Evaluation of EPA's Guidelines on Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Report to Congress

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In January 1999, the NAS published its report entitled, "Evaluation of Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials." In this report, the NAS Committee found that there are differences in TENORM guidelines among federal agencies and others. The Committee found that these differences in guidelines represent differences in policies for risk management rather than differences in the technical evaluation of TENORM.

Although the NAS Committee found that most of the relevant and appropriate scientific information has already been incorporated into current TENORM guidelines, many of the Committee's recommendations point to areas where new information would be useful. For example, the Committee recommended further investigation of the varying chemical and physical forms of TENORM, and the development of better techniques to distinguish discrete TENORM levels from background radiation levels. EPA is already working in many of the areas the Committee cited for additional technical information.

EPA recognizes that there are differences in TENORM regulations and guidance documents among organizations. EPA intends to take into consideration the significance of TENORM risks to the public and the environment to determine which TENORM wastes should be addressed first and what actions, if any, should be taken in response to potential risks. EPA is working in virtually all areas of

Over the past 20 years, EPA and other federal as well as state government agencies, industries, and other organizations have identified an array of naturally occurring materials that, because of human activity, may present a radiation hazard to people and the environment. These materials are known generally as technologically enhanced naturally occurring radioactive materials, or TENORM.[1] In general terms, TENORM is material containing radionuclides that are present naturally in rocks, soils, water, and minerals and that have become concentrated and/or exposed to the accessible environment as a result of human activities such as manufacturing, water treatment, or mining operations. In its report,[2] the Committee on Evaluation of EPA Guidelines for Exposure to Naturally Occurring Radioactive Materials, of the National Academy of Sciences and National Academy of Engineering (the "NAS Committee" or "the Committee") defines TENORM as "*any naturally occurring material not subject to regulation under the Atomic Energy Act whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities*" (p. 19). Much TENORM contains only trace amounts of radiation and is part of our everyday landscape. Some TENORM, however, contains very high concentrations of radionuclides that can produce harmful exposure levels. EPA is concerned about TENORM because of this potential for harmful exposure to humans and the environment.

TENORM is found in a wide variety of waste materials, some raw mineral ores, and in trace amounts in some consumer products where molecules of radionuclides may be bound to specific minerals used in the manufacturing process (zircon, for example, contains minute quantities of uranium and thorium and used widely as a glaze for ceramics and metal molds). The radionuclide Radium-226, a decay product of uranium and thorium with a radiation decay half-life of 1600years, commonly is found in TENORM materials and wastes and is the principal source of radiation doses to humans for natural surroundings. While normally occurring in soils of the United States[5] at concentrations ranging from less than 1 to slightly more than 4 picocuries per gram (pCi/g, where picocuries are a measure of radiation content in a material), Radium-226 in TENORM materials can occur in concentrations ranging from undetectable amounts to as much as several hundred thousand pCi/g. In comparison, EPA has issued guidance[6] that recommends that radioactively contaminated soils should be cleaned up so remnant radium concentrations are 5 pCi/g or less. Uranium, thorium and potassium radionuclides and their daughter products are also commonly found in TENORM wastes.

[11] The NAS report also presents an evaluation of the guidelines for indoor radon. The Committee found that this evaluation was relatively straightforward because the guidelines for the indoor radon exposure situation are well defined and the primary task for the Committee was to evaluate whether the differences among the various guidelines have a scientific and technical basis. This report does not address indoor radon guidelines because we are in the process of reviewing the NAS BEIR VI report and plan to send a report to Congress indicating whether the BEIR VI findings warrant any changes in EPA's policy on radon.

(3) Whether there is relevant and appropriate scientific information that has not been used in the development of contemporary risk analysis for NORM.

The NAS Committee identified research needs that could improve EPA's understanding of TENORM. It did not, however, find "*a substantial body of relevant and appropriate scientific information that has been used in the development and implementation of contemporary risk analysis for TENORM for purposes of developing and implementing guidelines*" (p.243).

Risk Management Issues

The NAS Committee was not tasked with, nor initially concerned with, evaluating nonscientific risk management issues such as cost and policy judgements. However, because the NAS found that

Appendix A - Table 1, TENORM Materials and References

As a comparison to background levels, radium 226 concentrations in soils of the U.S. are shown at the top of the table.

TENORM Material	**Range of Radioactivity Concentrations, Radium 226**		
	Low	**Average**	**High**
Soils of the United States[1]	0.2	1.1	4.2
Uranium Mining Overburden[2]	3	3.0	low hundreds
Uranium In-Situ Leach Evaporation Pond Solids[3]	300	-	3,000
Phosphate Ore (Florida)[4]	7	17.3-39.5	6.2-53.5
Phosphogypsum[5]		11.7-24.5	36.7
Phosphate Fertilizer[6]		5.7	21
Coal Ash[7] -Bottom Ash	1.6	3.5-4.6	7.7
Fly Ash	2	5.8	9.7
Petroleum (oil and gas)			
Produced Water[8]	0.1 pCi/1	-	9000 pCi/1
Pipe/Tank Scale[9]	<0.25 pCi/g	<200 pCi/g	>100,000 pCi/g
Water Treatment Sludge[10]	1.3 pCi/1	11 pCi/1	11,686 pCi/l
Treatment Plant Filters[11]	-	40,000 pCi/g	-
Rare Earths[12]	5.7	-	3,244
Monazite			
Xenotime			
Bastnasite			
Titanium Ores[13]	3.9	8.0	24.5
Rutile	-	19.7	-
Ilmenite	-	5.7	-
Wastes	-	12	-
Zircon[14]	-	68	-
Wastes	87	-	1300
Aluminum[15] (Bauxite) Ores	4.4	-	7.4
Product	-	0.23	-
Wastes	-	3.9-5.6	-
Copper Wastes[16]	0.7	12	82.6
Geothermal Energy Waste Scales[17]	10	132	254