Jun 26, 2006

Marcia C. Davies, Ph.D. Reference No. 04-0097
Director, USACE Hazardous,
Toxic and Radioactive Waste Center of Expertise
U. S. Army Corps of Engineers
12565 West Center Road
Omaha, NE 68144-3869

Dear Dr. Davies:

This is in response to your letter dated March 24, 2004 regarding the applicability of the Hazardous Materials Regulations (HMR; 49 CFR Parts 17 1-180). Specifically, you request that our office review your procedures for determining whether or not a package contains a reportable quantity (RQ) of a radionuclide when it is in secular equilibrium with its progeny. You state that a detailed explanation of your methodology can be found in your December 18, 2000 letter to the Office of Hazardous Materials Standards (henceforth referred to as “your previous letter”).

In your previous letter you also reference the RQ values cited in footnote ** to Table 2 of Appendix A of § 172.101, for four common mixtures: radium-226 in secular equilibrium with its progeny ($RQ_{mixture}$ = 0.053 Ci), natural uranium (0.1 Ci), natural uranium in secular equilibrium with its progeny (0.052 Ci), and natural thorium in secular equilibrium with its progeny (0.011 Ci).

You request that DOT provide formal concurrence, if appropriate, on your methodology and provide any additional interpretation on the proper method for using the footnote values.

In your previous letter you correctly summarize the procedure for calculating the RQ for a mixture of radionuclides described in Note 7 of Appendix A to § 172.101 of the HMR. That is, when all radionuclides and their activities are known, a mixture or solution contains an RQ if

$$?_{I}(\text{Activity}_i / \text{RQ}_i) = 1.$$

We also agree with your further observation that for mixtures consisting of a single decay series in secular equilibrium with a much longer lived parent radionuclide, both the identity and activity of all radionuclides involved can be calculated using known relationships after a single radionuclide activity is determined. Specifically, if the parent radionuclide and all its progeny are in secular equilibrium with the long lived parent, the activity of each radionuclide in the decay chain will be proportional to the activity of the parent. In the case where there is no branching, that is, where each radionuclide in the chain decays to only one radionuclide, the activity of each of the decay products will be equal to the activity of the parent.

We believe that the description in Note 7 of Appendix A to § 172.101 of 49 CFR, which says explicitly that "the ratio between the quantity per package (in curies or terabecquerels) and the RQ for the radionuclide must be determined for each radionuclide," implies that branching ratios must be taken into account. Such as, if an activity Q of polonium-2 18, in secular equilibrium with radium-226 and radon-222, decays 99.98 % of the time to lead-214 and 0.02 % of the time to astatine-218, one expects that, in secular equilibrium with the long-lived parent: the total activity of the lead-214 would be 0.9998 Q and that of the astatine-218 would be 0.0002 Q.

To determine the RQ of a mixture which contains one or more of the decay chains referenced in footnote ** to Table 2 of Appendix A to § 172.101, you may either use the procedure described in Note 7 of Appendix A, or use the values cited in footnote**.

I hope this satisfies your inquiry. If we can be of further assistance, please do not hesitate to contact this office.

Sincerely,

Hattie L. Mitchell, Chief
Regulatory Review and Reinvention
Office of Hazardous Materials Standards

172.101 App. A Table 2