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BUREAU ISSUE PAPER

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The Issue

The Bureau needs to determine appropriate natural background concentrations for combined Radium-226 and Radium-228 in Ohio for use by person(s) seeking to determine compliance with OAC 3701:1-43-07(A).

Introduction

The Ohio Department of Health- Bureau of Radiation Protection (BRP) administers the licensing and use of certain radioactive materials in the State of Ohio. With the increases in drilling activity for fossil fuels, increased volumes of solid waste are generated some of which require disposal in near surface municipal landfills. Source rock from these drill cuttings and associated wastes contain primordial NORM (Naturally Occurring Radioactive Material) nuclides such as the Uranium, Actinium, and Thorium series. As a consequence of the physical and chemical process of fracking, depletion of NORM nuclides in some rocks and the concentration of others in various waste streams may produce much higher levels of NORM in waste, producing TENORM.

Discussion

Regulation of TENORM is found in Ohio Administrative Code (OAC) 3701:1-43. OAC 3701:1-43-01 (H) defines TENORM as follows:

> "Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)" means naturally occurring radioactive material whose radionuclide concentrations are increased by or as a result of past or present human practices. TENORM does not include background radiation or the natural radioactivity of rocks or soils. TENORM

does not include "source material" and "byproduct material" as both are defined in 3701:1-38-01 of the Administrative Code.

OAC 3701:1-43-07(A) states:

> "Persons who receive, possess, use, process, transfer, distribute, or dispose of TENORM are exempt from the requirements of this chapter with respect to any combination of radium-226 and radium-228 if the materials contain, or are contaminated at, concentrations less than one hundred eighty-five becquerel per kilogram (five picocuries per gram) **excluding natural background**. The progeny of the exempt TENORM radium-226 and radium-228 are also exempt. Manufacture of consumer or retail products at concentrations greater than one hundred eighty-five becquerel per kilogram (five picocuries per gram) is regulated pursuant to paragraph (C) of rule 3701:1-43-10 and rule 3701:1-43-11 of the Administrative Code."

To date there has been no comprehensive sampling conducted in Ohio of surface soils in order to base a natural background value on. It is well known there can be large variations in the natural background concentration range of total radium in geological materials, dependent on the matrix. In light of these limitations, relying on existing data and studies applicable to NORM background values in Ohio is a logical point of reference to base an initial background value.

Reference #1
The CRCPD Guidance for Regulation and Licensing Part N of the SSR states an average background of about 2.0 pCi/g of combined Radium in soils in the U.S.

Reference #2
NCRP Report No.160 states for soils of the U.S; a range for Ra-226 as 0.2 – 4.2pCi/g with an average of 1.1 pCi/g.

Reference #3
National Research Council for soils in the U.S.; Th232 (Ra228) averages 1.0 pCi/g and U238 (Ra226) averages 0.6 pCi/g. This report finds that Ra228 and Ra226 commonly occur in soil and water in about a 1:1 ratio.

Reference #4
NCRP Report No.94 states for soils of the U.S.; Th232 (Ra228) averages 1.0 pCi/g and UNat (Ra226) averages 1.7 pCi/g.

Reference #5
Myrick, et al finds the concentrations in U.S. soils as Th232 (Ra228) ranges 0.1–3.4pCi/g and averages 1.0 pCi/g and U238 (Ra226) ranges 0.11-3.8pCi/g and averages 1.0 pCi/g. Twelve surface soil samples were taken in Ohio during this study. **Ohio specific results were Ra226 ranges 0.81-2.5pCi/g and averages 1.4 ± 1.4 pCi/g and Ra228 ranges 0.71-1.5 and averages 1.0 ±1.3pCi/g.**

Reference #6

The United States Geological Survey (USGS) has been collecting information on laboratory NORM measurements of surface soils across the U.S. and maintains a database of soil concentration values inferred from airborne gamma surveys (Duval, *et al.* 2005). Higher resolution maps using color scales for Ohio can be referenced online. An examination of this macroscopic surface view (see link) does not indicate greatly elevated NORM values in general http://pubs.usgs.gov/of/2005/1413/maps.htm.

Conclusion/Recommendations

Based on the above referenced studies, an initial value of 2.0 picocuries per gram combined Radium-226 and Radium-228 as Ohio natural background for determining compliance to OAC 3701:1-43-07(A) would be appropriate.

As drilling activity continues in Ohio, the BRP should seek to establish a more Ohio specific value of background. Partnering with Federal/State counterparts to conduct a background study is another option.

References

1. CRCPD. 2004. Implementation Guidance for Part N, Regulation and Licensing of Technologically Enhanced Naturally Occurring Radioactive Material.

2. NCRP 2009. NCRP Report 160, Ionizing Radiation Exposure of the Population of the United States.

3. National Research Council 1999. Evaluation of Guidelines for exposures to Technologically Enhanced Naturally Occurring Radioactive Materials.

4. NCRP 1987. NCRP Report 94. Exposure of the Population of the United States and Canada from Natural Background Radiation.

5. Myrick, et al 1983. Determinations of Concentrations of Selected Radionuclides in Surface Soil in the U.S.

6. Duval, et al. 2005. Terrestrial Radioactivity and Gamma-ray Exposure in the United States and Canada. U.S. Geological Survey