Contribution ID: **63** Type: **Poster**

Impact of the New ICRU Operational Dose Quantities - EURADOS Evaluation and Recommendations

As part of its strategic research agenda, the European Radiation Dosimetry Group, EURADOS (www.eurados.org), contributes to the development and understanding of fundamental dose concepts, such as operational quantities. Accordingly, EURADOS has carried out a project to evaluate the impact of the new ICRU operational quantities and to make recommendations for their application. The EURADOS report analyzes the impact that the new quantities will have on: radiation protection practice; calibration and reference fields; European and national regulation; international standards; and, especially, dosemeter and instrument design. The conclusions are that, while there are some advantages to adopting the new quantities, it is likely that the costs of adapting instruments and dosemeters will be significant. These costs will arise either from necessary alterations to design or from need to r4eplace obsolete types. For these reasons the period of adoption of the new quantities will be protracted.

The definitions of the new quantities are more closely aligned with those of the protection quantities effective dose and equivalent dose. The same calculational, anthropomorphic phantoms have been used, together with full-transport numerical calculations. New operational quantities for extremity, skin and eye lens dosimetry are based on absorbed dose, thereby anticipating developments in the protection quantities.

The new quantities cover a wider range of radiations and energies than before. For medical interventional procedures, the current overestimates compared to effective dose will be removed. The definitions of the new operational quantities are better aligned with those of the protection quantities and no longer depend on arbitrary constructs such as the ICRU sphere.

One drawback concerns the use of full-transport calculations. For photons in particular, in any practical situation, primary radiation beams will be contaminated with secondary charged particles –in this case, electrons. Calibration and type-testing laboratories can only ensure common conditions by ensuring charged-particle equilibrium (CPE). CPE conditions are closely linked to use of the kerma approximation for calculating conversion coefficients. Therefore ICRU have included alternative coefficients, calculated using the kerma approximation, in their report. It is these kerma-approximation coefficients that will be used in the vast majority of photon dosimetry.

Our report includes extensive analysis of the response of existing dosemeters and instruments in terms of the new quantities. The costs of adapting to the new quantities are likely to be significant, although further work is needed to establish the costs more precisely. Other impacts, for example in terms of updating international standards, are broadly as expected. The adaptation can be phased over a period of years, although in view of the instrument and dosemeter costs, this period could be decades and planning should begin at an early stage. We also comment on other aspects: for example, we recommend that, despite the apparent reduction in doses that will occur for medical diagnostic / interventional procedures, radiation protection measures should not be relaxed because the values of the protection quantities will not change.

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Session Classification: Session 2. Monitoring and dose assessment of occupational radiation exposures

Track Classification: 3. Monitoring and dose assessment of occupational radiation exposures