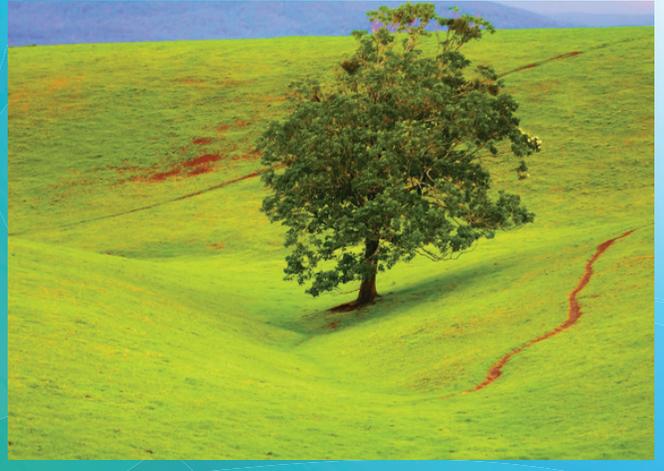


OHIO DEPARTMENT OF HEALTH NORM/TENORM INFORMATION SHEET



OHIO DEPARTMENT OF HEALTH

Naturally Occurring Radioactive Material (NORM) Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) INFORMATION SHEET

Naturally Occurring Radioactive Material (NORM) is radioactive material present in the environment; (i.e., soils, air and water) that is not man-made. NORM such as uranium (U), radium (Ra), and thorium (Th) emit low levels of naturally occurring radiation.

FAQs

What is NORM?

NORM, by definition, is naturally occurring and can be found everywhere. Since these materials are found in the natural environment, NORM is exempted from regulation by the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the State of Ohio.

Common examples of NORM include the following:

- radon gas that homeowners may detect in basements and living spaces;
- potassium-40 in all plants and animals, including humans;
- krypton-80 that is in the atmosphere and air we breathe;
- carbon-14 that is taken in by all organic matter and can be measured thousands of years later to determine its age in the process known as “carbon dating”;
- uranium and thorium and their decay products commonly used in stone work, including granite countertops used in residential kitchens; marble used for cemetery markers, statues, and building veneers; and granite and limestone walls used in buildings;
- radium in deep drinking water aquifers that causes additional burdens to water treatment plants; and
- uranium *while it is still in the ground*, before it is mined and processed into fuel rods for use in nuclear reactors.

What is TENORM?

When NORM is used for commercial purposes, processed, separated, or in some other manner has its radioactivity concentrated (intentionally or unintentionally), it becomes another category of radioactive material called Technologically Enhanced Naturally Occurring Radioactive Material (TENORM), which is regulated by the Ohio Department of Health. TENORM is the same group of NORM radionuclides, but it has been modified or “technologically enhanced” resulting in a man-made concentration higher than NORM.

Common examples of TENORM include the following:

- phosphate industry wastes including phosphogypsum and slag;
- phosphate fertilizers that are commonly used;
- coal industry wastes including fly ash, bottom ash and slag;
- oil and gas industry wastes including scale and sludges;
- water treatment plant wastes including sludges and resin filtration systems;
- metal mining and processing industry wastes including rare earths, zirconium, hafnium, titanium, and tin;
- large volume industries including copper and iron; and
- geothermal energy production wastes.

Where can I find Ohio TENORM regulations?

ODH TENORM rules were finalized in April 2012 and can be viewed at the following web link:
http://www.odh.ohio.gov/en/rules/final/3701_1-43-TENORM.aspx

How are Oil & Gas drilling-related TENORM wastes regulated in Ohio?

The state of Ohio has some of the most restrictive regulations in the country regarding TENORM.

- Ohio does not allow hydraulic fracturing water, flow back water, produced water, or other liquid wastes defined as brine to be used as drinking water. Since brine may contain elevated levels of NORM and other chemical constituents, Ohio requires this material to be sent to a permitted underground injection control-well where it can be safely disposed underground and not come into contact with drinking water supplies or wells.
- Oil & gas drilling-related waste, other than brine, that is TENORM must be tested before leaving the well pad to determine the concentration of radium-226 and radium-228.
- ***Wastes containing TENORM cannot be disposed of at an oil and gas drill site.***
- Solid waste landfills can only accept TENORM wastes for disposal at concentrations less than 5 picocuries per gram above natural background.
- If a solid waste landfill or other facility wants to dilute TENORM wastes with concentrations greater than or equal to 5 picocuries per gram above natural background prior to disposal, this activity requires authorization from the Ohio Department of Health.

If solid wastes cannot be managed at a solid waste landfill because of elevated levels of TENORM, the waste must be sent to a low-level radioactive waste disposal facility.

Where can you find NORM & TENORM in the Oil & Gas Drilling Process?

