^{239}Pu Intercomparison of ICP-MS, TIMS and FTA at μBq Levels

Neil M. Barss[1], R. Thomas Bell III[1]
David E. McCurdy[2], Leenu E. Kuruvilla[2]
Kenneth G.W. Inn[3]
[1]Department of Energy, Office of International Health Programs (EH-63)
[2]Yankee Atomic Environmental Laboratory
[3]National Institute of Standards and Technology

The Department of Energy, Office of International Health Programs (EH-63), is in the process of assisting Marshall Islanders to resettle their islands after five decades. The DOE and the resettled residents require assurances that the radiation dose to residents will not exceed recognized international standards or recommendations. One of the remaining radionuclides that could contribute to internal radiation dose from inhalation and ingestion intake pathways is ^{239}Pu. The uptake of ^{239}Pu is estimated from the excretion of ^{239}Pu in the urine of an individual. The analytical technique must have sufficient sensitivity to quantify ^{239}Pu at or below a level of 20 μBq/kg.

The goal of this phase of the project was to evaluate the state-of-the-art (accuracy and precision) for ^{239}Pu in artificial urine measurements by inductively coupled plasma, thermal ionization mass spectrometry and fission track analysis in the range of 18-278 μBq/kg. The major portion of the current tasks was performed by the YAEL, in terms of establishing the stability of ^{99m}Tc in the artificial urine, executing the dilutions, confirmational measurements and distributing the samples to participating laboratories.

The plan for diluting NIST ^{239}Pu SRM from kBq/kg to μBq/kg in artificial urine was iteratively developed between NIST and YAEL. After carefully selection of reagents, cleaning labware, and practicing high precision metrological techniques, the test materials were made, their concentrations confirmed, and sent to participating laboratories. The participating laboratories were given 10 weeks for the analyses.

Preliminary analysis of the data indicates that ICP-MS currently has the capabilities of making quantitative measurements of ^{239}Pu from urine down to the 18 μBq/kg level within 5 percent bias. Preliminary analysis also indicate, however, some potential technical difficulties by some of the participating laboratories include: a) data transcription; b) sample tracking; c) estimation of limits of detection; d) statistical control over analytical processes; and e) control of analytical background. These issues will be discussed during the presentation.