Waste Disposal Act (SWDA) of 1965, which had taken a first stab at solid waste disposal by providing state and local governments with research grants to study disposal practices, and encouraging them to develop state-specific regulations.[24] By the mid-seventies, though, the need for national regulation became clear. The United States was then producing three to four billion tons of solid and hazardous wastes annually, and the improper and inconsistent management of those wastes was of growing concern for regulators and citizens alike.[25]

In part, RCRA required the U.S. Environmental Protection Agency (EPA) to rewrite its rules around industrial waste management.[26] Any wastes that the EPA characterized as hazardous would be subject to a comprehensive "cradle to grave" registration system that tracked and controlled wastes from their point of generation until final disposal.[27] This initiative was designed to eliminate "the last remaining loophole in environmental law, that of unregulated land disposal of discarded materials and hazardous wastes," according to a report issued by the House of Representatives.[28]

In 1978, the EPA published a first draft of the new rules, as required by RCRA; already, those rules included a proposal to exempt a handful of oil and gas waste products from being categorized as hazardous. The agency justified the exemption with the statement that such waste products were "lower in toxicity" than other wastes regulated as hazardous.[29] Two years later, Congress passed the exemption, but with the stipulation that the agency study it further.[30]

The EPA took seven years to study the issue, missing its original deadline of 1982 by more than five years.[31] In 1987, the agency released its final report, which stated that oil and gas wastes "contain a wide variety of hazardous constituents," and that almost 25% of the waste samples it studied were highly toxic.[32] Despite these findings, the report concluded that the exemption should stand. Regulating oil and gas wastes, it explained, "would cause a severe economic impact on the

industry," not to mention "severe short-term strains" on disposal facilities and permitting agencies.[33] It further stated that the EPA "would not be able to craft a regulatory program" that would leave those stakeholders unaffected.[34]

Since 1987, the exemption has been left largely untouched. In 1993, the EPA further clarified its regulations around oil and gas waste, but did not change the exemption, which currently includes more than 20 industry byproducts.[35] In 2010, after the release of another EPA study recognizing that emissions from oil and gas waste pits posed an environmental risk, the Natural Resources Defense Council petitioned the EPA to reexamine the exemption.[36] The NRDC received no response. Most recently, Representative Matt Cartwright, a Democrat from Pennsylvania, proposed a bill that would end the exemption, called the "Closing Loopholes and Ending Arbitrary and Needless Evasion of Regulations Act of 2013." However, the bill was sent to the House Subcommittee on Environment and the Economy, where it ultimately died.[37]

In the absence of any oversight from the EPA, NORM and TENORM wastes could fall under the umbrella of other federal agencies or policies, such as the U.S. Nuclear Regulatory Commission (NRC) or the Low-Level Radioactive Waste Policy Act. However, none of these agencies or policies address the matter. See Figure 5 for a detailed list of federal agencies and policies that exempt or exclude TENORM waste.

FIGURE 5: TENORM WASTE REGULATORY EXEMPTIONS AND EXCLUSIONS

The EPA has exempted oil and gas waste from federal hazardous waste regulations under Subtitle C of the Resource Conservation and Recovery Act (RCRA).

The Atomic Energy Act of 1954 excludes materials that do not exceed 0.05 percent uranium or thorium by weight.

The U.S. Nuclear Regulatory Commission (NRC) does not regulate NORM or TENORM, because the agency derives its regulatory authority directly from the Atomic Energy Act of 1954.

The Low-Level Radioactive Waste Policy Act provides guidance to state regulators on the disposal of low-level radioactive material, but does not address oil and gas NORM and TENORM waste.

The Superfund Amendments and Reauthorization Act do not list the constituents of NORM and TENORM as "extremely hazardous substances."

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) considers some of the individual radionuclides found within NORM and TENORM hazardous, but does not categorize oil and gas waste as hazardous, because it abides by the RCRA exemption.

State Regulations

Colorado

Like most other states in the region, Colorado has experienced a surge in oil and gas production alongside the advent of new horizontal drilling and hydraulic fracturing technologies.[38] The Niobrara Shale formation, in the northeast part of the state, has become a hotbed of activity for generators eager to extract some 2 billion barrels of recoverable oil, while the Piceance Basin, along the western slope, contributes to state outputs as well.[39]

In 2014, Colorado produced more than 82.8 million barrels of crude oil. That number was not only 27 percent higher than the previous year's production levels and more than double the amount produced in 2011; it also set a new all-time production record for the state, smashing the previous record, which had stood since the 1950s.[40] Since 2014, growth has slowed but not stopped altogether, as oil and gas companies respond and adjust to the significant drop in oil prices. The industry has looked for ways to cut spending, but "thousands of existing wells…still need to be serviced, pipelines are being built, and gas processing and water recycling plants need employees," Eric Berglund, CEO of Upstate Colorado Economic Development, told the press.[41] Though the number of active drilling rigs has fallen by half in the past year, it remains at 36 today—significantly more than are currently active in Montana, by comparison.[42]

Like Montana and Wyoming, Colorado does not have formal regulations around TENORM. The Colorado Department of Public Health and Environment (CDPHE) developed an interim policy on TENORM waste disposal in 2007; this policy was created to address TENORM wastes generated from the treatment of drinking water, though, and does not make specific mention of TENORM wastes from oil and gas exploration and production.[43] The document merely states that the suggestions contained within it may "be applied to other diffuse sources on a case-by-case basis."[44]

It even explicitly excludes some oil and gas industry wastes—specifically, those generated by the "possession, storage, and distribution" of any fuel products "before combustion."[45] The bottom line is that any disposal protocol and limits established by this document do not hold up as official regulations; they only function as "suggested approaches" to managing such wastes.[46]

In 2013 and 2014, the CDPHE attempted to formally revise the existing TENORM policy, launching meetings, establishing a working group, and opening up the draft to public comment. However, the revision process was paused before anything final could be formally agreed upon.[47] According to one participant, the proceedings generated significant controversy, and grew somewhat contentious in nature. Many questioned the point of developing such revisions, as they would remain inherently unenforceable. Additionally, the process was criticized for trying to address TENORM wastes from multiple industries simultaneously.[48]

Since then, the CDPHE has reverted back to the 2007 document, and considers permits for TENORM waste disposal on a case-by-case basis.[49] In most cases—but ultimately depending upon the rules of the county or municipality in question—facilities must receive approval from both the CDPHE and the relevant local governing body.[50] This mechanism offers citizens some local control over what facilities are built in their community.

Limits

Colorado's policy document presents a tiered set of radioactivity limits. The highest limit applies to facilities that are designed and constructed in the model of

FIGURE 6: RADIOACTIVITY LIMITS FOR SOLID WASTE DISPOSAL FACILITIES IN COLORADO

	Combined radium-226 and radium-228	Uranium	Thorium
Exempt concentrations	3	30	3
Approved municipal solid waste landfills	10	100	10
Industrial landfills	50	300	50
RCRA Subtitle C hazardous waste landfills	400	0.05% by weight	0.05% by weight

(in picocuries per gram, except where otherwise stated)

RCRA Subtitle C hazardous waste landfills; facilities of this type can accept wastes with radioactivity concentrations of up to 400 picocuries per gram of combined radium-226 and radium-228, or up to 2,000 picocuries per gram of total radionuclides.[51] One such facility is located in Colorado (there are two in the region at large, with the other being in Idaho).

Facilities that do not meet RCRA Subtitle C standards can accept wastes with significantly lower radioactivity concentrations. The specific limits can be found in Figure 6.[52]

Facilities & waste flows

Colorado has one facility that meets RCRA Subtitle C standards, Clean Harbors Deer Trail, which is located some 70 miles east of Denver, in southeast Adams County.[53] The designation of "RCRA Subtitle C" landfill does not imply that the facility receives its authority or oversight from the EPA; rather, the facility falls under the authority of the CDPHE, but was designed and modeled off of the EPA's hazardous waste facility specifications.[54]

Clean Harbors Deer Trail has been in operation since the 1980s, but only applied for approval to accept TENORM wastes in the early 2000s. This permit expansion generated significant controversy: the Adams County Board of County Commissioners, the relevant local governing body, denied the facility's request, but its denial was later overruled by the CDPHE, contradicting the state's purported allowance for local control. At this time, the CDPHE attempted to grant Clean Harbors Deer Trail both a modified state RCRA permit and a Radioactive Materials License. In response to this overrule, and the issuance of those licenses, Adams County brought suit against the CDPHE; the case went as far as the Supreme Court of Colorado, and was ultimately decided in favor of Adams County. In a settlement, Clean Harbors Deer Trail was granted permission to accept TENORM wastes, but with certain county-specific conditions for acceptance and disposal.[55]

The controversy around this permit accurately reflects how significant this facility is. With the highest possible radioactivity limit in Colorado, Clean Harbors Deer Trail accepts wastes that have up to 400 picocuries per gram of combined radium-226 and radium-228, or up to 2,000 picocuries per gram of total radionuclides.[56] As a result, it's one of the major oil and gas field waste destinations in the region, receiving waste from generators throughout the Bakken, as well as from South Dakota, Wyoming, Nebraska, Kansas, and New Mexico.[57] Clean Harbors Deer Trail receives waste by both truck—accepting approximately 30 truckloads per day—and rail; contained within its boundaries are a stabilization

and treatment unit, state-of-the-art monitoring equipment, and an in-house laboratory.[58] According to the facility's website, it's been described by the EPA as "the nation's premier hazardous waste landfill."[59]

Colorado does not have any other facilities that are permitted to accept TENORM wastes yet. One facility, Conservation Services Inc., which is located about 40 miles northeast of Denver, has been approved for TENORM waste disposal by the CDPHE but still awaits the requisite approval from Adams County. Several municipal solid waste facilities have initiated the permitting process, as well, but not yet received approval from either the department or their local governing authorities.[60]

Permitting & public involvement

Permitting of solid and hazardous waste facilities in Colorado is a two-pronged process that involves both the local governing body with jurisdiction and the Department of Public Health and Environment. Facilities are required to seek a Certificate of Designation from the local governing body; after they receive this approval, they then seek subsequent approval from the CDPHE.[61] This mechanism for local control faced judicial scrutiny in 2009, when the permit application for Clean Harbors Deer Trail went to the Colorado Supreme Court; ultimately, though, the court decided that county approval was indeed a prerequisite for receiving a permit for the CDPHE, thus upholding local communities' ability to decide what facilities would be sited within their own boundaries.[62]

On the CDPHE's end of this process, the public has several more opportunities for involvement and feedback. The department notifies the public twice—first, upon the initial receipt of an application and second, upon departmental review of said application. It then convenes a public meeting to discuss the proposed facility and hear any interested parties' views. After the public meeting, the CDPHE posts an initial draft decision, and convenes a second public meeting. Finally, it issues a final draft decision, and gives any affected parties the chance to request an adjudicator hearing if the draft decision is not to their liking. If a hearing is convened, a hearing officer becomes responsible for issuing an initial decision, but the CDPHE still issues the final decision.[63]

Disposal protocol & site design

The CDPHE specifies a series of design and disposal protocol requirements for TENORM waste, based upon the type of facility accepting them. The aforementioned requirements can be found in full in Figures 7 and 8. Included among these are specifications around coverage, liners,

leachate collection and recovery, and groundwater monitoring systems, as well as a variety of recommendations for operational protocols.[64] However, these recommendations were designed specifically for drinking water treatment facilities, not for the oil and gas industry.[65]

The policy guidance document also provides a recommended syllabus for training landfill workers, as well as a set of suggested health and safety requirements, noting that "the landfill worker is the most likely exposed individual."[66] But those requirements are merely "suggested," or "for permitting authorities to consider."[67]

FIGURE 7: TENORM DISPOSAL REQUIREMENTS FOR MUNICIPAL SOLID WASTE FACILITIES IN COLORADO

1. TENORM wastes must be disposed of in a discrete area and covered immediately.
2. No TENORM wastes are to be disposed of within 3 meters of the final repository cover.
3. TENORM wastes can take up no more than 10% of the volume of the cell.
4. Disposal facilities must employ dust control methods during staging and application, but cannot add free liquids directly to the disposal cell.
5. Facilities must have a liner.
6. Facilities must have a leachate collection and recovery system.
7. If the facility does not have a leachate collection system, the groundwater monitoring wells must be sampled and analyzed.
8. If the facility does not have groundwater monitoring wells, then an appropriate groundwater monitoring network must be established.

