PLUTONIUM ODYSSEY: FIFTY YEARS OF BIOASSAY DATA

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Abstract - Plutonium urine bioassay samples have been collected and analyzed at the Los Alamos National Laboratory since July 1944. These data, some of which have been obtained for fifty years post an initial exposure, are an unique long term record of plutonium urine excretion data where the quantity and chemical make-up of the plutonium exposure material are unknown. Five different radio-analytical methods have been used at Los Alamos to obtain these data. An example of a fifty year plutonium bioassay urine record collected from one worker is shown in Fig. 1.

A parallel plutonium urine bioassay data base obtained from humans injected with known amounts of soluble plutonium compounds are also an unique plutonium urine bioassay excretion record. Data obtained for this source of human plutonium excretion were obtained by three different laboratories and against five different radio-analytical procedures. A thirty-three year record for one subject is shown in Fig. 2.

These two examples of human plutonium urine bioassay data are typical of published human plutonium bioassay data following entry and deposition of soluble plutonium compounds.

The human plutonium injection experiments have been subject to extensive review and reevaluation since publication of the data in 1950. Now, as a direct result of Secretary of Energy, Hazel O'Leary's, openness directive of 1994, additional information concerning the human plutonium injection experiments have been obtained. These "new" sources of scientific information have made possible further reevaluation of these data including information about the purpose of the experiments, the experimental designs used, and notebook records detailing the analytical results.

The new sources of information include the following:

1) Who was responsible for the scientific design and why were human studies necessary?

2) What was the basis of using both ^{238}Pu and ^{239}Pu and using 5 microgram and 94 microgram injection quantities?

3) What was the reasoning of having three different laboratories perform separate human plutonium injection experiments.

This paper will explore each of these subjects and discuss the significance of plutonium bioassay data obtained from occupationally exposed plutonium workers relative to information obtained from the injected subject's plutonium bioassay data.

This paper will also discuss the influence of; 1) analytical procedure as sources of bias; 2) radiometric alpha measurements detection limits as a source of bias; 3) quality control; 4) sample collection; 5) and other identified factors which contributed to the observed scatter within and between plutonium urine bioassay data.

Reference will also be made to the observation that these factors contributed a significant bias to the plutonium excretion data used by Langham et. al., to derive a single term power function model to describe plutonium excretion out to five years post intake.

References:

Voelz, G.L., L.H. Hempelmann, J.N.P. Lawrence, and, W.D. Moss, 1979, A 32-year medical follow-up of Manhattan Project Plutonium Workers, Health Phys. 37: 445-485.

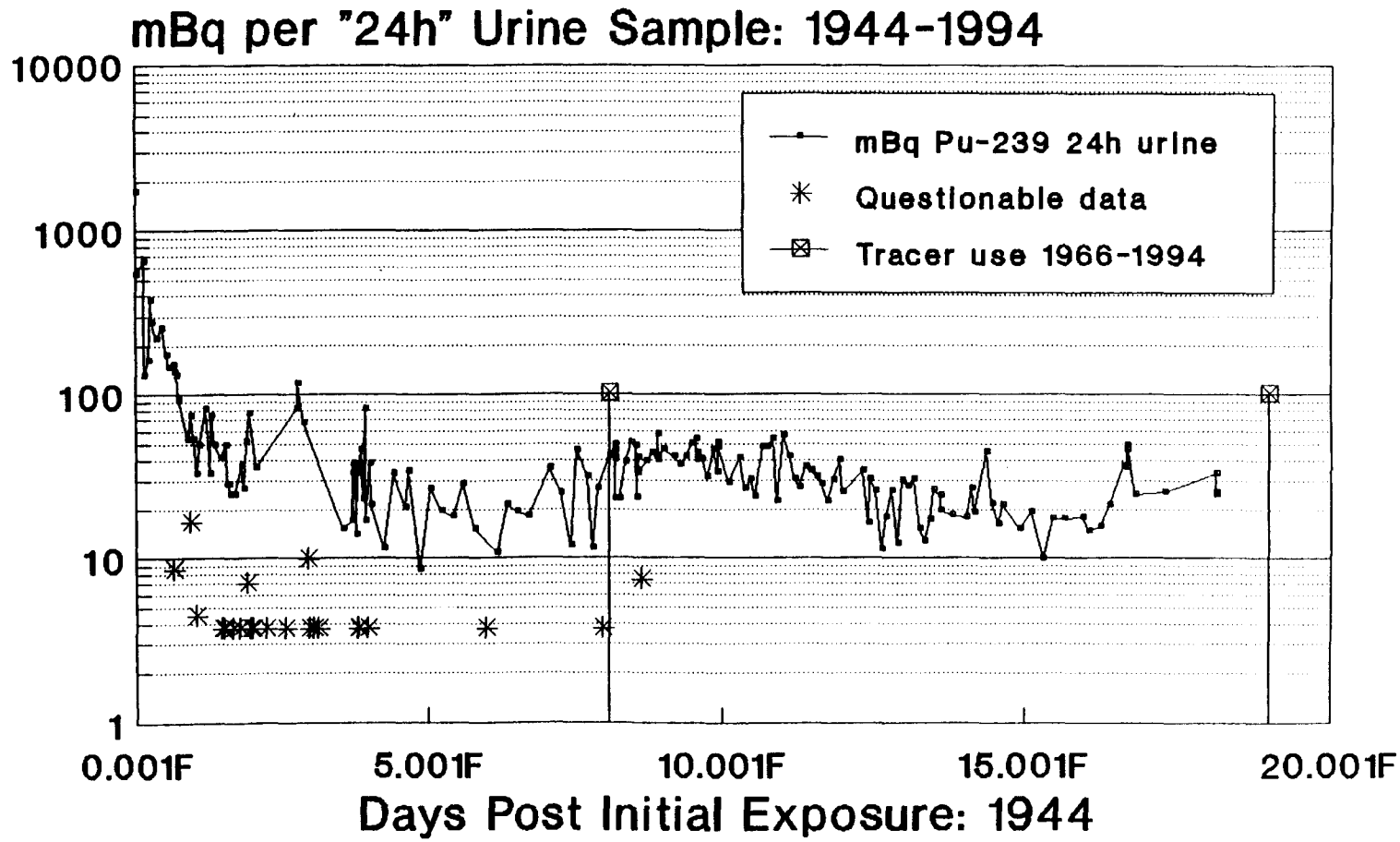
Moss, W.D., R. Eckhardt, The Plutonium Injection Experiments, Radiation Protection and the Human Radiation Experiments, Los Alamos Science, No.23, N.G. Cooper, Editor, Los Alamos National Laboratory, 1995.

