Project 2.1
Metabolism and Dosimetry of Plutonium Industrial Compounds

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Executive Summary

The long-term collaborative research project between the Dosimetry Registry of the Mayak Industrial Association (DRAMIA), operated by Branch No. 1 of the SRC Institute of Biophysics, and the I.S. Transuranium and Uranium Registries (USTUR), operated by Washington State University, continues into its third year under the sponsorship of the U.S. Department of Energy Office of International Health Programs.

The main purpose of the project is to combine data accumulated by both Registries, create a joint database, and perform a mutual analysis of this unique information regarding metabolism and Dosimetry of transuranic nuclides, specifically plutonium and americium, in the human body.

The primary focus of the second year of this collaborative research program was to use the joint USTUR-DRMIA database for a series of task involving biokinetic modeling. In the previous progress report, data were presented which suggested that the transportability (solubility) of aerosols from workplaces in plutonium processing facilities at Mayak could be measured in the laboratory. The data also suggested that those measurements would be useful in dose assessments for the workers inhaling the aerosols. Data were presented which related plutonium concentrations in the skeletal concentrations in healthy workers. Statistical analyses were subsequently performed on those data and the results of those analyses are presented in this report.

Statistical analyses of the relationships between the respiratory tract and systemic concentrations of plutonium in USTUR and DRMIA workers indicated a significant influence of residence time and of transportability (solubility) of inhaled plutonium-containing aerosols on the respiratory tract: systemic concentration ratios. The mean lung: systemic ratios were very significantly different between aerosol groups, indicating a need for separate lung retention and clearance parameters for each aerosol group. This model will be described more thoroughly and compared to other such biokinetic models in subsequent progress reports. There were few statistically significant differences between mean respiratory tract: systemic concentration ratios of groups of workers categorized on the basis of health impairment. This indicated that the health of workers did not influence the transfer of plutonium from the lung to the systemic circulation. The health of workers was shown to have a statistically significant influence on the distribution of plutonium in systemic organs, especially in the liver and the skeleton. Disease conditions of the liver resulted in a significantly reduced plutonium

concentration in that organ and a significant increase in the concentration in the skeleton when compared to the concentrations in those organs of relatively healthy workers. Such disease conditions were also shown to significantly increase the urinary excretion of plutonium from the system when compared to the urinary excretion of plutonium.

The shielding of a whole-body counter, formerly in use at the U.S. Rocky Flats Plant, was transported to FIB-1 and installed in a building addition which was newly constructed for that purpose. Assembly and installation was completed in November 1999. During the next reporting period, the refurbished detectors with computer system and software will be installed and the system will be calibrated and put into operation.

One manuscript, an interlaboratory comparison of radiochemical analytical methods for actinide elements in human tissues and bioassay samples, jointly authored by USTUR and DRMIA investigators, is under internal review by the USTUR and DRMIA and will be submitted to a peer-reviewed scientific journal for possible publication.

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