FIGURE 8: TENORM DISPOSAL REQUIREMENTS FOR INDUSTRIAL LANDFILLS IN COLORADO

1. TENORM wastes must be disposed of in discrete disposal cells and covered immediately.
2. No TENORM wastes are to be disposed of within 3 meters of the final repository cover.
3. TENORM wastes can take up no more than 10% of the volume of the cell.
4. Disposal facilities must employ dust control methods as necessary during staging and application.
5. Industrial landfills are "presumed" to have a liner and leachate collection and recovery system.
6. If the facility does not have a leachate collection system, groundwater monitoring wells must be sampled and analyzed for speciated radioactivity.
7. If the facility does not have groundwater monitoring wells, then an appropriate groundwater monitoring network must be established.

Tracking & reporting

Colorado requires entities involved in the transfer or disposal of TENORM to maintain records of those processes, according to the process outlined in Section 4.48 of the state's Radiation Regulations. However, the state does not maintain a specific list of metrics to record, nor does it collect those records in any centralized location.[68]

Some wastes may be held for "decay in storage" without regard for their radioactivity concentrations for a period of less than or equal to 120 days; for those wastes, handlers must record the wastes' dates of disposal, the survey instruments used, the background radiation level, the radiation level measured at the surface of each waste container, and the name of the individual who performed the survey.[69]

As part of its settlement arrangement with Adams County, the Clean Harbors Deer Trail facility is required to report its intake loads on a monthly basis to the Rocky Mountain Low-Level Radioactive Waste Board, which administers a radioactive waste compact between Colorado, Nevada, and New Mexico.[70]

Idaho

Historically, Idaho has had very little oil and gas development. Between 1903 and 1988—i.e., for the majority of the 20th century—only 145 wells were drilled in the entire state.[71] Attempts at exploration and production took place throughout much of the century, but, as a publication of the Idaho Geological Survey describes it, such attempts were an "ongoing saga of near successes and shattered expectations."[72]

Recently, however, the discovery of a series of natural gas reserves in southwestern Idaho and eastern Oregon has renewed interest in and attention around resource production in the state.[73] As of August 2015, Idaho Department of Lands had 17 active and pending permits to drill listed on its website.[74] Most of those permits await the construction of the necessary distribution infrastructure before they can begin producing.

Despite the slight uptick in exploration and production, Idaho creates very little TENORM waste of its own. The state does not produce significant amounts of oil, nor does it have fracking operations. As a result, Idaho wells—the few that exist—produce relatively small amounts of TENORM wastes, according to a regulator at the Idaho DEQ.[75]

Idaho does have regulations around TENORM, but those regulations do not specify a radioactivity limit. They specify very little, in fact, merely indicating that any radioactive material that does not fall under the purview of the U.S. Nuclear Regulatory Commission should be disposed of according to the state's Hazardous Waste Management Act, and that it cannot be disposed of at municipal solid waste landfills.[76]

The regulations also denote exposure limits for members of the public, but do not specify how exposure will be measured. Finally, the rules state that workers and operators should abide by radiation protection standards, as expressed in federal regulations 10 CFR 20.[77]

Despite making minimal amounts of TENORM itself, Idaho merits inclusion in this report because it is host to one of the biggest commercial radioactive waste facilities in the region. Called U.S. Ecology, the facility is located 70 miles southeast of Boise, in the Owyhee Desert, and it accepts a large variety of hazardous wastes. Among them are liquid and solid wastes, NORM and TENORM, exempted source, byproduct, and special nuclear

material, and water treatment residuals.[78]

The facility's limit for radioactivity concentration is 1,500 picocuries per gram of radium—more than 30 times the limit deemed safe by Argonne's North Dakota study.[79] This limit dwarfs the levels accepted in nearby states. As a result, Idaho receives wastes from all over the country, sometimes from as far away as the Pennsylvania shale fields. Joe Weismann, head of radiological operations at the company that runs the facility (also called U.S. Ecology), estimated in 2014 that the Idaho outpost receives "several thousand tons" of TENORM wastes from North Dakota annually.[80] This number has likely grown since then.

Montana

Despite sitting atop the far western edge of the Bakken formation, Montana has experienced only a fraction of North Dakota's Bakken boom. Annual production of oil increased between 2000 and 2006, climbing from 15,428,000 barrels a year to 36,294,000 barrels a year. Production began declining thereafter, and continued to do so during many of North Dakota's most productive years.[81] In 2014, the state issued 237 new drilling permits and produced 29,346,000 barrels of oil, compared with North Dakota's 3,031 new permits and 396,880,762 barrels of oil.[82] [83] [84] [85]

Most recently, Montana's production has hit a plateau. The price of oil began falling sharply in 2014, and has continued to drop; in August of 2015, it stood at $45.25 a barrel, less than half of what prices were one year prior.[86] As a result, new drilling has come to a near-halt. In May and June of 2015, Montana did not have a single active drilling rig, and though that is no longer the case, the state's rig count remains significantly lower than in 2014, falling from eight rigs in August 2014 to one rig in August of 2015.[87] Meanwhile, oil production at existing wells continues, but at lower production rates than in prior years.[88]

By consequence, Montana makes relatively little TENORM waste of its own. But the state has been an attractive disposal destination for generators in North Dakota since 2013, when Montana's first special oilfield waste facility opened. Montana has a radioactivity limit of 30 picocuries per gram, meaning that it can accommodate many of the oilfield wastes that exceed North Dakota's limit of 5 picocuries per gram; as a result, North Dakota generators and waste transporters have quickly flocked to this new facility.[89] Called the Oaks Disposal facility, this privately-owned landfill caters specifically to TENORM and other oilfield waste; its success has spurred several other individuals to seek licensing for similarly designed facilities in eastern Montana.

In August 2015, North Dakota tentatively raised its disposal limit to 50 picocuries per gram.[90] That limit had yet to receive final approval from the state's attorney general and legislative rules committee at the time of this report's writing; if it does, though, the waste flow between

the two states may be significantly altered. Even so, North Dakota's existing facilities would still need to obtain permit modifications before they could accept TENORM waste, a process that could take the North Dakota Department of Health months, if not years, to complete.[91] [92] Until that process happens, Montana will likely remain the closest and most convenient disposal option for TENORM waste from North Dakota's oil and gas fields.

Liquid waste that was spilled from trucks en route to the Oaks Disposal facility. (Source: Olivia Stockman-Splinter)

Despite the current influx of TENORM wastes from North Dakota, the Montana Department of Environmental Quality (DEQ) does not have regulations specific to TENORM waste disposal. Instead, the department maintains a series of recommendations for TENORM waste management in a guidance policy document on its website; however, this document is not the equivalent of formal rules or regulations. Its primary function is to provide facility operators with suggestions for handling and managing TENORM waste, rather than mandating or enforcing those suggestions.[93]

In early 2015, the DEQ initiated a rulemaking around TENORM waste, in order to institute formal regulations around its transport and disposal. The department has yet to publish any draft rules, however, and projects that it will not get to them until the spring of 2016 at the earliest.[95]

Despite this regulatory gap, the DEQ continues to approve new sites for TENORM waste disposal, an approach that critics have suggested leaves citizens throughout the state vulnerable to the decisions of individual generators and transporters.

Rulemaking process

The DEQ's rulemaking process will follow the guidelines established by the Montana Administrative Procedure Act (MAPA). A regulator at the DEQ explained the process as follows:

The DEQ will draft a set of rules on TENORM wastes. Those rules will undergo legal review, and then be submitted to the Secretary of State. At that point, the proposed rule must be published in the Montana Administrative Register, and sent to interested parties within 3 days of publication. Citizens then have 28 days to submit public comments, which can take the form of data, views, or arguments, either orally or in writing. If either 25 people or 10% of those who will be directly affected by the proposed rule request a public hearing of arguments within the 28 day period, the DEQ must grant that request.[96] [97]

At the end of the 28 days, the public comment period closes. The DEQ then considers the comments made; if any of them are deemed "relevant," they may be incorporated into the draft rules, which are then finalized.

Montana has yet to go through any of these steps for the TENORM rulemaking. The DEQ has begun communicating with and seeking input from various stakeholders, but has not yet held any public scoping meetings.

Limits

Montana's current limits for radioactive waste disposal can be found in Figure 9. The limit system has several stratifications, based on the design of the facility in question.[99]

Montana does not have any volumetric or tonnage-based limits.[100]

Facilities & waste flows

Montana has one special oilfield waste facility in operation called Oaks Disposal, and one that has been licensed for oilfield waste acceptance but not yet constructed called BAC Disposal. Both were licensed to accept TENORM wastes at the 30 picocuries per gram concentration level.[101] A third facility called Clay Butte Environmental was just issued a permit by

FIGURE 9: RADIOACTIVITY LIMITS FOR SOLID WASTE DISPOSAL FACILITIES IN MONTANA

	Combined radium-226 and radium-228
Facilities with a leachate collection and removal system and a synthetic liner	30
Facilities without a leachate collection system but with either an engineered clay or synthetic liner	15
Facilities with a natural clay liner	15

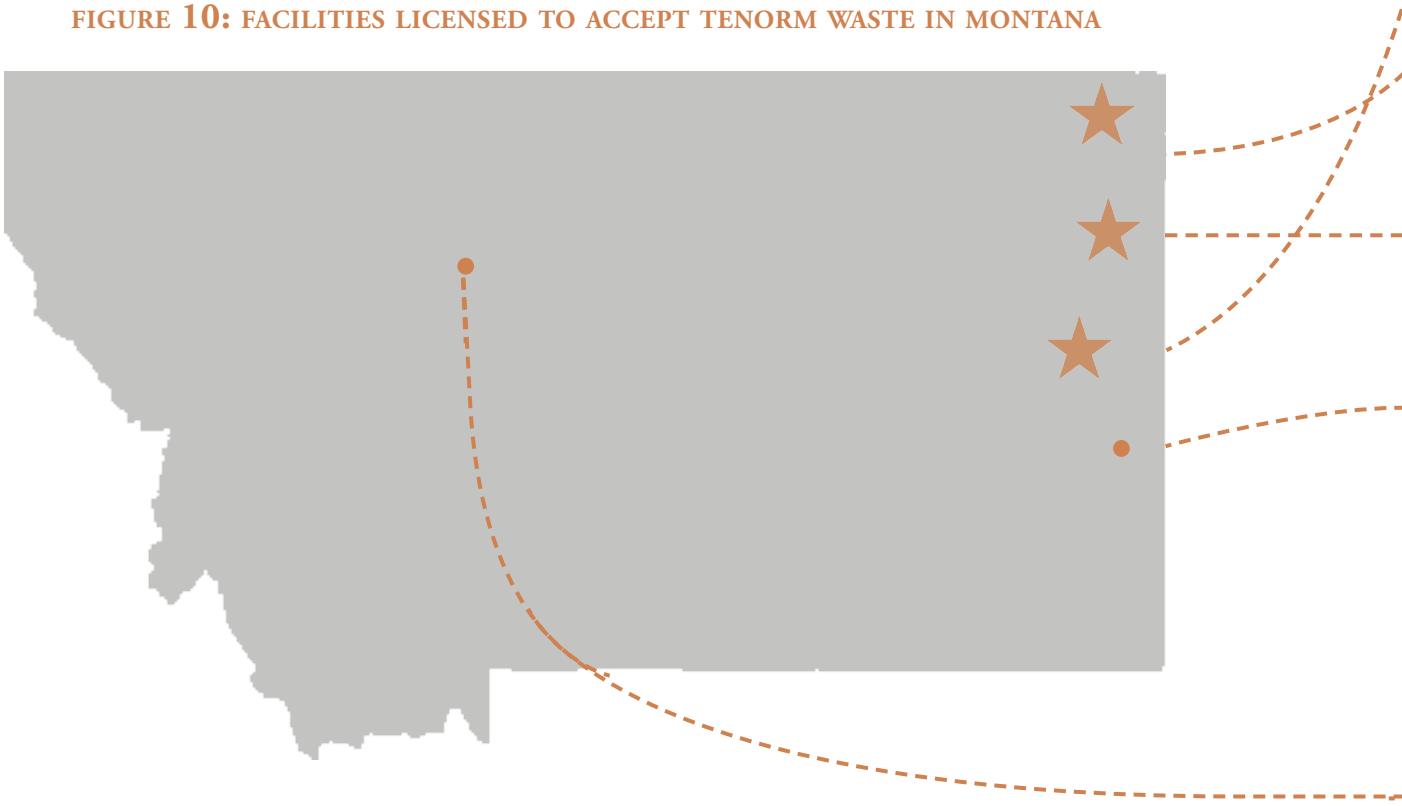
(in picocuries per gram, except where otherwise stated)

the DEQ in September of 2015, but that permit has not been finalized.[102] This new crop of special waste facilities has been wildly successful, drawing significant traffic from the North Dakota oil and gas fields. Ross Oakland, founder of Oaks Disposal, told reporters, "Before the facility opened, all the waste that was [in North Dakota] was going to Colorado or Idaho," whereas "now it can be disposed of here, 40 miles across the North Dakota border." More and more North Dakota generators have been taking advantage of this, Oakland said, and "the phone doesn't quit ringing."[103]

In addition to these special waste facilities, two of Montana's municipal solid waste facilities have been licensed to accept TENORM wastes at the lower concentration level of 15 picocuries per gram.[104]

These facilities are described in detail in Figure 10 below.

