# Evaluation of the Proposed Revisions to the ICRP Human Respiratory Tract Model Using The Human Data Associated with Occupational Inhalation Exposure to Refractory PuO$_2$ Aerosols.

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The dominant contribution to the uncertainty in internal dose assessment can often be explained by the uncertainty in the biokinetic model structure and parameters. The International Commission on Radiological Protection is currently updating its biokinetic models including the Human Respiratory Tract Model to reduce the uncertainties in internal dosimetry calculations.

A physiologically-based particle transport model was recently proposed by Gregoratto et al. that significantly simplifies the representation of particle clearance from alveolar-interstitial region. The bioassay and autopsy data from the U.S. Transuranium and Uranium Registries' tissue donors exposed to "high fired", refractory PuO$_2$ aerosols were used to examine the applicability of the revised model and to estimate the uncertainties on model parameters and the lung doses.

It was demonstrated that, with appropriate adjustments, the Gregoratto et al. particle transport model can describe the situations involving the exposure to highly insoluble particles. The parameters of the particle transport and blood absorption models were optimized to represent two USTUR registrants 0202 and 0407 bioassay and tissue radiochemical analysis data. Significant differences were observed in particle clearance pattern characteristic to these two individual's respiratory systems. The respiratory tract of the registrant 0202 was most likely compromised by his prior occupational exposure to coal dust, smoking habit and chronic obstructive pulmonary disease, while donor 0407 was a non-smoker and had no prior history of lung disorder.

PuO$_2$ particles produced by the plutonium fire were found to be extremely insoluble. About 1% of this material is absorbed from the respiratory tract relatively rapidly, with a half-time of about 8 h. The remainder (99%) is absorbed very slowly, with a half-time of about 400 y.

A Bayesian statistical analysis method using the Weighted Likelihood Monte Carlo Sampling algorithm was applied to these data and uncertainties on model parameters and tissue doses were calculated as expressed by the posterior probability distributions.

When considering this situation, it appears that doses to other body organs are negligible in comparison to those to tissues of the respiratory tract. About 96% of the total committed effective dose was contributed by the lungs.

USTUR-0321A-12