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United States Transuranium and Uranium Registries

United States Transuranium and Uranium Registries
Washington State University
100 Sprout Road
Richland, Washington 99352

Phone: (800)375-9317
FAX: (509)375-1817
Web Address: /WWW.tricity.wsu.edu/htmls/ustur/page1.html

ANNUAL REPORT
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Compiled and Edited by: *R.L. Kathren and S.M. Ehrhart*

Contributors: *S. Bao, A.L. Brooks, G.R. Dagle, R.H. Filby, R.E. Filipy, S.R. Glover, B. Gold, R.L. Kathren, C.L. Love, T.P. Lynch, M.V. Pham, J.J. Russell, D.B. Stuit*

DEDICATION

February 14, 1992, was a watershed date in the history of the Registries. On that date, the United States Transuranium Registry and its younger companion, the United States Uranium Registry, were officially consolidated into a single entity and transferred via a grant from the U.S. Department of Energy to Washington State University. In the nearly five years that have elapsed since the transfer, there have been numerous changes in the operation of the Registries. Among these have been several measures designed to make information and data produced by the Registries more conveniently accessible to the general public, the scientific community, and most of all, the Registrants themselves. It is, after all, the Registrants and their families whose unselfish contribution makes the research of the Registries possible, moving us further along the path towards achieving the scientific goals of the Registries. The knowledge thus gained will lead to a more complete understanding of the potential effects of heavy elements within the body, and greater assurance of the safety of those in the workplace who work with the actinide elements. It is to the prescient and unselfish participants in the program -- our Registrants and their families -- that we dedicate this Annual Report.

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Executive Summary

EXECUTIVE SUMMARY

Ronald L. Kathren

This Annual Report covers the period October 1, 1995 through September 30, 1996, and includes both scientific and administrative activities. As of September 30, 1996, the Registries had a total of 886 registrants of whom 350 were deceased and 292 classified as active. An anticipated funding cut of approximately 35% for the period beginning October 1, 1996, necessitated some staff cuts, but it is anticipated that the Registries core research will be maintained albeit at a somewhat slower pace.

The Registries received approximately 60 public information requests or inquiries ranging over a wide range of topics, about a third of which came from the media or official agencies, including Congress. Specific noteworthy inquiries were received from the President's Advisory Committee on the Gulf War Veterans with regard to uranium biokinetics and toxicity, and from the County of Los Angeles and the State of California with regard to the management and dosimetry of two separate instances of acute accidental intakes of ^{241}Am.

Other administrative activities included incorporation of the National Radiobiology Archives into the USTUR, and transfer of documents including original notebooks and laboratory data along with histopathology slides and similar biological materials from completed U.S. Department of Energy (DOE) sponsored radiobiology research programs. The USTUR home page on the World Wide Web, provided as a public service, was equipped with a counter which indicated an average of 240 visits per month during the first five months that the counter was in operation.

The regular annual Institutional Review Board review was completed and the program approved without change for another year. A revised Policies and Procedures Manual was issued along with a new similar manual specific for the radiochemistry operations. The regular annual USTUR Newsletter was sent to all registrants.

A proposal for collaborative research with the Dosimetry Registry of the Mayak Industrial Association, operated by Branch No. 1 of the Institute of Biophysics, Ozersk, Russian Federation was approved for funding as a three-year program. This proposal calls for 12 specific tasks to be accomplished, including comparison and standardization of tissue sampling radiochemical analysis procedures, characterization of workplace aerosols, various biokinetics studies, lung, lymph node, organ, and systemic depositions, in-vivo counter calibrations, tissue autoradiography and biomarker assays.

Significant scientific activities included an eight month follow-up of USTUR Case 0855, who had suffered an acute accidental inhalation of ^{241}Am which was instrumental in refinement of previously established USTUR biokinetic parameters for this nuclide. The new provisional biokinetic parameters for the four compartment excretion model are fractional uptake of 0.35, 0.20, 0.25 with retention half-times of 50, 2.5 and 10 years, respectively, for skeleton, liver and the rest of the body, with 0.20 going to early excretion.

Uranium content and concentrations in the tissues of two whole body donors with no known occupational exposure to uranium, USTUR Cases 0213 and 0242, showed concentrations of uranium in the bone of 4.8 and 5.8 ng/g wet weight, in close agreement with the Reference Man value of 5.9 ng/g. Uranium was well distributed among the soft tissues as a whole, and concentrations among the tissues as well as individual bones were quite variable. The largest concentrations were found in the tracheobronchial and other pulmonary related lymph nodes. Concentrations in liver were lower than for most soft tissues and the quantity of uranium in liver was less than in kidney. Complete tabulations of radiochemically determined ^{238}Pu in the tissues of USTUR case 0259, a whole body donor with an acute accidental exposure, are included, along with the completed radiochemical data for USTUR whole body donors Case 0262 and 0769.