FIGURE 10: FACILITIES LICENSED TO ACCEPT TENORM WASTE IN MONTANA



Oaks Disposal, LLC

is a special waste facility located in Glendive, MT, that opened in early 2013. The landfill covers 129.8 total acres, with 23.1 acres designated for active landfilling activities, and has a total waste capacity of 1,142,000 cubic yards, over an expected 14-year life.[105] [106] It can accept TENORM wastes with concentrations of up to 30 pCi/g above background radioactivity levels.[107] The original owner—a rancher named Ross Oakland—sold the facility in 2014.[108]

BAC Disposal

is a special waste facility set to be located in Sheridan County, MT. It has been permitted but is not yet constructed. When complete, the landfill will cover 44.2 total acres, with 14.58 acres designated for active landfilling activities, and a total waste capacity of 1,085,000 cubic yards over an expected 15-year life.[109] When open, it will be able to accept TENORM wastes with concentrations of up to 30 pCi/g above background radioactivity levels.[110]

Clay Butte Environmental

is a special waste facility that was recently issued a permit by the Montana DEQ.[111] That permit has not yet been finalized. If constructed, it would be located in Culbertson, MT, with a total waste capacity of 9,644,748 cubic yards. In other words, it would be capable of accepting about 9 times the amount of waste that the Oaks facility can take. It would also be able to accept TENORM wastes with concentrations of up to 30 pCi/g above background radioactivity levels.[112]

Coral Creek Landfill

is a municipal solid waste facility located in Baker, MT. It has been permitted to accept TENORM materials with radioactivity concentrations of up to 15 pCi/g above background radioactivity levels.[113] Coral Creek's site specifications do not meet the requirements for the higher limit. It does not accept filter socks, which, as the company says, "always exceed the analytical limits."[114]

Great Falls Landfill

is a municipal solid waste facility, located in Great Falls, MT. It has been permitted to accept TENORM materials at the lower limit of 15 pCi/g above background radioactivity levels.[115]

Permitting & public involvement

The Montana DEQ provides fewer opportunities for public response and engagement than the corresponding agencies in other states. Administrators only send out public notice about proposed facilities once, when the draft Environmental Assessment (EA) is published. At no other point does the DEQ provide public notice of any steps in the permitting process.[116]

After publishing the draft EA, the DEQ collects public comments for 30 days. It then conducts a review of the "substantive comments." "Substantive comments" refers to any comments that address one or more specific aspects of the proposed permit. This does not include mere position statements, such as "I'm in favor of this facility" or "I'm not in favor of this facility," which the DEQ does not take into account.[117]

For comments that fall into the "substantive" category, the DEQ reviews them to determine which ones need addressing. Those that do get incorporated into the final permit and facility EA, as additional requirements.[118]

FIGURE 11: PERMITTING PROCESS FOR SOLID WASTE FACILITIES IN MONTANA

1. The DEQ receives an application for a landfill license.
2. The DEQ notifies the relevant County Health Officer within 15 days of receipt.
    a. The DEQ has another 15 days to prepare a Notice of Deficiency (NOD) and send it to the applicant, if necessary.
    b. The applicant has 90 days to respond to the NOD.
    c. The DEQ responds to the response within 15 days.
    d. The DEQ prepares a draft Environmental Assessment. This can take 9 months to 1.5 years.
3. The DEQ publishes the draft EA, and sends out a public notice about the proposed facility, simultaneously.
    d. Public notice is made on the DEQ website, sent to adjacent landowners and other interested parties, tweeted, and published in the local newspaper.
5. The public has 30 days to comment.
6. The DEQ conducts a review of the "substantive comments."
7. The DEQ holds a public meeting during the public comment period, in the community where the proposed facility will be, if adequate interest is expressed.
8. At the end of the 30 day period, the DEQ makes a final decision on the facility. If the DEQ approves the facility, it publishes the final EA.
    a. Sometimes, additional requirements are incorporated into the EA in response to public comments.

There are no mechanisms for citizens to request a hearing on a permit, or appeal a final decision.

By comparison, waste facilities proposed in Colorado must get approval from both the respective regulatory agency (the Colorado Department of Public Health and Environment) and from a local governing body.[119] North Dakota has a similar process, in which facilities must be approved by both the Department of Health and the local board of county commissioners (which has the option of putting the decision to a county-wide vote).[120] In South Dakota, the permitting process gives citizens the option of requesting a hearing in front of the Board of Minerals and Environment.[121] In Wyoming, if enough written objections are filed, the regulatory agency must hold a public hearing, and send the permit before the Environmental Quality Council for a final decision.[122]

Seth Newman, neighbor to the Oaks Disposal facility, collects waste samples that were spilled from a truck en route to the facility. The samples were later determined to have radioactivity concentrations exceeding the 30-picocurie disposal limit. (Source: Olivia Stockman-Splinter).

Disposal protocol & site design

Montana does not have any protocols or site design requirements specific to TENORM waste acceptance, because, as mentioned earlier, it does not have any regulations specific to TENORM waste disposal in general. Solid waste disposal facilities are designed and operated according to the broader Montana Solid Waste Management Act, which has a variety of different landfill categories and specifications.[123]

Because Montana permits facilities on a case-by-case basis, the DEQ has been able to uphold a series of relatively detailed site design requirements, despite not having any regulations to that effect. They mandate a leachate collection system, a leachate removal system, groundwater monitoring wells, and one of several liner design options. The DEQ works closely with landfills to design and construct facility infrastructure that will appropriately contain or mitigate

any TENORM waste leachate or runoff. However, the DEQ does not require groundwater monitoring in all cases.[124]

More detailed site specifications are listed in Figure 12.

Montana does not have any qualifications or requirements for site operators or workers. The department does provide semi-regular trainings, but they are not mandatory.[125] Any workers coming into direct contact should be required to wear the appropriate protective equipment, and be monitored for dose exposure.

Tracking & reporting

Montana facilities are required to document a variety of information for all incoming loads. This includes the generator of the load, whether it came from in-state or out-of-state, the process that generated it, the load volume, and the load's characteristics. Facilities typically do not receive more specific information on source location than this.[126]

Facilities only provide on-site radioactivity metering as a back-up to the analysis done by the generator.[127] Ross Oakland, operator of the Oaks facility, told the Bismarck Tribune that he tests incoming drill cuttings by performing random sampling for every 300 tons of waste.[128] This leaves enormous room for wastes that exceed the radioactivity limit to slip through.

This information is kept on record at each facility, and is not maintained in any centralized system. The DEQ receives

FIGURE 12: DESIGN REQUIREMENTS FOR SOLID WASTE FACILITIES IN MONTANA

A **liner**, of one of the following varieties:

- Applicants can either design a facility based on the prescriptive requirements in the rule, which entail having a liner that is 2 feet thick, made of compacted clay, and has a connectivity of 1x10-7 cm per second, with a 60 mL HDPE liner on top,
- OR they can come in with an alternative liner, in which case they must demonstrate that it meets or exceeds the standards listed above, and is protective of the uppermost aquifer.

A **leachate collection system**, which sits on top of the liner and collects leachate in one place.

A **leachate removal system**, which can either apply the leachate back to the waste by sprinkling it on, move it to a leachate pond, or store it in leachate tanks (most facilities use ponds).

- Facilities that have given a successful "no-migration demo" do not need a leachate remove system (in other words, they've proven that there will be no release of leachate during the life of the facility or during the 30 year post-closure period).

Groundwater monitoring wells.

- Facilities that have given a successful "no-migration demo" do not need groundwater monitoring wells.

reports of the tonnages accepted per year at each facility, but does not require any information more specific than that, nor does it publish those numbers. These reports are maintained in hard copy at the DEQ's office in Helena, Montana.[129]

Montana's new rules should make tracking and reporting a priority. Every load ticket should be sent in to the department, where they should be compiled into a centralized database that could be accessed by the average citizen. RCRA was designed with such a tracking system in mind; Montana has the opportunity to institute one on a state level, despite the federal exemption.

Inspection & compliance

The DEQ conducts routine inspections of Class II Landfills at least twice a year (Class II includes municipal solid waste landfills that have special license to accept TENORM, like the landfill in Baker or the landfill in Great Falls, as well as landfills that are specific to oil and gas field waste, like Oaks). Inspections involve reviewing records to make sure that facilities are not managing anything outside of their permit, reviewing operations, driving around the facility, and checking to make sure anything required to be covered is covered.[130]

If a facility does groundwater monitoring (facilities that have proven "no-migration" do not have to do groundwater monitoring), those records get sent to the DEQ regularly, so inspections do not include any investigation of groundwater.[131]

Montana's inspection policies could be made much more stringent. Landfills should be inspected more frequently than twice a year. Inspections should be performed by qualified professionals, who have backgrounds or training in radioactivity. Currently, they are performed by solid waste management staff, none of whom have such background or qualifications. Inspections should also be unannounced.

If the DEQ discovers an instance of noncompliance, it writes the facility a violation, and tries to work with the facility to "elevate" them, or bring them back up to standard. After a facility has received a series of violations, and still seems unresponsive or uncooperative, the DEQ will write an enforcement request to the Enforcement Division. At that point, the Enforcement Division takes over.[132]

Violations of the Montana Solid Waste Management Act can garner administrative penalties of up to $250 per day per violation, civil penalties of up to $1,000 per day per violation, and criminal penalties of anywhere from $50 to $500 per day (the criminal penalty for dumping is slightly higher: $100 to $5,000, or imprisonment for 30 days). These fines get deposited in the Solid Waste Management account.[133]

North Dakota

North Dakota's oil landscape has changed dramatically in recent years. The state sits atop the Bakken formation, an unconventional shale play that spans some 200,000 square miles beneath western North Dakota, eastern Montana, and southeastern Saskatchewan.[134] First discovered in 1953, the Bakken was drilled in successive boom cycles throughout the 20th century, but much of its vast oil reserves remained unrecoverable until recently.[135]

Over the past decade, advances in drilling and extraction technologies have made the Bakken's reservoirs—once considered too thin, too deep, and too widely dispersed to be viably and profitably drilled—suddenly accessible.[136] As a result, North Dakota has witnessed a surge of industry activity, and oil production levels have skyrocketed. Between 2006 and 2012, North Dakota climbed from eighth to second in oil production nationally.[137] In 2006, the state produced 39 million barrels of oil; by 2014, that number had grown more than ten-fold, to over 390 million barrels.[138] Today, it remains the second-largest oil-producing state in the country, outpaced only by Texas.[139]

This meteoric rise in production levels has a less visible, less glamorous shadow: the equally meteoric accumulation of solid waste from oil and gas fields. In 2001, North Dakota's waste facilities took in around 10,000 tons of oilfield solid waste; in 2013, they took in nearly 1.8 million tons, a one hundred and eighty-fold increase.[140] These numbers do not account for the amounts of NORM and TENORM waste generated, which remained untracked until recently, nor do they include the vast quantities of waste being shipped out of state and disposed of elsewhere—but it's likely that both numbers have ballooned at similar rates.

