AbstractID: 2640 Title: Science Behind Proposed ICRP Recommendations: Dosimetric Quantities and Units used in Radiation Protection

The International Commission on Radiological Protection (ICRP) and the International Commission on Radiation Units and Measurements (ICRU) have developed two types of special dosimetric quantities for radiation protection: those that are related to risk and demonstrate compliance with exposure limits, and operational quantities that are used in monitoring and measuring external exposure and intakes of radionuclides. All are based on mean absorbed dose with its distributions in time and in linear energy transfer (linear collision stopping power).

In Publication 26 (1977), ICRP introduced the concepts of *dose equivalent* and *effective dose equivalent* to take into account the varying effectiveness of different radiations (the Q factors) and the variations in radiation sensitivity of different tissues (6 were specifically considered) for the induction of stochastic effects (the weighting factors, w_T). In Publication 60 (1991), the ICRP introduced *equivalent dose*, *effective dose* and the subsidiary quantities *committed dose* and *collective dose*. Q factors were superseded by w_R values and the number of tissues was increased to 12, with new values for w_T. In 2005, the ICRP proposes the terms *radiation-weighted dose, effective dose, committed dose* and *collective effective dose.* Based on new scientific evidence, w_R values are unchanged for photons and alphas, but have changed for neutrons and protons. w_T are different for the gonads, the breast an the "remainder" (the treatment of which has also changed); the number of tissues has increased to 14.

The operational quantities for external exposure, defined by ICRU (1993, 2001), include *ambient dose equivalent* and *directional dose equivalent* for area monitoring, and *personal dose equivalent* for individual monitoring. For internal exposure, the ICRP proposes to use activity quantities in combination with dose coefficients based on physiological models and 4-D computations.

The unit for all the quantities listed above is the Sievert (although the ICRP would like a different unit for the *radiation-weighted dose*).

The weighting factors and the dosimetric quantities based on w_R and w_T relate only to stochastic health effects, cancer induction and hereditary disease. The risk factors, from which w_R and w_T values are derived, have been obtained from epidemiological and experimental radiobiological data in the medium and higher dose ranges and have been extrapolated to the lower dose ranges using the linear no threshold model, which bears a high degree of uncertainty. The assumed linearity and additivity are, however, necessary conditions for all the dosimetric considerations.

Effective dose is to be used by regulators for occupationally exposed workers and members of the public, where doses are assumed to be low. At doses above about 0.5-1 Sv, tissue reactions (deterministic effects) may occur. At these levels, the dosimetric quantity to use is the absorbed dose in the irradiated tissue modified by the radiobiological effectiveness of the radiation for the biological endpoint of concern. The unit is the Gray.

Effective dose should not be used for retrospective evaluation of exposed populations or to assess individual risks, as is the case in medical exposures, which are not subject to dose limitations.

Educational Objectives:
1. To understand the dosimetric concepts involved in radiation protection.
2. To understand the uses of and the limitations and uncertainties associated with the dosimetric quantities.