The causes of death in the USTUR of the cohort of 260 deceased registrants who had enrolled in the USTUR were examined. Cause of death was established with virtual certainty in 244 of the 260 cases (94%) and the correlation between cause of death reported on the death certificate and from autopsy was 89%. Because of the self-selected and highly biased nature of the USTUR cohort, statistical comparison of causes of death in this cohort with the general population, or indeed with any other group is clearly inappropriate. However, no grossly elevated causes of death were apparent in this cohort, nor was there an apparent excess of tumors or leukemia, other than an apparent excess of brain tumors (astrocytomas), likely unrelated to radiation exposure, among workers at Rocky Flats who were members of the cohort.

The sensitivity of acute ^{60}Co exposure with that from alpha radiation from radon in both CHO cells and deep lung fibroblasts was compared using a radiation damage criterion and RBE/cell sensitivity criterion to assess the sensitivity for the formation of micronuclei and the deposition, retention and local dose to the cells from the radon progeny in the different regions of the respiratory tract with the ultimate goal of developing a practical biodosimetric technique applicable to other α-emitters, such as plutonium. Evaluation of the dose-response curves for the two types of radiation demonstrated that biological dosimetry can be very useful in determining the distribution of dose and damage in the respiratory tract following inhalation of radon or other environmental pollutants.

Interspecies comparisons of actinide biokinetics and radiation doses utilizing beagle dog data available in the National Radiobiology Archives and human data from the USTUR revealed that in general, such ratios were essentially the same for the two species. Most significantly, the beagle dog appears to reasonably approximate plutonium biokinetics in humans. The data for beagle dogs suggest that individual tissue retention curves based on initial lung deposition would be useful in modeling the biokinetics of plutonium in humans and could yield reasonable estimates of radiation doses to all of the tissues or organs studied.

Significant radiochemistry development activities included an ion exchange method for $^{228/232}$Th determination in tissues, a high resolution alpha spectrometry for determination of $^{239/240}$Pu ratios in human tissues, a high sensitivity method for uranium in urine using kinetic phosphorescence analysis, progress towards development of a high resolution alpha spectrometry technique for determination of $^{239/240}$Pu ratios in human tissues utilizing a software program specifically developed to deconvolute the combined five-peak multiplet from the two Pu isotopes, and a combined neutron activation analysis and alpha spectrometry for Th isotope determination, and determination of ^{239}Pu in low activity samples of human tissues by fission track analysis with a sensitivity of less than the currently achievable level of 0.7 mBq (0.02 pCi) accomplished by alpha spectrometry.

Administrative Activities

ADMINISTRATIVE ACTIVITIES

Ronald L. Kathren

Program Objectives and Description

The United States Transuranium and Uranium Registries (USTUR) was broadened to include the National Radiobiology Archives. The USTUR, which now includes both the National Human Radiobiology Tissue Repository (NHRTR) and National Radiobiology Archives (NRA), are unique human tissue research studies of the deposition, biokinetics and dosimetry of the actinide elements in humans with the primary goals of providing data fundamental to the verification, refinement, or future development of radiation protection standards for these and other radionuclides, and of determining possible bioeffects on both a macro and subcellular level attributable to exposure to the actinides. The NHRTR serves as a resource for researchers who desire to utilize human tissues and related biologic materials from persons with known depositions of actinides and other long-lived radionuclides. The NRA serves as an archival repository for original notebooks, laboratory data, histopathology slides and similar biological materials from U.S. Department of Energy (DOE) sponsored radiobiology research. The materials of the NHRTR and NRA are fully accessible to researchers, and collaborations are encouraged and sought.

Budgets

Revised budgets for FY97 and FY98 were received from DOE. The indicated reduction of approximately 35% in the FY97 and FY98 funding levels will necessitate deep cuts in personnel and slow the planned reduction of the backlog of samples awaiting radioanalysis. In anticipation of the projected budget reduction of $400,000 annually, staff reductions were effected; the Administrative Assistant position and a senior secretary position were eliminated, and these staff replaced by two part-time student assistants. The student assistants are funded 70% by WSU work-study funds and provide primarily clerical assistance. In addition, two graduate research assistant positions will not be filled in the coming fiscal year.

Policies and Procedures Manual

The USTUR Policies and Procedures Manual was reviewed, revised and reissued; the Table of Contents for the Manual is given in Appendix G. The initial USTUR Analytical Policies and Procedures Manual was published and distributed at the 1996 Advisory Committee meeting; Table of Contents for this document is given in Appendix H.