Until August of 2015, North Dakota had a disposal limit of 5 picocuries per gram of radioactivity, one of the lowest in the region.[141] Much of the TENORM waste being generated in the state far exceeded that limit, however. During their study of TENORM waste disposal in North Dakota, Argonne National Laboratories compiled radionuclide analysis data for each type of TENORM waste product; they found that filter socks from North Dakota oilfields had

average radium-226 concentrations of 32.8 picocuries per gram, average radium-228 concentrations of 13.8, and average lead-210 concentrations of 36.9. Bakken pipe scale, meanwhile, had average radium-226 concentrations of 548 picocuries per gram, average radium-228 concentrations of 332, and average thorium-232 concentrations

FIGURE 13: RADIOACTIVITY CONCENTRATIONS IN NORTH DAKOTA, AS MEASURED BY ARGONNE NATIONAL LABORATORIES

	Scale	Sludge	Filter sock	Proppants
Average radium-226 (pCi/g)	548	58.3	32.8	8.2
Median radium-226 (pCi/g)	134	24.5	6.9	8
Minimum radium-226 (pCi/g)	9.4	2	0.9	1.8
Maximum radium-226 (pCi/g)	4,710	1,230	374	9.1
Number of samples	38	57	18	6
Average radium-228 (pCi/g)	332	15.4	13.8	9.9
Median radium-228 (pCi/g)	66.2	9.7	5.6	9.8
Minimum radium-228 (pCi/g)	2.6	0.5	2.4	3.1
Maximum radium-228 (pCi/g)	3,590	66.3	130	11.2
Number of samples	38	57	18	6
Average lead-210 (pCi/g)	5,270	67.2	36.9	8.5
Median lead-210 (pCi/g)	5,270	31.1	5	8.6
Minimum lead-210 (pCi/g)	5,270	2.1	3.5	6.2
Maximum lead-210 (pCi/g)	5,270	318	70	9.74
Number of samples	1	7	17	6
Average thorium-232 (pCi/g)	71.7	17.2	12.7	9.1
Median thorium-232 (pCi/g)	40.3	9.4	12.7	9.2
Minimum thorium-232 (pCi/g)	6.5	2.1	6.5	8.1
Maximum thorium-232 (pCi/g)	460	97.5	18.9	10.2
Number of samples	27	50	2	6

of 71, with maximum readings of radium-226 reaching values as high as 4,710 (see Figure 13).[142]

As a result, landfills around the state have been inundated with wastes that they are neither equipped nor permitted to handle. Rick Schreiber, operator of the McKenzie County municipal landfill in North Dakota, told the press that his facility has experienced an onslaught of TENORM disposal requests, many of them for loads "so hot our meters are maxed out."[143] Their meters can register up to 1,000 picocuries of radioactivity.

Landfills statewide rejected a total of 208 loads in 2014, 63 of which tripped radiation detectors.[144] Many facilities began to pre-empt TENORM disposal requests by enacting steep fees—some as high as $10,000—for load rejections, hoping to deter generators from even attempting to get such wastes through the door.[145]

With no local disposal options, some generators developed illicit solutions of their own. Among them are concealing filter socks and other materials in non-radioactive loads in order to sneak them into landfills—or just illegally dumping them altogether. In 2013, 954 filter socks made it past Schreiber into his landfill, despite his every effort to screen and search incoming loads.[146] In February of 2014, thousands of pounds of them were discovered at an illegal dump site just nearby, in Watford City.[147] Incidents of this kind occur all too often, with radioactive filter socks turning up in dumpsters on the Fort Berthold Indian Reservation, in an abandoned gas station in Noonan, or in garbage cans in the town of Crosby.[148] [149] [150] In some cases, it took weeks or even months for the sites to be discovered and cleaned up, leaving the surrounding communities and environments vulnerable to exposure for the intervening time periods.

Oil filters and other radioactive byproducts illegally stashed outside of Tioga, North Dakota. (Source: Darrell Dorgan)

Such practices garnered significant media attention, and sparked a public outcry. In response, the North Dakota Department of Health (DoH), the agency that regulates TENORM waste disposal in the state, initiated a rulemaking on TENORM in

December of 2014.[151] Despite earlier declarations that it would not finalize the rules until 2016 at the earliest, the DoH decided to do so at its August 11, 2015, meeting—a decision for which it only gave five days' public notice.[152] [153] The new rules accommodate the oil industry by raising the disposal limit to 50 picocuries per gram of combined radium-226 and radium-228, meaning that North Dakota could become its own disposal destination for much of the TENORM waste generated in-state.[154] In order for the rules to be implemented, though, they still need to go through multiple steps. First, the rules must receive final confirmation from both the Attorney General and the Administrative Rules Committee of the Legislative Council, and then the state's existing special waste landfills would need to receive permit modifications that approve them for TENORM waste acceptance.[155] [156] At the time of this report's writing, none of these steps had happened.

Handheld radioactivity monitoring at a well site in Tioga, North Dakota. (Source: Darrell Dorgan)

New rules

North Dakota's new TENORM rules come on the heels of a bill passed by the state legislature in 2015 that also addresses TENORM waste. House Bill 1113 was signed into law on April 23, 2015, but only included a minor number of actions. Most notably, it excluded facilities permitted to accept TENORM waste from a provision that required facilities handling radioactive materials to transfer the title of their land over to the state government prior to the end of their permit term, and increased the maximum penalties that can be assigned to violators of the radiation regulations.[157]

The new rules themselves comprise two sections. The first, NDAC 33-20, or "Landfill Disposal of Technologically Enhanced Naturally Occurring Radioactive Material Waste," falls under the Solid Waste Program.[158] The second, NDAC 33-10-23, or "Regulation and Licensing of Technologically Enhanced Naturally Occurring Radioactive Material," falls under the Radiological Health Rules, and thus the purview of the Radiation Control Program.[159]

There are several important things to note about the new rules. First and foremost, they raise the disposal limit from 5 to 50 picocuries per gram of combined radium-226 and radium-228, meaning that, pending final approval and permit modifications for existing special waste facilities, North Dakota will be able to accept radioactive waste generated by oil and gas development at disposal sites in state. Secondly, the rules create a "cradle-to-grave" tracking system for all TENORM waste loads that will record the original generator, site of original generation, waste characteristics, and final disposal location, among other things.[160] This system mimics, in ways, the system that was envisioned under RCRA, from which oil and gas wastes were exempted.

Third, these rules give responsibility for the oversight & management of radioactive materials to two departments, the Solid Waste Program and the Radiation Control Program. Both programs are housed in the Department of Health, but they are staffed by different people. The first major consequence of this is that most parties involved in the handling, transporting, or disposing of TENORM waste would need to obtain two permits, one from the Solid Waste Program and one from the Radiation Control Program.[161] [162] The second major consequence is the creation of an overlap of responsibilities, particularly in the area of inspection and enforcement. When the final rules were published in August of 2015, a DoH regulator could not definitively say which program would be responsible for conducting inspections of licensed facilities.[163] This leaves a major gap in the interpretation and implementation of this critical part of the rule.

The new rules include various other additions and changes to existing disposal practices and requirements; the most notable among these are the requirement to cover TENORM waste with at least one foot of non-TENORM waste at the end of each operating day, the requirement to store TENORM wastes in a leak-proof container, the requirement to create a training and safety program for all workers who come into contact with TENORM waste, and the requirement to designate a "radiation safety officer," who will act as an individual facility's authority on TENORM safety and protocol.[164] [165]

Despite significant improvement upon the previous rules, however, this new set of rules still fails to address certain key considerations. The Argonne report tested not only for radium-226 and radium-228, but also for thorium-232 and lead-210; it found noteworthy quantities of both, and specifically recommended a limit for thorium-232. Existing regulations could be safely modified to allow for a disposal limit of 50 picocuries per gram of total radium, the report concluded, if and only if "the

average thorium activity concentration in the waste does not exceed 24 picocuries per gram."[166] Despite these findings, the new rules do not enact this limit, nor do they address lead-210. When asked about this deficiency, a regulator at the DoH said that they "didn't get any comments to that effect," so there was no need to address it.[167]

In addition, North Dakota's mechanism for local control—in which new disposal facilities have to be approved by the local board of county commissioners—only applies to new facilities and does not apply in the case of existing facilities applying for a permit modification.[168] In other words, existing facilities that already have a permit but wish to obtain additional approval for TENORM waste acceptance will not be subject to the same protocols of public approval and involvement that new facilities are, despite the fact that their permits may receive significant modifications. Communities will still have the ability to comment on draft permits, participate in public hearings, and appeal a final permit decision, but their most powerful mechanism of control will not apply in cases of permit modification.

Finally, as mentioned earlier, neither set of rules addresses exactly who will be performing inspections of facilities with TENORM licenses or permits, what those inspections will entail, or how frequently they will occur. This division of regulatory authority may pose challenges for operators, transporters, and other involved parties attempting to follow the regulations, and for any members of the public seeking information or action on radioactive oil and gas-field waste.

The following sections address both the current rules and the new rules in greater detail. The new rules will be treated here "proposed changes," given that, at the time of this report's writing, they had yet to receive final approval from the attorney general and the legislative rules committee.

Limits

Currently, North Dakota treats materials with radioactivity concentrations of less than 5 picocuries per gram of radium-226 and radium-228 as exempt from TENORM regulation. Any materials at or below those concentrations can be disposed of as regular solid waste. Any that exceed that limit must be rejected from North Dakota disposal facilities, and sent out of state.[169]

The proposed changes would maintain that exemption, but increase the limit for disposal to 50 picocuries per gram, as recommended by Argonne.[170] The Argonne study analyzed a series of exposure scenarios for both workers and the general public, and determined that 50 picocuries per gram was the maximum allowable radionuclide concentration that could be present in landfilled wastes if potential

FIGURE 14: PROPOSED RADIOACTIVITY CONCENTRATION LIMITS FOR DISPOSAL FACILITIES IN NORTH DAKOTA

Radionuclide	Limit
Radium-226	50 pCi/g
Radium-228	50 pCi/g
Combined radium	50 pCi/g
Lead-210	None
Thorium-232	None

doses to humans were to be kept below the 100-millirem per year dose limit recommended for members of the general public by the International Commission on Radiological Protection.[171] This new limit would apply only to approved oilfield special waste landfills and large volume industrial waste landfills; TENORM waste would still be prohibited at municipal solid waste facilities.[172]

As recommended by Argonne, the DoH also instituted a new tonnage limit. The rule would limit facilities to 25,000 tons of TENORM waste per year.[173] Because North Dakota did not track TENORM waste until very recently, it's unclear what portion of the total waste flow this number represents; the department estimates that the state creates 75 tons per day, which would mean that one facility could handle almost all of the state's waste.[174] This daily estimate may be inaccurate, though.

