LETTERS TO THE EDITOR

COMMENT ON SHIELDING METHODS FOR THE DESIGN OF PLUTONIUM PROCESSING FACILITIES

Gillett et al. present a modified point kernel technique for radiation analysis of plutonium processing components in their recent paper.[1] The application of a radiation transport code to generate point kernel data for use in a three-dimensional point kernel code (QAD-Pu in their case) is a useful technique that we ourselves have used.[2]

However, as the authors themselves state, care must be taken where more than one important shielding medium exist. We believe a key factor has been overlooked in their approach that is likely to be important for their tank vault configuration. The missing item is to account for secondary gamma rays (from capture and inelastic scattering) generated in the concrete wall.

To do this properly, their ANISN calculation should have used a coupled neutron-gamma-ray cross-section set, such as DLC-23 (Ref. 3). While two of their neutron source spectra are fairly hard, it must be realized that the neutron source in the tank vault configuration is present in a 2-ft-diam tank containing water, and this water will significantly slow down the energetic source neutrons. Thus, the neutron spectrum impinging on the concrete wall will be primarily in the lower energy groups (<0.1 MeV). Calculations by Schmidt have shown[4] that for a neutron flux of 0.1 MeV (upper energy of the four lowest neutron groups) incident on a 30-cm concrete wall, the emerging dose rates due to neutrons and secondary gamma rays are equal. For any larger thickness of concrete, the dose rate component due to secondary gamma rays dominates.

The application of the QAD-Pu code may still be appropriate, but only if the point kernel data utilized were based on a response such as total dose rate, which included both neutron and secondary gamma-ray contributions (similar to that used in Ref. 2). To confirm our observations, measurements for the tank vault configuration, with both neutron and gamma-ray detectors, would be very helpful. Finally, it should be realized that the same general observations apply to the glovebox configuration as well, although the effect of secondary gamma rays would probably be smaller because there is less hydrogenous material between the source and shield.

A final word is in order regarding the low-energy buildup factors. Buildup factor tabulations based on the "straight ahead" approximation have been developed[5] for the standard materials covering most of the Z range for low-energy photons (<200 keV). These buildup factors are in rough agreement with values obtained through Monte Carlo calculations.[6] More recently,[7] buildup factors for water and concrete covering the range 0.03 to 10 MeV have been calculated using the moments method and then fit to the Berger formula. Since the buildup factor peaks in the approximate range of 0.1 to 0.2 MeV, which includes the major part of the plutonium gamma sources, it would be prudent to check how use of such data affects the calculated dose rates, since the authors' extrapolated buildup factors[1] may not have exhibited this peak.

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REPLY TO "COMMENT ON SHIELDING METHODS FOR THE DESIGN OF PLUTONIUM PROCESSING FACILITIES"

We are writing in response to Normand's comments[1] on our paper, "Shielding Calculation Techniques for the Design of Plutonium Processing Facilities."[2]

We hope the brevity of our statement that secondary gamma rays were included in our calculations did not