

Debunking "America's Radioactive Secret" by Rolling Stone Magazine

Rolling Stone magazine recently published the article ["America's Radioactive Secret"](#) about radioactive materials in oil and gas. The Health Physics Society (HPS) feels that there are a number of factual issues with this article. We go into some specifics on the most egregious errors below, but first some basics:

(1) Oil and gas workers should be properly informed about the risks and safety precautions for all the materials they deal with, including both chemical and radiological hazards. Generally speaking, radiological exposures at the levels experienced by most workers in the oil and gas industry are significantly below those where any observable effects are likely to occur, and, because of the human body's natural repair mechanisms, are unlikely to contribute to future cancers¹.

(2) There are many types of hazardous material (hazmat) on our roadways (i.e., toxics, flammable and combustible liquids, compressed gas, oxidizers, poisonous and corrosive materials, etc.). The US Department of Transportation (US DOT) groups these into various hazmat classes. State DOT agencies must utilize the federal DOT regulations. If a shipment meets the federal definition of hazmat Class 7 radioactive material and is transported on public roads, it is subject to the federal DOT's safety regulations in 49 CFR².

(3) The levels of radioactivity in oil and gas brine (O&G brine) do *not* meet the regulatory threshold of Class 7 radioactive material and, to our knowledge, never have; this is discussed in more detail below. It does not appear that any of the sources cited in the *Rolling Stone* article are trained or certified hazmat shippers.

(4) The National Council on Radiation Protection and Measurements will be publishing a commentary in the near future that calls for a full study of technologically enhanced naturally occurring radioactive material (TENORM) in the oil and gas industry. We take this issue seriously and devote a lot of our professional time working on these problems and trying to raise awareness. The issue does not need sensationalism or exaggeration. It needs to be taken seriously, however. We hope that this brief article helps to clarify these issues. Check out the HPS Ask the Experts section on [TENORM and environmental radioactivity](#) for more information!

Response to specific points made in the article:

- *"A lot of guys are coming up with cancer, or sores and skin lesions that take months to heal," he says. Peter experiences regular headaches and nausea, numbness in his fingertips and face, and 'joint pain like fire.'"*

Oil and gas workers should be informed about the risks and safety precautions they should take for all the materials they deal with, including both chemical and radiological hazards. Numbness and joint pain are not symptoms of exposure to radioactive materials. Cancer is a potential long-term risk, but studies show no statistically significant increase in cancer at levels below 100 millisieverts (mSv) or 10,000 mrem¹, which is well above the doses received by oil and gas truckers. While some experts believe that any amount of radiation can, hypothetically, initiate a cancer, the probability of that happening is well under one in a million per mrem of dose. The risk to the truck driver from highway accidents is several orders of magnitude higher than any potential radiation risk he or she might incur from transporting oil and gas wastes.

- *"Radium, typically the most abundant radionuclide in brine, is often measured in picocuries per liter of substance and is so dangerous it's subject to tight restrictions even at hazardous-waste sites. The most common isotopes are radium-226 [²²⁶Ra] and radium-228 [²²⁸Ra], and the Nuclear Regulatory Commission requires industrial discharges to remain below 60 for each. Four of Peter's samples registered combined radium levels above 3,500, and one was more than 8,500."*

The definition for "radioactive material" for the purpose of transportation regulations can be found in footnote 2, and is a function of type of material, concentration, *and* total quantity. Should a shipment not exceed the regulatory

¹ [HPS Radiation Risk in Perspective Position Statement](#)

² [Electronic Code of Federal Regulations; Subpart I—Class 7 \(Radioactive\) Materials](#)

threshold concentration *and* total quantity, it is exempt from US DOT shipping requirements. When one does the unit conversion and math, for ^{226}Ra , the shipment must be over 270 picocuries per gram (pCi g^{-1} , 10 Bq g^{-1}) in concentration *and* have a total activity above 0.27 microcuries (μCi) ($10,000 \text{ Bq}$). Note that radionuclide activities and concentrations are given here in pCi g^{-1} (called traditional units) because that is the unit used by US regulatory agencies. However, the HPS has adopted the SI (International System) of units and these are given in parentheses. There are about 1,000 grams of water in one liter³. Thus, one would need a concentration of $270,000 \text{ pCi L}^{-1}$ ($10,000 \text{ Bq L}^{-1}$) of ^{226}Ra to exceed the US DOT first criteria to be classified as hazmat Class 7 radioactive material for shipping. We are not aware of any used frac or produced water (O&G brine) that measured over $30,000 \text{ pCi L}^{-1}$ ($1,110 \text{ Bq L}^{-1}$).

Further, the NRC limit of 60 pCi L^{-1} (2.22 Bq L^{-1}) is for a release at an unrestricted point and would only result in a dose of 50 millirem per year if that was the concentration in a potable water source and not further diluted. For context, the average member of the public receives about 300 mrem per year of "background" radiation from natural sources.

- *"... radium readily attaches to dust, making it easy to accidentally inhale or ingest."*

Radium does not readily attach to dust. Its daughter products, lead-214 (^{214}Pb), bismuth-214 (^{214}Bi), and ^{210}Pb can attach to dust particles; ^{214}Pb and ^{214}Bi are short-lived radionuclides.