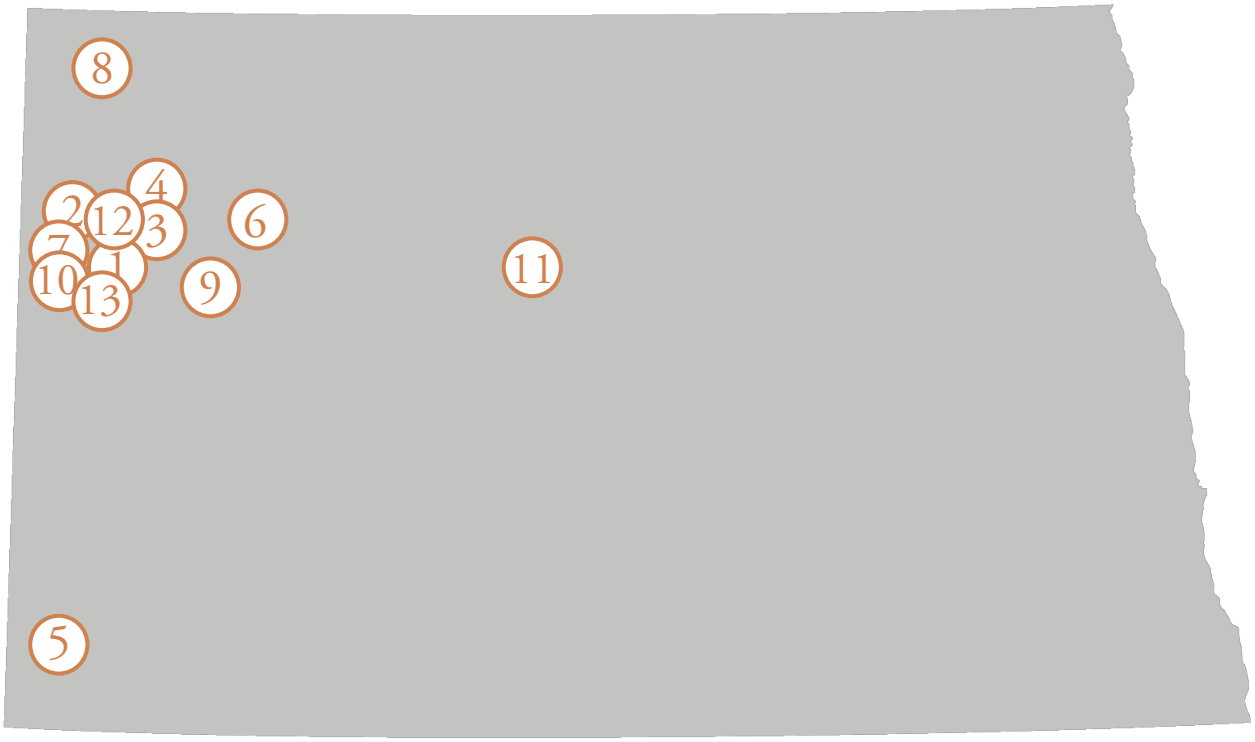
Facilities & waste flows

Under the current limit, North Dakota generators ship the vast majority of their TENORM wastes elsewhere.[175] Two facilities in the region are equipped for radioactive waste of significantly elevated concentrations; they are Clean Harbors Deer Trail, located in Colorado, and US Ecology, located in Idaho. Both have disposal limits upwards of 1,000 picocuries; as such, they each absorb a significant amount of North Dakota's outflows.[176] Other common disposal destinations include a series of new special waste facilities along the Bakken's western edge in Montana, as well as sites in Washington, Utah, Texas, and various places on the east coast.[177] South Dakota's limit matches North Dakota's, at 5 picocuries per gram, while Wyoming does not accept any TENORM waste from out of state; otherwise both states would likely receive some of North Dakota's waste, as well.

North Dakota does have 13 special oilfield waste facilities that currently accept a variety of waste forms from oil and gas

production.[178] If the new radioactivity limit gets approved, these facilities would be eligible to accept TENORM waste after receiving the appropriate permit

FIGURE 15: FACILITIES ELIGIBLE FOR POTENTIAL TENORM WASTE DISPOSAL IN NORTH DAKOTA



1. Nuverra Environmental Treatment Center
   WATFORD CITY, ND
2. Chimney Butte Environmental
   FAIRFIELD, ND
3. Dishon Disposal
   WILLISTON, ND
4. Ideal Oilfield Disposal
   ARNEGARD, ND
5. IHD Solids Management
   ALEXANDER, ND
6. Petrocomp
   MARMATH, ND
7. Prairie Disposal
   TIOGA, ND
8. Secure Energy Services
   WILLISTON, ND
9. Smoky Butte Environmental
   FORTUNA, ND
10. Tervita Blue Buttes Facility
    KEENE, ND
11. Clean Harbors: Sawyer
    SAWYER, ND
12. WISCO Oilfield Landfill
    WILLIAMS COUNTY, ND
13. Alexander TRD
    ALEXANDER, ND

modification, and would likely become top destinations for TENORM waste. A full list of them can be found in Figure 15.

Permitting & public involvement

North Dakota does not currently permit for TENORM waste disposal, given that wastes above exempt concentrations remain illegal.

If the new rules go into effect, any facilities, transporters, or generators that handle or come into contact with TENORM at concentrations higher than 5 picocuries per gram would need to obtain a license from the Radiation Control Program.[179] Facilities and transporters would also need to obtain a permit from the Solid Waste Program. Existing disposal facilities would need to go through a permit modification process, even if they have an existing special waste permit.[180]

During the solid waste permitting process, permit applicants and regulators are required to uphold the following measures of transparency and public involvement:

1. When submitting an application, permit applicants must publish a public notice of the proposed site.
2. After a draft permit has been prepared, the DoH must issue a notice of opportunity for public comment and public hearing.
3. If a hearing is requested, the Department of Health holds one, reviews any testimony shared, and issues its findings, before making a final decision on the permit.
4. The Department of Health must also notify the local board of county commissioners of the intent to issue a permit.
5. The board of county commissioners can either vote on the permit itself or call a special election. The latter option gives local voters the power to outright deny a permit.
6. Lastly, as of a recent legislative amendment, the public has the ability to appeal a final permit decision, as long as the individual who files the appeal participated in the public comment process, or in the public hearing.[181]

Steps 4 and 5 provide North Dakotans with an unusual degree of local control over the permitting and construction of new waste facilities. This procedural requirement has helped communities block undesired landfills in the past.[182] The rulemaking will not change this requirement, though it is worth noting that citizens only have this option in the case of a new permit application—not for renewals, amendments, or expansions of existing permits.

Disposal protocol & site design

North Dakota has a relatively detailed set of requirements for site design and monitoring, and these will get more comprehensive after the rulemaking, which proposes significant additions.[183] These requirements include specifications around landfill cover, burial depth, land slope, liners, leachate removal systems, system collection efficiency, soil

hydraulic conductivity, and much more.[184] A full list of existing and new requirements can be found in Figures 16 and 17.

North Dakota also requires various qualifications from landfill operators and workers. Municipal solid waste (MSW) operators must be certified by the state to operate a special waste landfill. In order to achieve certification, they must have at least one year's experience operating a municipal solid waste landfill, attend a training session, and pass a written examination.[185] These requirements set a baseline standard for experience and familiarity with TENORM waste, before operators can begin managing it. However, special waste facility operators are not required to have any specific qualifications.[186]

Landfills should implement a worker training and safety program, and prevent their workers from receiving an exposure dose that exceeds one hundred millirems per year.

Tracking & reporting

A major component of the new rules is a highly involved "cradle-to-grave" tracking system for TENORM waste loads. Each

FIGURE 16: EXISTING LANDFILL DESIGN SPECIFICATIONS IN NORTH DAKOTA

- Must have a liner and leachate removal system that are compatible with the waste and leachate
- Must have a liner and leachate removal system that maintains its integrity during the operating period and through the post-closure period
- System must have a collection efficiency of ninety percent or better and must be capable of maintaining a hydraulic head of twelve inches or less above the liner
- For landfills that receive wastes containing water soluble constituents, the liner must consist of at least four feet of compacted natural soil having a hydraulic conductivity not to exceed 1 x 10-7 centimeters per second. This requirement does not apply to landfills receiving only oilfield drilling cuttings and drilling mud
- A composite liner is required for landfills receiving wastes which may contain leachable organic constituents. This liner must consist of at least three feet of recompacted clay with a hydraulic conductivity not to exceed 1 x 10-7 centimeters per second overlain with at least a sixty mil flexible membrane liner
- The drainage layer must have a hydraulic conductivity of 1 x 10-3 centimeters per second or greater throughout. The drainage layer must have a sufficient thickness to provide a transmissivity of 3 x 10-2 centimeters squared per second or greater.
- The liner and leachate removal system in combination with the final cover must achieve a site efficiency of at least ninety-eight and one-half percent or better for collection or rejection of the precipitation that falls on the site

FIGURE 17: PROPOSED ADDITIONS TO NORTH DAKOTA'S DESIGN SPECIFICATIONS

Design

- TENORM waste must be covered by at least one foot of non-TENORM waste or daily cover material by the end of each operating day. For landfills that operate continuously (24 hours per day), all TENORM waste shall be covered at least once every twenty-four hour period.
- TENORM waste must be disposed at a depth of greater than ten feet below the surface of the final landfill cover.
- If any part of the final cover has a slope of greater than fifteen percent, then the final cover must have an additional two feet of low permeability soil, for a total minimum cover thickness of five feet.

Monitoring

- Facilities must perform analysis of their leachate collection system and groundwater monitoring network for background concentration of radionuclide parameters prior to receipt of any TENORM waste.
- Leachate shall be analyzed for radionuclides at the same frequency as groundwater samples are collected.
- If radionuclides are detected in the leachate at a concentration greater than drinking water maximum contaminant levels, then the groundwater monitoring network must begin analysis for radionuclide parameters.

waste load is assigned a "manifest," or a sheet containing information about the load; the manifest gets transferred from generator to transporter to final disposal facility, at which point the disposal facility must send it back to the original generator within 45 days. This functions as a form of receipt, or confirmation that the waste made it to its designated destination. If the original generator does not receive the manifest within this period, they must notify the department and then conduct an investigation into what happened.[187]

Every entity that holds a TENORM license from the Radiation Control Program will also be required to file quarterly reports with the DoH that list every single TENORM load transferred, along with that load's weight in tons, original generator, type, date transferred, and final disposal facility.[188] In other words, these reports will compile the results of each manifest.

The DoH has also instituted a robust reporting process around rejected loads. If any waste that exceeds the picocurie limit is delivered at a landfill, the owner or operator must reject it, and then notify the department of the rejection within five days (including the source, amount, generator, and other identifying

information). The DoH then tracks that rejected load down, in order to help the generator or transporter properly dispose of it and prevent illegal dumping of the load in question.[189] This has proven to be a very effective method of preventing illegal dumps from happening, according to DoH regulators.[190]

Inspection & compliance

Despite making significant headway in many other aspects of TENORM regulations, state regulators had yet to establish inspection protocols at the time of this report's publication. When asked, a regulator in the department was unsure which program would take primary responsbility for inspection, but postulated that it would likely be Solid Waste.[191] The Solid Waste Program inspects regular solid waste sites on a monthly basis, so that frequency would likely apply to TENORM waste sites as well, the regulator said.

Those inspections are performed by Solid Waste Program staff; there are approximately eight such staff members in total. None of them have formal qualifications or experience in radioactivity or radioactive science.[192]

As for compliance, the DoH's enforcement policy depends on the severity of the penalty, and the intent of the violator. If it believes that a violation was incurred by mistake, for instance, the DoH will simply ask the facility to correct it, and give them a warning letter. For repeat offenders, the DoH will issue a formal enforcement action, penalties, and occasionally even initiate criminal charges or proceedings.[193] It is legally permissible to collect as much as $12,500 per penalty per day.[194]

North Dakota regulators have come under fire for allowing large reductions in penalty fees for those in violation of the rules. Zenith Produced Water, LLC, a company linked to the illegal dumping of filter socks in an abandoned gas station in Noonan, saw its penalty drop from $800,000 to just $20,000, after company representatives and regulators met and "came to an agreement."[195] RP Services, a contractor that had been stockpiling used filter socks on two flatbed trailers in rural McKenzie County, initially received a penalty assessment of $103,000 for its violation; that fine was later reduced to $16,000, just 15 percent of the initial amount.[196] Meanwhile, the company that originally contracted with RP Services, Continental Resources, merely received a notice of violation for the incident, which was later dismissed.[197]

The lack of rigorous inspection and enforcement protocols poses challenges to the successful adoption of the new rules by generators, transporters, and facility operators.

South Dakota

South Dakota produces far less oil and gas than North Dakota, Montana, and Wyoming, its neighbors to the north and west. In 2014, South Dakota produced 1,791,000 barrels of oil all year, or roughly the same amount North Dakota produces in one day.[198] South Dakota currently has no active oil rigs.[199]

As North Dakota's immediate neighbor to the south, many would expect South Dakota to be another prime destination for TENORM waste from the Bakken oil fields. However, South Dakota's radioactivity limit matches North Dakota's former limit, at 5 picocuries per gram of combined radium-226 and radium-228 plus background.[200] If North Dakota's new limit passes, South Dakota's limit will be the lowest in the region, making the state a non-option for most TENORM disposal.

Beyond having a strict limit, South Dakota's Department of Environment and Natural Resources (DENR), the regulatory body that handles TENORM waste disposal, does not have any other regulations around TENORM waste. Facilities that accept TENORM waste follow the standard solid waste regulations, though they must abide by TENORM-specific protocols.[201]

The only facilities that can accept TENORM waste are regional municipal solid waste landfills, of which South Dakota has 15.[202] They do not have to receive specific approval or a permit for TENORM waste acceptance. All other types of facilities are prohibited from accepting such wastes.[203]

Limits

The DENR maintains a radioactivity limit of 5 picocuries per gram of combined radium-226 and radium-228.[204] Facilities also have the option of measuring their own background radioactivity level, in order to establish a site-specific background concentration; this then permits them to accept wastes at concentrations of 5 picocuries plus their established background concentrations.[205] For example, if a facility determined that its background concentration was 2 picocuries per gram, it would be able to accept wastes with concentrations of up to 7 picocuries per gram—or 2 picocuries plus 5 picocuries.