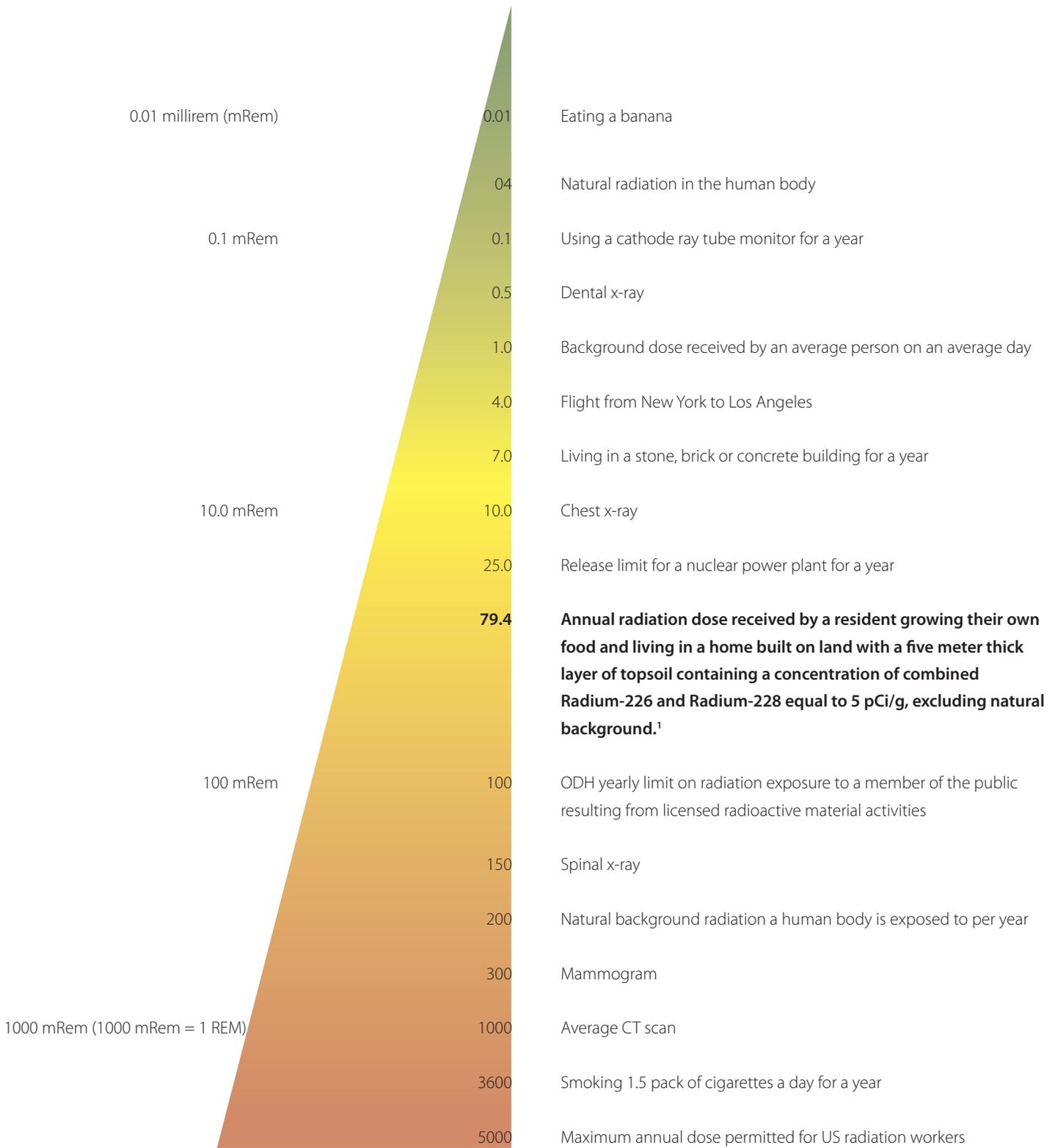
The radioactive material categories found in Oil & Gas exploration and production (E&P) associated with drilling and hydraulic fracturing include the following:

- (1) Exploration: preparing for production (includes drilling, hydraulic fracturing, produced fluids):
 - “Earthen material” from the drilling process – **NORM**
 - “Earthen material” with residual coating of refined-oil based muds - **NORM**
 - Recycled drilling mud – **TENORM**
 - Recycled hydraulic fracturing water / flow back water including some Brine (likely concentrated) – **TENORM**
 - Spent tank bottoms - **TENORM**
 - Filtrate, either liquid or solid, that results from, created during, processing and/or recycling of used hydraulic fracturing water, flow back water, or produced water – **TENORM**
 - Used hydraulic fracturing sands – **TENORM**
- (2) Production: pumping out gas, oil, and brine (a separation station is used to separate the gas, oil, and brine.)
 - Gas
 - Oil
 - Brine – **NORM**
 - Pipe scale (buildup) - **TENORM**

What are the relative risks from radiation exposures to the Public?

Radiation exposures from TENORM will vary based on individual activities. The relative exposures from TENORM are low compared to the risks from other sources of radiation. See exposure comparisons below.

Comparison of Radiation Doses



¹The 79.4 mRem value was generated using the U.S. NRC's RESRAD 6.5 software program developed by the U.S. Department of Energy's Argonne National Laboratory. The "Resident Farmer" scenario that was used is the most conservative model and will produce the highest radiological dose potential.

TENORM concentrations ≥ 5 pico-Curies per gram (5pCi/g) are not allowed in Ohio landfills.

REM (Roentgen Equivalent Man) is the standard unit of measure for absorbed dose or dose equivalent to humans. A millirem is one thousandth of a rem (1000 mrem = 1 rem)

Source: President's Blue Ribbon Commission on America's Nuclear Future Report to the Secretary of Energy January 2012