JSB ASSOCIATES

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RULES & DIR. BRANCH
US NRC

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March 29, 1999
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Chief, Rules Reviw and Directives Branch
U. S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Re: Comments on Draft NUREG-1640, Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities

Dear Sir:

During my review of the subject draft NUREG, I examined the modeling of Appendix C, Section C.3.6, Geometry Factor Calculation for Small Metal Object Close to Body, GF-6. The document presents an approach of using a 1 cm depth dose calculation for determining the effective dose equivalent. While this approach is consistent with the NRC's application of the deep dose equivalent, which provides a reasonable approximation of the effective dose equivalent when the body is uniformly exposed, it will grossly overestimate the effective dose equivalent for sources close to the body where dose is highly dependent on distance from the source. The doses to the radiosensitive organs of the body, to which the tissue weighting factors are applied for determining the effective dose equivalent, will vary significantly depending on distance from the source and attenuation.

An in-depth evaluation of the effective dose equivalent for photon radiation sources external to the body was performed by Reece, et. al., for the Electric Power Research Institute.* This evaluation presented calculations of the effective dose equivalent for point sources located on the external body surface. Mathematical models of the adult male and female body were coupled with Monte Carlo modeling of photon source and transport for the calculations. Doses to internal organs were calculated for specified source-organ geometries; organ weighting factors were applied; and the EDE was calculated by summing the weighted organ doses.

Using this method, the EDE was calculated with the point source at varying locations on the torso of the body. The position of the source was incrementally increased circumferentially around the body and vertically up from the base of the torso to 61 cm. The EDE was calculated for a total of 52 locations for a point source located on the torso of an adult male and adult female. For the male, the highest EDE was for the source in front part of the torso at a 6 cm height above the base, which resulted primarily from the dose to the gonads. For the female, the highest calculated EDE was with the source located in front at a height of 61 cm, which resulted primarily from the dose to the breast.

From my review of the EPRI report and calculations using a point kernel radiation shielding code, it appears that a 10 cm depth may be more appropriate for use in calculating the effective dose equivalent for sources close to the body. In any case, the use of a 1 cm depth will grossly overestimate the actual effective dose equivalent.

Sincerely,

J. Stewart Bland

* Electric Power Research Institute, Assessment of the Effective Dose Equivalent for External Photon Radiation, EPRI TR-101909, prepared by: Reece, W. D., J. W. Poston, and X. G. Xu, Texas A&M University, February 1993

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