Two facilities in South Dakota have completed this

step: Custer-Fall River and Northwest Regional. The Custer-Fall River landfill has established a background radioactivity level of 7.25 picocuries per gram, meaning it can accept wastes with concentrations of up to 12.25 picocuries per gram, while the Northwest Regional landfill has established a background level of 3.36 picocuries per gram, and can accept wastes with concentrations of up to 8.36 picocuries per gram. No other landfills have established background levels, so they are all held to the 5 picocurie per gram limit.[206]

South Dakota's only volumetric limit is that facilities that receive more than 100,000 tons per year of solid waste must obtain a special permit authorizing them to do so.[207] There are no volumetric limits specific to TENORM waste.

Handheld radioactivity monitoring in Tioga, North Dakota. (Source: Darrell Dorgan).

Facilities & waste flows

Most solid waste facilities in the state are prohibited from accepting TENORM wastes by the terms of their permits. This includes restricted use sites, construction and demolition debris sites, contaminated soil sites, and medical waste treatment sites. The only types of facilities that can accept TENORM waste are regional municipal solid waste landfills, of which South Dakota has 15.[208]

Historically, the Custer-Fall River Landfill has been the only facility to consistently accept oil and gas wastes, according to a DENR regulator.[209] Custer-Fall River is a municipal solid waste landfill located in Fall River County, one of the two main oil producing counties in South Dakota, so it receives waste from both local generators and from eastern Wyoming.[210] The Belle Fourche Landfill, another municipal solid waste landfill, has also accepted oil and gas wastes in the past. It largely receives waste from sites in southern North Dakota and Harding County, South Dakota--the other main oil producing county in the state.[211]

Until several years ago, South Dakota landfills rarely took in more than a combined 1,000 tons of oil and gas field waste per year. In the past few years, however, the Custer-Fall River landfill saw a spike

in tonnages received, to about 10-12,000 tons per year. Those numbers began to decline again when the price of oil dropped significantly in July of 2014, and have hovered close to zero ever since.[212]

Permitting & public involvement

Unlike in North Dakota, where facilities have to apply for a permit modification in order to begin accepting TENORM, South Dakota does not have a permitting process specific to the disposal of TENORM wastes. Municipal solid waste landfills can accept TENORM wastes automatically, and do not need special permission or approval from the DENR to do so.[213] All other types of facilities are prohibited from accepting TENORM wastes.[214]

The department grants two types of permits, general permits and individual permits. Municipal solid waste facilities receive individual permits, which signify that the permit has been customized in some way. No facility that receives a general permit would be able to accept TENORM wastes.[215]

During the permitting process, South Dakota provides citizens with several mechanisms for public involvement. To initiate the process, an applicant must notify all adjacent landowners of its intent to request a permit. Copies of the letters that the applicant sends out must be included in the facility's permit application. The DENR then receives the application, and is allowed by administrative rule 180 to 270 days for review. Once the application is complete, the DENR drafts a permit, and sends it to the facility operator for review. The DENR also places a public notice at this stage.[216]

Public notice initiates a public comment period, which lasts for 30 days. If citizens wish to contest a permit, they can request a hearing in front of South Dakota's Board of Minerals and Environment. Final permitting would then fall to the board. If the board chose to grant the permit anyway, the public can then appeal that decision.[217]

South Dakota's regulations include a stipulation that allows local governing bodies to adopt stricter standards for solid waste disposal facilities than those maintained by the DENR. Such standards would have to be enacted by ordinance or resolution, and could not be instituted for just a single site.[218] In addition to this stipulation, South Dakota has mechanisms for local control similar to those provided in North Dakota and Colorado, which state that new facilities must receive approval from the governing body of the county in which the facility is proposed to be located.[219] The regulations also explicitly require the relevant board of county commissioners to hold at least two meetings on the proposed facility, and to provide public notice for each of those meetings.[220]

The most unusual part of South Dakota's solid waste regulations is the requirement that large-scale solid waste facilities receive legislative approval before being permitted.[221] In other words, the state legislature needs to enact a bill in order to approve the siting, construction, and operation of a facility with a waste capacity of over 200,000 tons before it can be granted a permit. This law was passed via ballot initiative during a particularly contentious permitting process for the Lonetree landfill, a 1200 acre balefill facility in the southwestern part of the state that was proposed in the early 1990s.[222] The landfill was never built, but the owners in charge of the project were awarded millions of dollars in "damages" after not receiving a permit.[223]

Though existing procedures include several opportunities for public involvement, South Dakota could provide still more. Public notice should be made when the application is initially submitted, not just when the permit is drafted; furthermore, the DENR should automatically hold public meetings or hearings in affected communities.

Disposal protocol & site design

Because South Dakota does not have regulations on TENORM waste other than the picocurie limit, the state also does not have any formalized design specifications or disposal protocols for TENORM waste materials. In an interview with a regulator at the DENR, the regulator confirmed that the department does require TENORM wastes to be buried in a lined disposal area, but could not be more specific than that.[224] Most TENORM wastes are disposed of according to broader solid waste disposal protocols, which, for municipal solid waste facilities, would entail a liner, a leachate collection system, and a groundwater monitoring system, among other components.[225]

The DENR does require all municipal solid waste landfills to implement groundwater monitoring programs, unless they can demonstrate that groundwater degradation will not occur.[226] Facilities must also present a plan for the control and treatment of leachate and methane as part of their original permit application.[227] The department does not, however, require facilities to test the radioactivity content of every load. Generators must obtain a radioactivity analysis from an independent third-party entity for every 100 tons delivered to a landfill, but facilities themselves only collect verification samples and have them tested for radioactivity once every 250 tons.[228]

South Dakota does not require landfill operators to have any specific qualifications, though the DENR strongly encourages it.[229] Facilities are required to train their workers on a variety of things, but those trainings do not have to address radioactivity or radioactive waste.[230]

Tracking & reporting

South Dakota has the beginnings of a strong tracking and reporting program, but it could be strengthened in several ways. The DENR requires facilities to document an extensive amount of information upon intake, including but not limited to the specific generator, the latitude and longitude of the source well, and the characteristics of the waste, as determined by lab analysis from an independent entity. However, these records are kept at the facilities themselves, and are only sent to the DENR if requested by staff. These records are available to the public upon request.[231]

The DENR does have the ability to require out-of-state generators to file more detailed waste records with the landfill operator, if they are bringing out-of-state wastes to a South Dakota disposal site. The department can also mandate that landfill operators send those records in to the department. This is not a universal requirement, however.[232]

Finally, facilities that accept more than 100,000 tons of waste per year must submit monthly reports to the department stating the total amount of solid waste disposed of during the preceding month.[233] This is the most stringent reporting requirement for South Dakota's solid waste facilities, but the department would do well to expand it to all facilities, regardless of intake volumes.

Inspection & compliance

South Dakota's solid waste regulations do not specify how frequently inspections should occur. According to a regulator, the DENR aims to inspect landfills twice a year. Inspections are all conducted by a DENR staffer with no qualifications in radiation or radioactive isotopes.[234]

South Dakota addresses violations primarily through verbal and written consultations with facilities that are not in compliance for minor violations, or by sending a notice of violation for more serious or repeat violations.[235] The latter option is much more formal than the former, and typically outlines some corrective action for the facility to take, in order to return to compliance. Several violations—such as unauthorized dumping, disposal in water, and burning of waste, as well as the construction, alteration, or operation of a solid waste facility without a permit—qualify as Class 2 or Class 1 misdemeanors, and could subject violators to civil action in South Dakota's circuit court and penalties of up to ten thousand dollars per day per violation.[236] The DENR also has the ability to suspend or revoke any solid waste permit whose terms or conditions have been violated.[237]

Wyoming

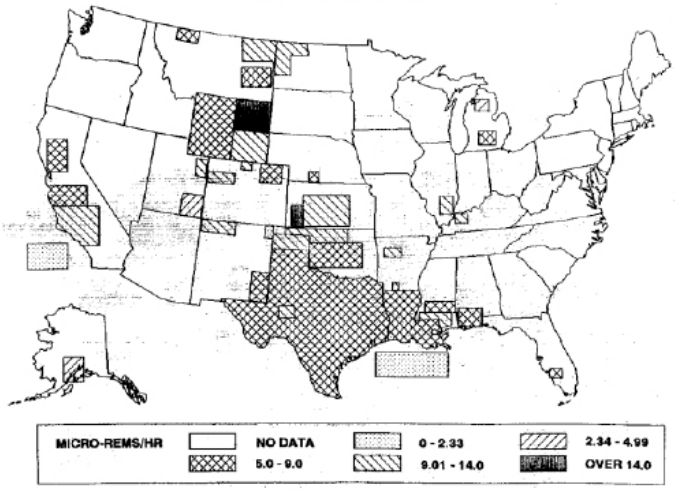
Wyoming has long been a national leader in oil and gas production. Mineral extraction ranks as the state's top industry, and the associated royalties and taxes make up a major portion of the state's budget.[238] It has more producing federal oil and natural gas leases than any other state, with extraction occurring in 22 of its 23 counties.[239] Moreover, as the state with the smallest population in the U.S., Wyoming consumes very little of its own resources, making it the biggest net contributor to domestic energy markets of any state.[240]

The state's coal and natural gas industries contribute the lion's share of those outputs. Wyoming is one of the top 10 natural gas-producing states in the nation, but only accounts for 2 to 3% of national oil production.[241] In recent years, though, Wyoming's crude oil production has seen a slight uptick. In 2009, the state produced 141,000 barrels of crude oil per day; in 2014, that number had risen to 208,000.[242]

Production levels of this sort would typically suggest corresponding levels of TENORM waste. However, the Wyoming Department of Environmental Quality (DEQ) maintains that NORM and TENORM are "encountered less frequently in Wyoming" than in comparable states, and that, as a result, such wastes do not require significant departmental attention or regulation.[243] This conclusion, according to a very vague, in-text citation in the department's policy document, was drawn from a U.S. Geological Survey (USGS) fact sheet on NORM and TENORM, as well as from "other published sources." The fact sheet in question, however, does not state that NORM and TENORM exist in lower concentrations in Wyoming. What it does state, in map form, is that Wyoming's typical NORM and TENORM waste readings are "at background."[244]

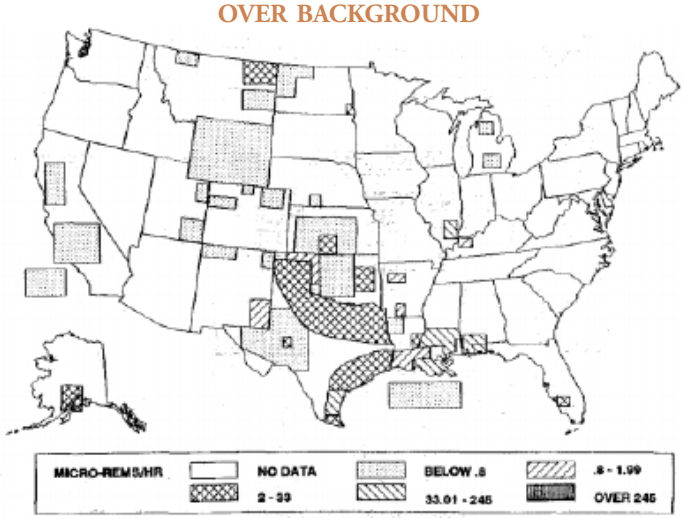
Background levels of radioactivity can vary widely, though; stating that Wyoming's NORM and TENORM measurements correspond to its background radioactivity levels does little to clarify what those measurements actually are, and means very little without additional reference. Luckily, the USGS provides that reference, citing a 1989 report called "A national survey of naturally occurring radioactive materials (NORM) in petroleum producing and gas processing facilities" as the source of the aforementioned conclusion.[245]

FIGURE 18: MEDIAN BACKGROUND LEVELS OF NORM



Source: American Petroleum Institute

FIGURE 19: MEDIAN OVER BACKGROUND



Source: American Petroleum Institute

That report, which was sponsored by the American Petroleum Institute, surveyed background levels of radioactivity across the United States, and compared them to radioactivity concentrations in samples taken outside of oil and gas industry facilities.[246]

The report determined its findings by measuring the *difference* between those two numbers. In other words, it sought to establish which states' oil and gas producing facilities had the highest NORM and TENORM activity levels *over background*. Wyoming's background levels of radioactivity were among the highest in the nation, as seen in Figure 18 above; as a result, Wyoming's radioactivity concentrations *over background* were relatively low, as seen in Figure 19. However, because the report used the data represented in Figure 18 as baseline data, and the data represented in Figure 19 as its official findings, that fact-- that Wyoming had some of the highest levels of background radioactivity in the nation-- never seemed to surface.

