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Perspective

Lung Dose Coefficient for Radon Exposure in Mines

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INTRODUCTION

Radon is a radioactive noble element that is found in nature and usually exists as a gas or is dissolved in water. Three isotopes of radon-radon (Rn-222), thoron (Rn-220) and actinon (Rn-219)-occur naturally. These isotopes are typically found in the earth's crust as progeny radionuclides of radium isotopes (Ra-226, Ra-224 and Ra-223) in the natural radioactive decay chains of U-238, Th-232 and U-235, respectively. Due to its comparatively long half-life, Rn-222 is the most prevalent of these isotopes in nature. It can be found in rocks and soils in a variety of settings, including uranium and coal mines, caves, underground parking lots, metro stations, underground car parks, spas and wine cellars of homes. Rn-222 gas is found in both indoor and outdoor air since it originates from the Earth's crust and can travel by convection and diffusion to reach the atmosphere. In contrast to Rn-222, Rn-220 has a shorter half-life (56 s) and covers a smaller radius from its source. Therefore, the primary source of indoor exposure to Rn-220 is building materials. Rn-219 can often escape from the source less readily because it has the shortest half-life (4s). Consequently, Rn-219 and its offspring are rarely and very rarely exposed at work. As a result, Rn-222 and Rn-220 are the most significant radon isotopes for radiation protection; exposure to these isotopes has been linked to human natural radiation exposure for the majority of the past few decades.

DESCRIPTION

The lung receives the largest dose from Rn-222 inhalation, which is the second leading cause of lung cancer globally after tobacco smoking. Nearly all of the dose (>95%) is from inhaling the progeny rather than from the gas itself because almost all of the inhaled gas is exhaled later. This makes inhaling Rn-222 and its progeny a major cause of lung cancer among underground miners and indoor workers.

But a significant amount of radon progeny that is inhaled is deposited in the lung's respiratory tract, where its brief half-life distributes a significant amount of the dosage to lung tissue before it is eliminated through blood absorption or particle transport to the digestive tract. The majority of the dose to lung tissue is accounted for by the energy of the alpha particles released by two of the short-lived radon progenies (Po-218 and Po-214).

The International Commission for Radiological Protection's (ICRP) Human Respiratory Tract Model (HRTM) can be used to compute the equivalent dosage to the lung after breathing in radon and its short lived progeny. Since the ICRP models are reference models with parameters characteristic of a reference person, by definition the model parameters are fixed values devoid of ambiguity, which presents one of the primary obstacles in determining the equivalent lung dosage for radon progeny ingestion. Thus, in order to gain a deeper understanding of the models and determine the impact of individual parameters on the model predictions, sensitivity analysis and calculation of the corresponding parameter uncertainties in HRTM must be carried out.

Thus, taking into account parameter uncertainty serves as a foundation for evaluating the danger associated with exposure to radon progeny. Second, uncertainty analysis offers a technique to pinpoint the crucial steps in calculating an effective dose and evaluate how reliable it is as a radiation protection measure. As a result, the findings of this kind of research might shed light on the validity of the doses that were evaluated and identify key variables that will improve the models' capacity to match the monitoring data. In order to serve as a guide for the authors' and other stakeholders' future research, the purpose of this review is to determine the parameters that impact the predicted lung dose per unit exposure to radon progeny in underground mines as well as their corresponding of probability distributions. The information

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will be used by the authors in their uncertainty analysis for the two exposure scenarios dry drilling with inadequate ventilation and wet drilling with adequate ventilation-in underground uranium mines.

This section examines the potential health consequences of radon on humans as well as the sources of radon in underground mines and the factors that affect its migration from the source into enclosed places. The morphology, deposition, particle movement and dissolution/absorption components of the HRTM are all covered in this section. The equivalent lung dose coefficient and its applicability to the evaluation of underground miners' radiation risk. The sources of variability and uncertainty in the HRTM along with how they impact the equivalent lung dose coefficient calculation.

CONCLUSION

The internal dosimetry uncertainty quantification techniques. The authors give the corresponding probability distributions for the parameters that influence the computed equivalent lung dose coefficient resulting from underground miners' absorption of radon progeny in the two exposure scenarios of concern. Assessing the uncertainty in the equivalent lung dose coefficient for radon and progeny intake in underground mines presents distinct challenges and constraints. The literature compares the findings of the several investigations.