WM'2010
Cynthia S. Barr, US NRC, 301-415-4015 (w), 301-415-5397 (fax), cynthia.barr@nrc.gov

Development of Site-Specific Shielding Factors for Use in Radiological Risk Assessments

Sami Sherbini, Cynthia S. Barr, Duane Schmidt, US Nuclear Regulatory Commission

Some form of an external gamma shielding factor (or transmission factor) is typically used in decommissioning dose assessments to account for attenuation of gamma radiation by building materials and the resulting reduction in dose to a potential indoor receptor (e.g., resident or industrial worker). The shielding factor is one of the most important parameter values impacting dose for those cases where the external dose pathway dominates the risk from residual soil contamination (e.g., cases where no soil cover exists and penetrating gamma-emitting radionuclides are the primary residual radioactivity at the site). While the uncertainty in the shielding factor, which varies from 0.04 to 1.0, may be relatively low compared to other parameter values, if the external pathway dominates the dose, the selection of the parameter value can mean the difference between compliance and non-compliance with radiological criteria for license termination for a decommissioning site. Default parameter values used in decommissioning dose modeling codes such as RESRAD are typically pessimistic. Parameter distributions developed for probabilistic assessments are necessarily based on national statistics on building types/materials and a few "representative" radionuclides. Thus, the generic parameter distributions may either over- or under-estimate the potential dose compared to dose estimates that consider the actual mix of radionuclides and types of buildings expected to be constructed at the site.

Shielding calculations were performed using the MCNPX code to estimate external gamma shielding factors for use in RESRAD to reduce the uncertainty in dose estimates for a thorium contaminated site. Regional-specific information was used to evaluate the types of buildings or residences expected to be potentially constructed at the site. Additional considerations included the impact of (i) in-growth of daughter products that introduced changes in gamma energy distributions over time, (ii) potential changes in source/receptor geometries over time due to leaching and erosional processes, and (iii) heterogeneity of contaminant distributions. Sensitivity analyses were conducted to identify important factors influencing the shielding factors and resultant risk estimates.

Development of site-specific external gamma shielding factors are recommended in those cases where the external dose pathway dominates the dose and more accurate estimates of risk are needed to demonstrate compliance with regulatory criteria. The modeling approach and risk analysis discussed in this paper could be widely applicable to other decommissioning sites.