INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

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Dear Dr Garribba,

Thank you for your interest in the radon dose coefficients soon to be published in ICRP *Publication 137* (ICRP 2017, in press). This report is scheduled to come out in January 2018, as Part 3 of a series of reports on occupational intakes of radionuclides. It will provide dose coefficients for the inhalation and ingestion of a number of elements and their radioisotopes, including radon isotopes (^{219}Rn, ^{220}Rn and ^{222}Rn). This letter provides advance information on the dose coefficients for inhaled radon-222 and its radioactive progeny.

Dose coefficients were calculated using reference ICRP biokinetic and dosimetric models and ICRP *Publication 103* (ICRP 2007) methodology for the derivation of equivalent doses to organs/tissues and effective dose. Based on the results of these calculations, and recognizing the results of calculations based on epidemiological data (see below), ICRP recommends the use of one primary rounded value for the dose coefficient for inhaled radon-222 and progeny, but also refers to a second value applicable under specified circumstances.

For the calculation of doses following inhalation of radon and radon progeny in underground mines and in buildings, in most circumstances, the Commission recommends a dose coefficient of 3 mSv per mJ h m^{-3} (approximately 10 mSv per WLM). The Commission considers this dose coefficient to be applicable to the majority of situations with no adjustment for aerosol characteristics. The corresponding dose coefficient expressed in terms of radon-222 gas exposure depends on the equilibrium factor, F, between radon gas and its progeny. Using the standard assumption of F = 0.4 for most indoor situations, 3 mSv per mJ h m^{-3} corresponds to 6.7 x 10^{-6} mSv per Bq h m^{-3}.

For the specific situations of indoor work involving substantial physical activity, and exposures in tourist caves, the Commission recommends a dose coefficient of 6 mSv per mJ h m^{-3} (approximately 20 mSv per WLM). Using the standard assumption of F = 0.4 for most situations, 6 mSv per mJ h m^{-3} corresponds to 1.3 x 10^{-5} mSv per Bq h m^{-3}.

In cases where aerosol characteristics are significantly different from typical conditions, where sufficient, reliable aerosol data are available, and estimated doses warrant more detailed consideration, it will be possible to calculate site-specific dose coefficients using data provided in *Publication 137*.

While ICRP *Publication 137* does not specifically address public exposures, it is intended that the primary doses coefficient of 3 mSv per mJ h m-3 will also apply to exposures in homes. Dose coefficients for radionuclide intakes by members of the public will be published in due course and will include radon.

ICRP *Publication 126* (ICRP 2014) presented an integrated approach to protection from radon in homes and workplaces, with optimization in relation to a national reference level set as low as reasonably achievable in the range of 100–300 Bq m^{-3}. Using standard occupancy times of 2000 hours per year for a worker and 7000 hours per year in homes (ICRP, 1993; 2010) and a dose coefficient of 6.7×10^{-6} mSv per Bq h m^{-3}, 300 Bq m^{-3} corresponds to 4 mSv at work and 14 mSv at home.

Background

ICRP *Publication 65* (ICRP, 1993) provided an epidemiologically based dose conversion convention, with a value of 1.4 mSv per mJ h m^{-3} (5 mSv WLM^{-1}) for workers. In ICRP *Publication 115* (ICRP, 2010), more recent epidemiological data were reviewed, focusing on results for lower levels of exposure in mines, and a revision of the detriment adjusted nominal risk coefficient for a mixed adult population of smokers and non-smokers was proposed, from 8×10^{-5} per mJ h m^{-3} to 1.4×10^{-4} per mJ h m^{-3} (from 2.8×10^{-4} WLM^{-1} to 5×10^{-4} WLM^{-1}). Comparisons of lung cancer risks for residential exposures with estimates derived for miners showed good agreement. A more recent study of a large cohort of German uranium miners showed slightly lower but broadly consistent results for lung cancer risks at lower levels of exposure (Kreuzer et al. 2015).

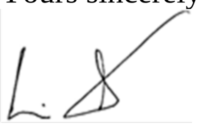
The Statement on Radon included in ICRP *Publication 115* (ICRP, 2010) adopted the revised nominal risk coefficient of 1.4×10^{-4} per mJ h m^{-3} (5×10^{-4} WLM^{-1}). The statement further indicated the Commission's intention to apply the same approach to intakes of radon and its progeny as for other radionuclides, and to provide dosimetrically based coefficients.

Using the revised nominal risk coefficient of 1.4×10^{-4} per mJ h m^{-3} (5×10^{-4} WLM^{-1}), and ICRP *Publication 103* (ICRP, 2007) detriment values, a dose conversion convention value of 3.3 mSv per mJ h m^{-3} (12 mSv WLM^{-1}) for adults is obtained (Marsh et al. 2010). The dose coefficients for inhalation of radon and progeny, calculated using biokinetic and dosimetric models using the average breathing rate for the Reference Worker, are 3.3 mSv per mJ h m^{-3} (12 mSv WLM^{-1}) for mines, 5.7 mSv per mJ h m^{-3} (20 mSv WLM^{-1}) for indoor workplaces and 6.7 mSv per mJ h m^{-3} (24 mSv WLM^{-1}) for the specific case of tourist caves. In these calculations, the Reference Worker is assumed to spend two-thirds of the time in exercise. Using a more realistic breathing rate for sedentary occupations such as office workers gives a dose coefficient of 4 mSv per mJ h m^{-3} (about 14 mSv WLM^{-1}) (Harrison and Marsh, 2012). Using the same methodology, the dose coefficient for exposure in homes has been calculated as 3.7 mSv per mJ h m^{-3} (13 mSv WLM^{-1}) (Marsh and Bailey, 2013).

The present situation is a remarkable consistency between coefficients obtained by dosimetric calculations and conversion coefficients based on epidemiological comparisons. Noting that inhaled radon-222 and progeny is a special case for which there is good epidemiology as well as dosimetry, and taking account of the two methods of calculation of dose coefficients with their associated uncertainties, the Commission recommends the rounded dose coefficients presented above.

We hope that this summary of our soon-to-be-published work on radon dose coefficients is helpful.

Yours sincerely,



Christopher Clement
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cc: J Harrison (john.harrison@phe.gov.uk), S Mundigl (stefan.mundigl@ec.europa.eu)

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