Uncertainty Analysis on Organ Doses from Exposure to Soluble Plutonium Material

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The respiratory tract tissues collected from four former nuclear workers involved in various inhalation incidents were analyzed post mortem for plutonium by the United States Transuranium and Uranium Registries. The activities in the upper respiratory tract of these individuals were found to be higher than that predicted using the most recent biokinetic models described in the publications of the International Commission on Radiological Protection. An assumption of 'bound fraction' was able to explain the data from three workers who had inhaled soluble to fairly insoluble forms of plutonium. For the fourth worker who had inhaled high-fired plutonium oxide, a more insoluble form of plutonium, a mechanism other than bound fraction was required to explain the observed retention of plutonium in the respiratory tract tissues. Literature review points to the presence of – and significant retention of – plutonium activity in the scar tissues of the lungs. This presentation proposes a human respiratory tract model modified with the addition of scar tissue compartments to describe the long-term retention of plutonium in the respiratory tract of these individuals. The transfer rates between the compartments were determined using Markov Chain Monte Carlo analysis of the urinary excretion data, lung counts, and post-mortem measurements of the systemic and respiratory tract compartments, as available.

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