Contrary to the DEQ's conclusion, then, Wyoming's TENORM waste products may actually have radioactivity concentrations that are on par with--or even higher than-- those of neighboring states, because those wastes are emerging from soils that have higher concentrations already.

The API report, however, was conducted long before the combination of horizontal drilling and hydraulic fracturing became common practice-- a process that has significantly altered the impacts left by oil and gas exploration and production. It would be prudent, then, to revisit the state's background radioactivity levels, as well as the radioactivity levels of oil and gas industry wastes, rather than to assume that they've remained unchanged in the intervening decades.

Per the conclusions drawn from the reports mentioned above, Wyoming does not

currently regulate TENORM waste. As a stand-in, the Department of Environmental Quality's Solid and Hazardous Waste Division (SHWD) published a guidance document on TENORM waste called "Guideline #24" in August of 2011; however, much like the documents published by regulators in Montana and Colorado, this document has no regulatory power.[247] The upper limit it sets forth is 50 picocuries per gram of radium-226, but again, that limit functions more as a suggestion than anything else.

Wyoming also does not require facilities to be permitted specifically for the disposal of TENORM wastes, and instead allows them to independently determine whether they will accept TENORM waste and how they will dispose of it.[248] Facilities are not required to relay this information to the department. As a result, the Wyoming DEQ does not have a complete list of all the facilities in the state that accept TENORM wastes, nor do they know the amounts and major types of TENORM wastes that are being generated.[249] Contrary to the DEQ's belief that TENORM does not pose a significant problem in Wyoming, however, landfills around the state—and several outside of it—do encounter TENORM waste loads from generators in Wyoming on a regular basis, a fact that was came to light during interviews with a series of individual Wyoming landfill operators.

In 2010, the Wyoming DEQ conducted a report on "Groundwater Impacts and Remediation Costs" at Wyoming municipal solid waste disposal facilities, at the request of the state legislature's Joint Minerals, Business, and Economic Development Interim Committee. Tasked with determining the extent to which municipal solid waste disposal facilities were causing or contributing to groundwater pollution throughout the state, the report found that there was evidence of contamination at 96% of the landfills surveyed, while contaminant concentrations exceeded groundwater protection standards at 91% of the landfills surveyed.[250] Since the report's publication, many of the landfills in question have closed, while others are still undergoing remediation efforts of some kind.[251] This information underscores the need for stringent and thorough regulatory attention to solid waste management and disposal—particularly when the waste in question poses additional risks to environmental and human health.

Limits

The DEQ's guidance document provides facility operators with a stratified limit system. This limit system is not a set of formal regulations, though, and merely functions as a set of strong suggestions. The specifics of this system are as follows.[252]

FIGURE 20: RADIOACTIVITY CONCENTRATION LIMITS FOR DISPOSAL FACILITIES IN WYOMING

Radioactivity concentration (for radium-226)	Disposal option
8 picocuries per gram or less	May be disposed of as normal solid waste
30 picocuries per gram or less	May be disposed of in quantities of up to 20 cubic yards at one time
5o picocuries per gram or less	May be disposed of in quantities of up to 10 cubic yards at one time
Greater than 50 picocuries per gram	May not be disposed of in Wyoming

TENORM wastes with radioactivity concentrations of less than 8 picocuries per gram of radium-226 are considered exempt, meaning that they can be disposed of in any landfill as normal solid waste. TENORM wastes with radioactivity concentrations of less than 30 picocuries per gram of radium-226 can be disposed of in any landfill that chooses to accept them, in quantities of up to 20 cubic yards at a time. TENORM wastes with radioactivity concentrations of less than 50 picocuries per gram of radium-226 can be disposed of in any landfill that chooses to accept them, in quantities of up to 10 cubic yards at a time. TENORM wastes with radioactivity concentrations that exceed 50 picocuries per gram of radium-226 must be sent out of state for disposal. These limits apply to solid waste in the form of contaminated soil, pipe scale, and sludge.

These limits are also described in more digestible form in Figure 20.

The department determined its current threshold for exemption (8 picocuries per gram) by researching U.S. Geological Survey (USGS) data on TENORM activity levels and by considering the TENORM limits set by other states. According to a regulator at the Wyoming DEQ, they also measured background levels of radioactivity in various places around Wyoming, and found that soils had an average radioactivity concentration of 4 picocuries per gram, with standard deviations of about 2. As a result, they chose an exempt concentration of 8 picocuries per gram.[253]

The key takeaway with respect to these limits is that they are merely "guidance," and cannot be enforced as state rules. This leaves Wyoming and its citizens vulnerable to the decisions and protocols of individual oil and gas waste generators, particularly given the stipulation in the guidance document that "it is the responsibility of any generator to know about their wastes and to manage them appropriately."[254] This leaves little incentive for oil and gas companies to manage their wastes

appropriately, as such efforts involve additional time and increased costs; as a result, the burden of determining how to screen for and manage TENORM falls entirely on landfills, rather than on the DEQ.

Facilities & waste flows

Wyoming has multiple categories of solid waste facilities.[255] Several of those facilities frequently accept TENORM wastes; those categories are delineated below. Facilities that do not accept TENORM wastes—such as construction/demolition landfills, which can only accept construction materials—are not included in this list.

A municipal solid waste landfill is a solid waste management facility that utilizes an engineered method of controls to dispose of municipal solid waste via land burial.

A commercial solid waste management facility is any facility that receives a monthly average of greater than 500 short tons per day of either unprocessed household refuse, or mixed household and industrial refuse.

An industrial landfill is a solid waste management facility that utilizes an engineered method of land disposal, primarily for the disposal of industrial solid waste.

All of Wyoming's municipal solid waste landfills can accept TENORM wastes with radioactivity concentrations above the exempt level (8 picocuries per gram) if they so choose. There is no formal list of the landfills that do this, though, since the department does not formally require facilities to report their TENORM policies and practices. According to the operator of the Campbell County Landfill, in Gillette, Wyoming, that facility seeks case-specific permission from the DEQ whenever it receives a load of TENORM waste.[256] Meanwhile, the Casper Landfill, in Casper, Wyoming, accepts TENORM waste without contacting the DEQ, but follows the department's published protocols.[257]

Wyoming also has a proposed industrial landfill that would be designed specifically for oil and gas exploration and production waste. This facility is still going through the permitting process, so it's not yet clear whether it would accept TENORM wastes or not.[258] A second new facility is under construction, as well, despite the fact that it has not yet initiated the permit application process.[259] When asked about this, a regulator at the Wyoming DEQ said that there was nothing illegal about beginning construction, and then acquiring the necessary permits later.[260]

Permitting & public involvement

As stated earlier, Wyoming does not require waste facilities to receive specific approval for TENORM waste acceptance or disposal. Solid waste facility permits do not consistently address TENORM wastes; as

such, they automatically give the operators of individual facilities the authority to accept or reject TENORM wastes at their own discretion.

The general solid waste permitting process involves a relatively high number of opportunities for public engagement and involvement, particularly in comparison to Montana. When applicants submit a permit application, that application first undergoes a "completeness review," in which the department checks to make sure that it includes all necessary components and materials. During this initial stage, the applicant must notify any landowners that own property within a half mile of the proposed facility of their application. That notification must happen via certified mail. If the application is determined to be complete, the department publishes a public notice in a newspaper of general circulation in the county where the facility is proposed. Public notice is also made via e-mail to members of the department's "interested parties mailing list," to which anyone can self-subscribe. The department then has 90 days to perform a technical review of the application. If the application is technically satisfactory, the department prepares a proposed permit. At this point, the applicant must again notify nearby landowners via certified mail (of the proposed permit), and the department again makes public notice, initiating a 30-day public comment period.[261]

If "substantial" written objections are filed during the public comment period, the proposed permit will be decided via public hearing at the Environmental Quality Council (EQC). The DEQ does not provide a definition of "substantial;" a regulator in the department said that a written objection from someone who would be affected by the proposed facility is generally considered substantial enough, and would send the permit in question to the EQC.[262] The EQC would then issue a decision on the permit. If no written objections are filed, the DEQ would make the final decision.[263]

All final decisions are subject to appeal, however, which would send the permit back to the Environmental Quality Council. The second final decision would not be subject to appeal with the EQC, but could be challenged in court.[264]

Wyoming has an interesting stipulation that applies only to commercial solid waste management facilities; the state requires that such facilities receive permit approval from the local board of county commissioners, in the county where a facility would be located. Industrial landfills, while not subject to this same measure, must abide by local zoning ordinances or land use plans that have been adopted by a county commission or municipality.[266]

Disposal protocol & site design

Wyoming does not have any design specifications for facilities to accept TENORM wastes. It also lacks specific disposal protocols for such materials, stating only that TENORM wastes should be stored in enclosed containers or durable synthetic "super sacks" while they await disposal, and after disposal, wastes with radioactivity levels higher than 30 picocuries per gram should be covered with a minimum of 4 feet of approved coverage material.[267]

The guidance document does not make mention of liners or type of liners, leachate collection systems, leachate removal systems, groundwater monitoring systems, or any other design components, nor does it instruct facility operators on proper protocol for accepting and handling TENORM waste. Though these elements are included in the standard solid waste disposal rules and regulations, they are not addressed in a TENORM-specific context.

Tracking & reporting

Wyoming expects generators to perform their own analysis of the wastes they produce. Generators are not required to have analysis done by a third-party, as they are in many other states. They can either test their own waste for radioactivity or use "generator knowledge" of their waste streams to approximate the waste's radioactivity concentrations and characteristics.[268]

Landfills, meanwhile, screen incoming loads using "visual inspections" and the paint filter test, which is an EPA-approved method of determining the presence of free liquids in a representative sample of a hazardous waste.[269] Facilities that have the requisite equipment also screen for radioactivity, either with a handheld Geiger counter or by sending off wastes for their own testing. However, most simply rely on lab reports submitted by the waste generator, as the alternatives are both time-consuming and costly.[270]

Inspection & compliance

The DEQ performs compliance inspections on all of its facilities at varying frequencies. The department is required by rule to inspect all municipal solid waste facilities on an annual basis. Industrial facilities are not subject to a mandatory inspection schedule, so the department generally attempts to inspect them annually, but doesn't always accomplish that.[271] Inspections are performed by SHWD staff.

The DEQ addresses instances of noncompliance primarily through conferences and conciliation with the party that has committed a violation. The next step would be initiating a formal or informal enforcement action, some of which involve financial penalties.[272]

Recommendations

Current efforts to regulate and manage TENORM wastes, as described throughout this report, are failing. In order to appropriately address regulatory gaps, stem mismanagement, ward off illegal disposal actions, and sufficiently protect both human and environmental health, states should take the following actions.

Federal regulations

The EPA should eliminate its exemption for oil and gas field wastes from the Resource Conservation and Recovery Act, thereby including such wastes in the list of materials considered "hazardous." Patchwork regulation by individual states has failed to comprehensively and effectively address this waste stream, leaving the American public vulnerable to its impacts.

State rules & rulemaking

In the absence of comprehensive federal regulation of oil and gas field wastes under RCRA, individual states should establish their own regulations around the identification, storage, transport, and disposal of radioactive oil and gas field wastes.

