

APPENDIX - B
Plutonium-239 Equivalent Activity

The concept of Plutonium-239 Equivalent Activity (PE-Ci) is intended to eliminate the dependency of radiological analyses on specific knowledge of the radionuclide composition of a transuranic waste stream. A unique radionuclide composition and/or distribution is associated with virtually every transuranic waste generator and storage site. By normalizing all radionuclides to a common radiotoxic hazard index, radiological analyses can be conducted for the WIPP facility, which are essentially independent of these variations. Plutonium-239, as a common component of virtually all defense transuranic wastes, was selected as the radionuclide to which the radiotoxic hazard of other transuranic radionuclides could be indexed.

Operational releases from the WIPP facility, including both routine and accident related, are airborne. There are no significant liquid release pathways during the operational phase of the facility. This, and the fact that transuranic radionuclides primarily represent inhalation hazards, allows a valid relationship to be established, which normalizes the inhalation hazard of a transuranic radionuclide to that of Pu-239 for the purpose of the WIPP radiological analyses. In effect, the radiological dose consequences of an airborne release of a quantity of transuranic radioactivity with a known radionuclide distribution will be essentially identical to that of a release of that material expressed in terms of a quantity of Pu-239.

To obtain this correlation, the 50-year effective whole-body dose commitment or dose conversion factor (DCF) for a unit intake of each radionuclide will be used.

For a known radioactivity quantity and radionuclide distribution, the Pu-239 equivalent activity is determined using radionuclide specific weighting factors. The Pu-239 equivalent activity (AM) can be characterized by:

$$AM = \sum_{i=1}^K A_i / WF_i$$

where K is the number of TRU* radionuclides, A_i is the activity of radionuclide i, and WF_i is the PE-Ci weighting factor for radionuclide i.

WF_i is further defined as the ratio:

$$WF_i = E_0 / E_i$$

where, E_0 (rem/ μ Ci) is the 50-year effective whole-body dose commitment due to the inhalation of Pu-239 particulates with a 1.0 μ m AMAD (Activity Median Aerodynamic Diameter) and a W pulmonary clearance class, and E_i (rem/ μ Ci) is the 50-year effective whole-body dose commitment due to the inhalation of radionuclide particulates with a 1.0 μ m AMAD and the pulmonary clearance class resulting in the highest 50-year effective whole-body dose commitment.

The values of E_0 and E_i may be obtained from DOE/EH-0071.¹ Weighting factors calculated in this manner are presented in Table B-1 for selected radionuclides of interest.

*TRU as designated in this equation refers to any radionuclide with an atomic number greater than 92 and including U-233.

Table B-1, PE-Ci Weighting Factors for Selected Radionuclides

Radionuclide	Pulmonary Clearance Class*	Weighting Factor
U-233	Y	3.9
Np-237	W	1.0
Pu-236	W	3.2
Pu-238	W	1.1
Pu-239	W	1.0
Pu-240	W	1.0
Pu-241	W	51.0
Pu-242	W	1.1
Am-241	W	1.0
Am-243	W	1.0
Cm-242	W	30.0
Cm-244	W	1.9
Cf-252	Y	3.9

*(D) Daily; (W) Weekly, (Y) Yearly

References for Appendix B

1. DOE/EH-0071, Internal Dose Conversion Factors for Calculation of DOSE to the Public, July 1988.