Langham, W, H.,; S.H. Bassett, P.S. Harris, and R.E. Carter, 1980, Distribution and excretion of plutonium administered to man. Health Phys. 38: 1031-1060.

Rundo, J.,The late excretion of plutonium following acquisition of known amounts, Actinides in Man and Animals, Proceeding of the Snowbird Actinide Workshop, October 15-17, 1979, M.E. Wrenn, Editor, RD Press 1981.

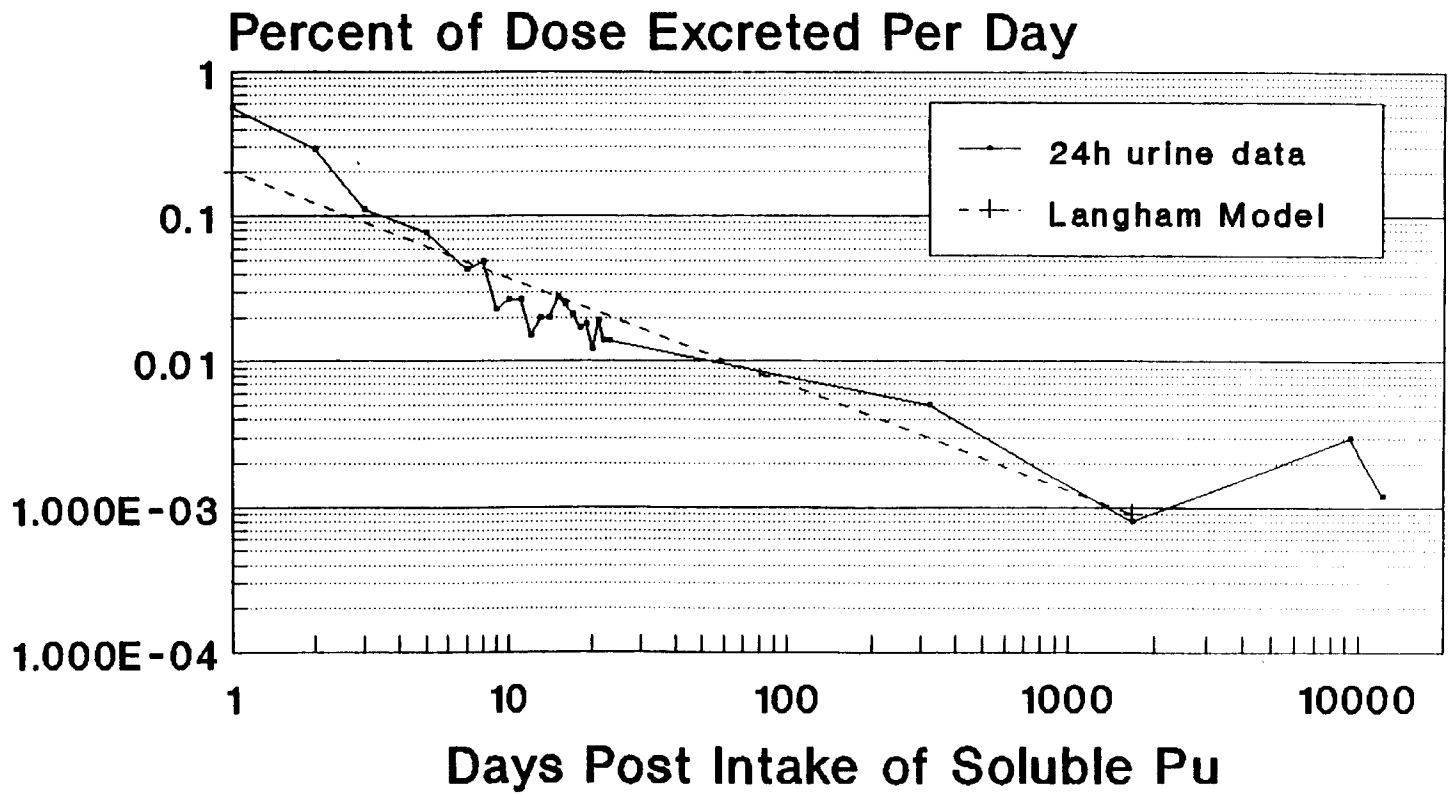
Sedlet,J., Private communication.

Fig. 1. A Fifty Year Plutionium Urine Bioassay Record: LANL I.D. No. 4.



Samples analyzed against five different radio-analytical procedures.

Fig. 2. Los Alamos Case HP-3, Urine Bioassay Data, Injected with 11 kBq Pu-239, Thirty-three years of data.



Injection Solution: Pu(IV) citrate
Injected 11/27/45.
One additional sample at day 12,168