Uncertainty Analysis of the Weighted Equivalent Lung Dose per Unit Exposure to Radon Progeny in the Home

J. W. Marsh[1], A. Birchall[1], G. Butterweck[2], M.-D. Dorrian[1], C. Huet[3], X. Ortega[4], A. Reineking[5], G. Tymen[3], Ch. Schuler[2], A. Vargas[4], G. Vessu[2], J. Wendt[5]

[1]National Radiological Protection Board, UK; [2]Paul Scherrer Institut, Switzerland; [3]University of Bretagne Occidentale, France; [4]Universitat Politècnica de Catalunya, Institut de Tecniques Energetiques, Spain; [5]University of Göttingen, Germany

A parameter uncertainty analysis has been performed to derive the probability distribution of the weighted equivalent dose to lung for an adult (w_{lung} H_{lung}) per unit exposure to radon progeny in the home. The analysis was performed using the ICRP Publication 66 human respiratory tract model (HRTM) with tissue weighting factor for the lung, w_{lung} = 0.12 and the radiation weighting factor for alpha particles, w_R = 20. It is assumed that the HRTM is a realistic representation of the physical and biological processes, and that the parameter values are uncertain. The parameter probability distributions used in the analysis were based on a combination of experimental results and expert judgement from several prominent European scientists. The assignment of the probability distributions describing the uncertainty in the values of the assigned fractions (A_{BB}, A_{bb}, A_{AI}) of the tissue weighting factor proved difficult in practice due to lack of quantitative data. Because of this several distributions were considered. The results of the analysis give a mean value of w_{lung} H_{lung} per unit exposure to radon progeny in the home of 15 mSv per working level month (WLM) for a population. For a given radon gas concentration, the mean value of w_{lung} H_{lung} per unit exposure is 13 mSv per 200 Bq.m^{-3}.y of ^{222}Rn. Parameters characterising the distributions of wlung Hlung per unit exposure are given. If the ICRP weighting factors are fixed at their default values (A_{BB}, A_{bb}, A_{AI} = 0.333, 0.333, 0.333; w_{lung} = 0.12; and w_r = 20) then on the basis of this uncertainty analysis it is extremely unlikely (P " 0.0007) that a value of H_w/P_p for exposure in the home is as low as 4 mSv per WLM, the value determined with the epidemiological approach. Even when the uncertainties in the A_{BB}, A_{bb}, A_{AI} values are included then this probability is predicted to be between 0.01 to 0.08 depending upon the distribution assumed for describing the uncertainties in the A_{BB}, A_{bb}, A_{AI} values. Thus, it is concluded that the uncertainties in the HRTM parameters considered in this study cannot totally account for the discrepancy between the dosimetric and epidemiological approaches.

USTUR-0452A-17