1. States should prohibit facilities from accepting TENORM wastes until they have formal rules around its disposal.
2. States should hire an independent, impartial entity to conduct a study of NORM and TENORM in their state, as North Dakota did, before creating rules around it. If this is not possible, states should rely on North Dakota's Argonne study, Pennsylvania's study, and Michigan's white paper.
3. Montana, Wyoming, and Colorado should initiate formal rulemakings around the identification, storage, transport, & disposal of TENORM waste from oil and gas exploration and production.
4. States should provide ample opportunities for public input, both before and after draft rules are published, including conducting public scoping and formal hearings on draft rules in impacted communities.
5. States should adopt final rules governing TENORM waste disposal and transport.

Rules need to specify site design, intake protocols, worker and operator safety and training mechanisms, cradle to grave tracking and reporting, leachate and groundwater monitoring, and other categories covered in this report. Rules cannot simply establish picocurie limits.

6. States should ensure that there are sufficient resources to enforce the new rules.

Limits

As part of their state-specific radioactive oil and gas field waste regulations, states should establish a set of radionuclide concentration limits that correlate to data on the most heavily concentrated radionuclides in that state. Disposal limits should not be established arbitrarily, or under the assumption that radionuclide concentrations in one state will be the same as in surrounding states.

1. States should set the lowest practical disposal limit for combined radium concentrations.
2. States should set additional disposal limits for other radionuclides that appear in noteworthy concentrations in that state. This explains the need for each state to do its own study, and determine which radionuclides exist in the highest concentrations within its borders.
3. States should also set total radionuclide concentration limits. Considering radionuclides in a vacuum does not take into account their combined effects.
4. The aforementioned limits should be hard and fast numerical values, and should not include the stipulation "plus background." Having a higher background level of radioactivity at a specific site does not make it safe to add more.
5. States should establish a tiered system for tonnage or volumetric limits that considers the size and design of landfills in question. Larger, more advanced landfills should be permitted to accept more TENORM waste than small, less advanced landfills. These limits should be derived from the state-specific studies of TENORM.
6. All radioactive oil and gas field waste should be included in the definition

of TENORM, and thus regulated. For example, drill cuttings should not be excluded from TENORM regulation (as they are in North Dakota), despite not being concentrated by human activity. They are exposed by human activity, which the EPA includes in its definition of TENORM. Either way, the radionuclides pose a risk to human and environmental health, and should be regulated.

Permitting

Facilities seeking to dispose of TENORM wastes should be required to have specific permit approval to do so. This will allow the relevant regulatory agency to more effectively manage TENORM waste flows, inspect TENORM disposal facilities, and uphold such facilities to stringent regulatory standards.

1. Municipal solid waste facilities should be prohibited from accepting TENORM wastes.
2. Industrial or special waste facilities should be required to apply for specific TENORM licensing, and should not automatically be able to accept TENORM waste.
3. Regulatory agencies should be required to assess the potential environmental impacts of new facilities before licensing them to accept TENORM, as well as of all existing facilities that are interested in expanding their permits to include TENORM waste disposal.
4. Facilities should not be allowed to begin construction before receiving a final permit. Those that do should be penalized appropriately.
5. Permits should also be subject to approval from the appropriate local governing body (i.e., city council or county commission). If the local governing body approves a permit, voters should have the ability to place an initiative on the ballot to overturn that decision.
6. Agencies should assess the potential cost of remediation or reclamation, and set a financial assurance amount that reflects that cost.

Public involvement

The public should be given ample opportunities to participate in and comment

on the siting and permitting of TENORM waste facilities. Facilities handling a waste stream of this kind should not be appearing without prior knowledge and, preferably, consent of adjacent and nearby landowners.

1. Adjacent landowners, any landowners within 2 miles of the site, and any landowners within a 10 mile down-gradient of the site should all be given written notice via certified mail of proposed facilities, and permit modifications seeking TENORM disposal approval.
2. Public notice should be made in newspapers of record in the appropriate county at the following points:
    a. Initial submission of a permit application
    b. Completion of the permit review and publication of the draft permit
    c. Initiation of the public comment period
    d. Announcement of any public meetings, hearings, etc.
    e. Approval or denial of final permit
3. Public comment period should last at least 60 days.
    a. Comments should be published online and made publicly accessible.
    b. The responsible agency should respond formally in writing to every substantive comment, and explain whether it is accepted, rejected, or adopted with modifications.
4. Public hearings should be held in communities affected by proposed facility
    a. Communities should be notified of the hearings at least 30 days in advance.
    b. Hearings should be held at times that are convenient for the majority of people in the affected community (i.e., not during work hours on a week day).
    c. Public meeting format should allow citizens to testify before the whole room, and comments should be recorded and published.
    d. The responsible agency should respond formally in writing to every

substantive comment, and explain whether it is accepted, rejected, or adopted with modifications.

5. Citizens should have the ability to appeal final permit decisions.
6. Significant permit modifications (i.e., giving a facility approval to accept TENORM wastes) should be subject to the same metrics of public involvement.

Siting & design

Facilities seeking to accept TENORM waste should be designed and equipped according to the most stringent and thorough design standards and protocols. Facilities that are not equipped in this fashion should be prohibited from accepting TENORM wastes.

1. Before sites are determined to be eligible for construction, the permit applicants should have to hire independent consultants to conduct surveys of the site geology, hydrology, and soil composition. If the geology, hydrology, or soils prove to be unsuitable, the applicants should have to find another site.
2. Facilities should not be permitted to be constructed within 2 miles of schools, hospitals, and other public institutions.
3. Facilities should have a leachate collection system, a leachate removal system, a leak detection system, and a composite liner that is sufficiently protective.
4. Facilities should have groundwater monitoring wells and a gas monitoring system.
5. Facilities should be built to withstand a 100-year flood event.

Facility operations

Oil and gas operators, waste transporters, and disposal facilities should all be required to follow specific operating protocols around the handling and management of TENORM wastes. These protocols should not be left up for determination by individual licensees, who may not possess the requisite knowledge to handle TENORM wastes appropriately.

1. Waste radioactivity concentrations and specific radionuclide contents should

be analyzed by an independent third-party laboratory before the waste's arrival at a facility.

2. Leachate should be collected and tested monthly, and reported to the regulatory agency on a monthly basis as well.
3. Groundwater monitoring should be performed monthly, and results should be reported to the regulatory agency monthly as well.
    a. If elevated levels of contaminants are found, or if the facility has been found to be in violation of a rule, frequency of groundwater monitoring should be increased to biweekly or weekly.
4. Down-gradient water monitoring should also be performed monthly, and results should be sent to both the regulatory agency and the down-gradient landowners.
    a. This sampling should include both surface and groundwater.
5. TENORM wastes should be covered daily by non-TENORM wastes or other earthen materials.
6. TENORM wastes should not be disposed of within 10 feet of the final repository cover, as recommended by both Argonne and a Michigan TENORM Advisory Committee.
7. Facilities should employ fugitive dust controls, such as a wind speed limit that requires the facility to suspend waste acceptance operations when winds reach a certain speed.
8. Facilities need to provide down-gradient baseline water testing for landowners within 10 miles of the site, as well as seasonal monitoring of those wells.
9. Facilities should monitor for radon gas near landfill vents.

Tracking & reporting

TENORM wastes should be subject to a "cradle to grave" waste tracking and reporting system that makes TENORM waste flows around the region visible, transparent, and publicly accessible, and allows for more effective regulatory oversight, including the prevention of illegal waste dumps.

1. TENORM waste should be tracked from "cradle to grave."
    a. Waste disposal facilities must document: type of waste, quantity in tons, company that generated the waste, process that generated the waste, date received, and radionuclide content and concentration, as determined by a third-party laboratory.
    b. Waste disposal facilities must also document any rejected loads (with all of the information above) and report them to the relevant regulatory agency within 5 days of rejection (North Dakota has this requirement & has found it a very effective preventative measure around illegal dumping).
    c. Individual waste records should be sent to the relevant regulatory agency. This includes rejected loads, so regulatory agencies can follow up with the generator or transporter and help prevent illegal dumps.
    d. Regulatory agencies should maintain online, publicly accessible databases of the aforementioned records. Citizens should be able to access both individual waste tickets and bulk statewide numbers.
2. Water and gas quality sampling results should be published in an online database.

Transport

Transport of TENORM wastes should also be subject to governmental oversight and attention, given the potential for spills or other instances of contamination along transport routes.

1. TENORM waste transporters should be required to obtain a license to do so from the appropriate regulatory agency, in order to ensure that the transporter is appropriately equipped and sufficiently knowledgeable.
2. Trucks carrying TENORM waste should be required to have visible placards that state that they're carrying radioactive waste.
3. Trucks carrying TENORM waste should be required to cover their loads.

Worker health & safety

Worker health and safety should be addressed within state-specific TENORM regulations, in light of the Argonne report's finding that landfill workers face the greatest potential doses of radioactivity. Increased attention to training and safety protocols will also help protect the public, as it will decrease instances of improper management and contamination.

1. Worker & operator training programs should be mandatory. Several independent consulting groups offer such programs nationally.
2. Operators should be required to receive certification to a) operate an industrial or special waste landfill and b) manage TENORM wastes.
    a. A prerequisite of certification should be a year or more's experience operating a municipal solid waste facility, along with a training session on TENORM waste and a written examination demonstrating a familiarity with or understanding of TENORM waste.
3. Workers should be required to wear protective personal equipment (PPE) that includes gloves and respirators. As the Argonne report says, "if PPE is not worn, potential doses to these workers would be unacceptably high."
4. Workers should also be required to wear cumulative dose monitoring devices.

Inspections & enforcement

Any oil and gas operators, waste transporters, and disposal facilities that regularly handle TENORM wastes should be subject to regular, unannounced inspections by qualified governmental officers, in order to ensure that regulations around TENORM waste are being thoroughly and sufficiently upheld. Any violations of such regulations should be subject to strong enforcement mechanisms.

1. Quarterly, unannounced inspections by qualified governmental officers.
    a. "Self-inspections" should not suffice as a stand-in for governmental inspection.
    b. Inspectors need to receive training on TENORM before conducting inspections of TENORM waste disposal facilities.

2. Citizens should have the right to request and receive an inspection of TENORM waste facilities. Citizens should also have the right to accompany the inspector on the inspection.
3. All notices of violations should be submitted for public notice in the newspaper of record in the appropriate county, and sent via certified mail to landowners within one mile of the facility in question.
4. A stratified penalty system that corresponds to the severity of violations and invokes significant fines when companies commit violations
    a. Companies found to be in violation of rules should receive an immediate cease-and-desist order until the violation is addressed or the incident is cleaned up.
    b. Companies that are assigned financial penalties should have to pay them in full.
    c. Companies should be subject to a "three strikes and you're out" provision. If a company has three violations, it should lose its permit for good.
    d. Agencies need to be able to initiate criminal charges or proceedings, in the most extreme cases.

Conclusion

On January 21, 2015, Ted Lone Fight III, a member of the Hidatsa nation and a resident of Mandaree, North Dakota, spoke before the North Dakota Department of Health at a public hearing on TENORM held in Bismarck. "Today we hold hearings to decide if we are going to be poisoned," he told the department. "And you've already poisoned the lands."

"We say no to this poisoning."

His comments give voice to a fundamental human right and desire-- the right to have a say in decisions that affect the quality of our lives and the viability of our livelihoods.

Communities across the West deserve that right. They deserve to know what's going into their air, water, soils, and skin, and they deserve to feel protected from environmental harm in their homes and neighborhoods.

The issue of radioactive oil and gas-field waste demands immediate attention from state and federal regulators alike. Without sufficient opportunities for public involvement, access to information, or protection from potentially harmful materials, citizens are left vulnerable to serious health and environmental impacts.

Used filter socks left uncovered in a household garbage can at a wastewater recovery facility in Keane, North Dakota.
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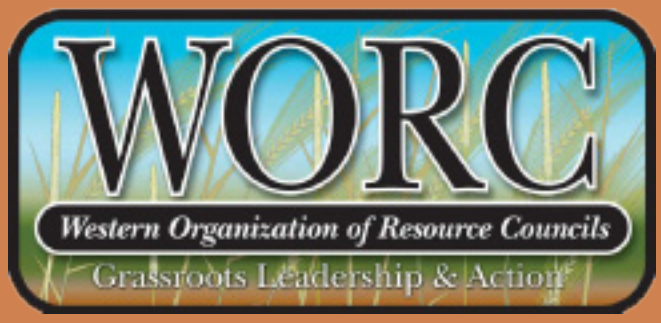
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