

APPENDIX B

ORGANS OR TISSUES OF CONCERN

APPENDIX B

ORGANS OR TISSUES OF CONCERN

The U.S. Department of Energy has established limiting values for occupational exposure to radiation in DOE 5480.11 (1988). These values include a limit on dose to individual organs or tissues to prevent deleterious non-stochastic effects, and a limit on the effective dose equivalent based on the risk of stochastic effects. Section 9.m of the Order requires the recording of annual and committed dose equivalents to organs and tissues of concern as well as the annual and committed effective dose equivalent. However, the Order does not explicitly state which organs and tissues are to be considered in the calculation of effective dose equivalent, nor does it state what constitutes an organ or tissue of concern.

For the purposes of performing internal dose assessments to determine compliance with limiting values for occupational dose, and for complying with recording and reporting requirements in the Order, organs and tissues considered in the evaluation of effective dose equivalent and as "organs/tissues of concern" are those listed as potential target organs in Publication 30 of the International Commission on Radiological Protection (ICRP 1979). As noted below, doses received by localized tissues are not included in either the assessment of effective dose equivalent or in the assessment of dose equivalent to organs and tissues of concern.

Practices for recording doses to "organs and tissues of concern" are defined in the Hanford Internal Dosimetry Program Manual (PNL-MA-552).^(a) Candidate organs are those identified above. Chapters of this technical basis document provide organ dose factors for specific radionuclides, based on intake and on cumulated activity at deposition sites for organs considered to most likely meet the recording criteria in PNL-MA-552. In cases involving

(a) Pacific Northwest Laboratory. 1989. Hanford Internal Dosimetry Program Manual. PNL-MA-552, Richland, Washington.

relatively small effective dose equivalents, there may be no single organ that meets the recording criteria, whereas for a very significant exposure, several organs may qualify.

Effective dose equivalent is calculated by summing, over specified tissues, the products of the dose equivalent in a tissue and the weighting factor for the tissue. Appendix A describes the criteria used for determining the organs contributing to effective dose equivalent. Chapters on specific radionuclides provide dose factors that can be used to evaluate effective dose equivalent from intake or from cumulated activity (in nCi-day) in source organs. Where assessment of internally deposited activity is readily accomplished by in vivo measurements, effective dose equivalent factors are shown for cumulated activity in the lung, as well as for cumulated activity in the remainder of the body. The total effective dose equivalent is calculated by summing the contributions from these two sources.

Intakes of radionuclides via wounds may result in the irradiation of local tissues at the wound site, as well as regional lymph nodes that drain the wound region. Because of their small mass, the absorbed dose to the regional lymph nodes may greatly exceed that to other tissues. Evidence from studies of experimental animals suggests that the lymph nodes are not primary sites for development of radiation-induced malignant disease (Nenot and Stather 1979). For this reason, there has been no attempt by either the ICRP (1979) or the BEIR Committee (National Research Council 1988) to derive stochastic risk estimates for lymphatic tissue. Similarly, the irradiation of local tissues at the wound site is not considered to carry significant risk of carcinogenesis.

Concentrated activity in such localized sources can be expected to result in relatively high doses and cell death within a limited area, but unless this area comprises more than a minor fraction of the organ/tissue, there will likely be no observable nonstochastic effect at any dose. Assessment of organ or tissue dose equivalent from highly localized sources, made by averaging the energy deposited in the organ over the organ mass, is not a relevant measure for comparison to the limiting values for assessed dose based on nonstochastic effects. Furthermore, in most situations, it is not possible

to determine the actual mass of affected tissue for computing the absorbed dose. Because the absorbed dose is highly nonuniform over the tissue and only a limited number of cells within the organ/tissue are affected, the use of dose equivalent for assessing this localized exposure is not valid.

For these situations, the Hanford Internal Dosimetry Program will estimate the quantity of radionuclide(s) locally deposited and the projected retention half-time. These estimates become part of the individual's radiation protection record, but are not used for determining compliance with either the stochastic or nonstochastic limits. This approach is analogous to the approach required in DOE 5480.11 for irradiation of limited areas of the skin.

REFERENCES

International Commission on Radiological Protection (ICRP). 1979. Limits for Intakes of Radionuclides by Workers. ICRP Publication 30, Part 1, Pergamon Press, New York.

National Research Council. 1988. Health Risks of Radon and Other Internally Deposited Alpha-Emitters. BEIR IV, National Academy Press, Washington, D.C.

Nenot, J. E., and J. W. Stather. 1979. The Toxicity of Plutonium, Americium, and Curium. Commission of the European Communities, Pergamon Press, Oxford, England.

U.S. Department of Energy (DOE). 1988. Radiation Protection for Occupational Workers. DOE 5480.11, Washington, D.C.