- *"'If I had a beaker of that on my desk and accidentally dropped it on the floor, they would shut the place down,' says Yuri Gorby, a microbiologist who spent 15 years studying radioactivity with the Department of Energy. 'And if I dumped it down the sink, I could go to jail.'"*

This is FALSE. Dr. Gorby likely was working with concentrated, regulated, licensed radioactive materials, not TENORM (which by definition is *not* regulated under the Atomic Energy Act.) If he spilled such regulated materials, didn't report it, and caused a major accident, only then would he be cited with a violation and possible charges. Thus, while a spill would certainly prompt an individual practicing good radiological hygiene and common sense to isolate the spill area and decontaminate, it is intellectually dishonest to say that a spill of the material described at its maximum concentration would require a facility shutdown.

As for the sink disposal, 10 CFR 20.2003 authorizes that very practice, provided that the material is soluble and properly diluted. This hypothetical one-liter beaker contains $28,500 \text{ pCi}$ ($1,055 \text{ Bq}$). That would mean that the entire facility would only need to discharge an additional 47 liters of water to the sewer in one month's time in order to satisfy the regulatory requirements for the case in which he "dumped it down the sink." The US Environmental Protection Agency estimates average daily wastewater flows of approximately 50 to 70 gallons ($190\text{--}265 \text{ L}$) per person per day being typical of residential dwellings built before 1994. Thus, on the low end of this estimate, the additional 12.4 gallons (47 L) needed to satisfy the regulatory requirements would likely be accounted for in less than one day for a single person in a typical household. The example of "a beaker" of material being poured down the sink being considered for criminal prosecution by the US Department of Justice is again intellectually dishonest.

- *"Brine haulers are a ghost fleet. No federal or state agency appears to know how many drivers like Peter are out there, how long they've been working, how much radioactivity their bodies have accumulated, or where this itinerant workforce might be living."*

The radiation doses to O&G wastewater drivers do not exceed the 100 millirem per year radiation exposure limit for a member of the "public," and the drivers are not classified as "radiation workers." Thus, one would not perform bioassay for internal radioactivity deposition.

³ Brine is denser than water, but radionuclide concentrations still do not come anywhere near US DOT thresholds.

- *"But the Department of Transportation does have jurisdiction over the roads, and there are rules on hazardous materials. Any truck with a load that contains more than the DOT radioactivity limit must be placarded with a radioactivity symbol, meet strict requirements for the container carrying the radioactive substance, uphold hazmat-training requirements for drivers, and travel only on approved routes."*

No O&G brine has ever measured above the federal DOT threshold to be considered hazmat Class 7 radioactive material. Some solids have, and those are subject to US DOT transportation regulations. Even then, there is no requirement for approval of travel routes.

- *"That would generally mean not driving near a waterway or source of drinking water, or on routes through areas that may be more populated, or a school," says a DOT spokesman."*

Only when there is a very large quantity (defined by US DOT as highway route control quantity) of radioactive material transported through a state is it subject to routing around population centers. No O&G waste solids or liquids have ever come near to that highway route control quantity threshold of 27,000 Ci, or 27,000,000,000 μCi (1×10^{14} Bq).

- *"Resnikoff says the standard brine truck in Pennsylvania would be six times above DOT limits, and 1,000 times above Nuclear Regulatory Commission limits for a radioactive substance. Which would mean they're breaking the law. 'There isn't anything specifically preventing them from doing that,' says the DOT spokesman."*

Mr. Resnikoff should provide the data and exact regulatory references to support that false claim. The US NRC and federal DOT transportation regulations are harmonized for transport of radioactive material and are based on international (International Atomic Energy Agency) standards.

- *"Testing, he said, is the responsibility of the operator at the wellhead who dispatches the brine to the hauler, and so the system mostly relies on self-reporting."*

We recognize that there are few reporting requirements for TENORM that is not Class 7 radioactive material. Shipments should still have papers for whatever the disposition of the brine is, but there are few if any requirements for sampling for radioactivity; this would be in the purview of the state oil and gas conservation commission (or similar regulator). There are also no reporting requirements for radioactivity for TENORM spills (with few exceptions). With respect to the US DOT, it is a federal DOT regulatory requirement that any person offering hazmat (e.g., Class 7 radioactive material) for transport on a public road is responsible for proper evaluation, classification, packaging, and manifesting of the shipment. The carrier is responsible for driver training. That shipper of radioactive material could be an O&G well developer, wastewater treatment facility, hospital or clinic with a nuclear medicine department, nuclear power plant, etc. Spills of materials with radionuclides that exceed specific criteria are reported; however, since the O&G brine does not exceed the US DOT definition of Class 7 radioactive material, such spills are not reportable on a federal level. Individual states have implemented TENORM regulations that could include spill notification requirements.

We also must point out that roads that are part of the drilling process are generally not under US DOT regulation, but rather that of the state oil and gas conservation commission. Once the trucks are on public roads, then they fall under the US DOT (again, the radioactivity levels in brine do not make the cut and are not Class 7 radioactive materials, even if they contain some radioactivity).

Still have a question or want to learn more? Check out the HPS Ask the Experts section on [TENORM and environmental radioactivity](#) for more information, or submit your question [here](#)!