

## **The Mayak Worker Dosimetry System (MWDS 2013): A Re-Analysis of USTUR Case 0269 to Determine Whether Plutonium Binds to the Lungs**

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Radionuclides in ionic form can become chemically bound in the airways of the lungs following dissolution of inhaled particulates in lung fluid. The presence of long-term binding can greatly increase lung doses from inhaled plutonium, particularly if it occurs in the bronchial and bronchiolar regions. However, the only published evidence that plutonium binding occurs in humans comes from an analysis of the autopsy and bioassay data of United States Transuranium and Uranium Registries Case 0269, a plutonium worker who experienced a very high (58 kBq) acute inhalation of plutonium nitrate. This analysis suggested a bound fraction of around 8 %, inferred from an unexpectedly low ratio of estimated total thoracic lymph node activity:total lung activity, at the time of death. However, there are some limitations with this study, the most significant being that measurements of the regional distribution of plutonium activity in the lungs, which provide more direct evidence of binding, were not available when the analysis was performed. The present work describes the analysis of new data, which includes measurements of plutonium activity in the alveolar–interstitial (AI) region, bronchial (BB) and bronchiolar (bb) regions, and extra-thoracic (ET) regions, at the time of death. A Bayesian approach is used that accounts for uncertainties in model parameter values, including particle transport clearance, which were not considered in the original analysis. The results indicate that a long-term bound fraction between 0.4 and 0.7 % is required to explain this data, largely because plutonium activity is present in the extra-thoracic (ET 2 ), bronchial and bronchiolar airways at the time of death.

USTUR-0357A-14