Public Information and Technical Assistance Requests

The Registries received on average four to five public information requests or inquiries per month, or about 50 to 60 annually. Although largely related to the actinide elements and hence the primary purposes of the Registries, the inquiries range over a wide variety of topics. About a third of the inquiries came from the media or official agencies, including Congress. Important examples of this category of inquiry includes a call received from DOE-RL regarding a query by Senator Glenn and Representative relative to possible forensic laboratory capabilities of the Registries. Agency inquiries came from both federal and non-federal bodies and included a telephone request from the President's Advisory Committee on Gulf War Veterans requesting background information on uranium in humans. Other noteworthy requests were received from the County of Los Angeles and the State of California to whom scientific assistance was provided to with regard to the management and dosimetry of accidental exposures to actinides, specifically in relation to two separate instances of acute accidental intakes of ^{241}Am. One resulted in an individual who incurred an acute accidental exposure enrolling as a registrant.

In response to another request, technical assistance was provided to the County of Los Angeles, State of California, and Agency for Toxic Substances and Disease Registry regarding a well in Los Angeles County that served as the domestic water supply for a small trailer park. Natural uranium levels in the well water were elevated, exceeding permissible levels by a factor of 200. The Registries served as consultants to the agencies, providing information regarding uranium toxicity and biokinetics and in evaluating the hazard and establishing a program of additional study that will include urinalyses for uranium and possible medical follow-up that is now in progress.

The County of Los Angeles and the State of California were also provided with consultation and technical assistance relating to the evaluation and dosimetry for employees of a state licensee who suffered exposures to americium and curium. The regulatory agencies agreed to advise the Registries of potential registrants and make the initial contacts with respect to recruitment.

Somewhat more than half of the public inquiries received by the Registries are requests from interested or concerned citizens who by and large have had an exposure experience of some sort. Noteworthy examples include contact by former Hanford site workers concerned about the possibility of a connection between exposure to plutonium and chronic fatigue syndrome (CFS). The workers had noted an apparent large number of workers in the Plutonium Finishing Plant (PFP) who appeared to have been diagnosed with CFS, and believed that the disease was work related. They were referred to the local health officer for follow-up; the Registries agreed to assist in the evaluation of the medical and dosimetry records as indicated by the physician.

Another example is a telephone inquiry from a Seattle physician regarding a patient who had presented with lung pain, and was subsequently diagnosed with plasma cell granuloma, a relatively rare nonmalignant tumor. The patient had worked at the DOE Rocky Flats facility and had a known exposure to plutonium and beryllium. The physician was provided with information regarding the toxicological and radiological aspects of the case. He subsequently requested the assistance of the Registries in evaluation of the case, and requested information regarding the Registries and enrollment materials for the patient. Subsequently, the patient enrolled in the Registries, and the Registries were provided with a sample of the tumor for independent evaluation which is currently in progress.

Several inquiries were received from members of the general public who had submitted hair samples to a commercial laboratory and had received results that indicated elevated or abnormally high levels of uranium. A particularly noteworthy inquiry in this regard came from an occupational physician with a teenaged female patient who had been diagnosed as having "ten times the normal level of uranium" by an outside commercial laboratory which provides trace metal analyses using hair samples to members of the general public. The physician was provided with information regarding the toxicology of uranium, endogenous levels in humans, and detection technology.

World Wide Web Home Page Visits

As indicated elsewhere in this report, the Registries maintain a home page as a public service. In May, a counter was installed to monitor visits to the USTUR home page. During the period from May through September, there were 1201 outside visitors, or an average of 240 visits per month during the first five months that the counter was in operation.

Human Subjects/Institutional Review Board Review

Research programs at Washington State University which use human subjects are required to undergo a complete review annually by the University Institutional Review Board (IRB). The Registries application for renewal and human subjects program review received unconditional approval from the Washington State University IRB. No programmatic changes were recommended by the Board.

Registrant Statistics

As of September 30, 1996, the Registries had a total of 886 registrants in all categories. Of this number 350 were deceased and 292 were classified as active. Active registrants are persons with current valid informed consent and release forms on file. The remaining 243 individuals are inactive registrants, or persons who are no longer participants in the program, whether by their own request or for other reasons. For example, if the Registries are not notified of the death of a registrant in a timely manner, it may not be feasible or even possible to perform an autopsy and collect tissues. In this case, the registrant would be classified as inactive. Similarly, tissues from an active registrant who dies and who has a positive or potentially positive test for hepatitis B or HIV would be refused and the registrant would be classified as inactive.

Registrant Newsletter

The third annual USTUR Newsletter was mailed to registrants in early December; the Newsletter is included as Appendix F.

USTUR Database

THE UNITED STATES TRANSURANIUM AND URANIUM REGISTRIES DATABASE

Minh V. Pham

Introduction

The USTUR database system experienced considerable growth and a number of significant changes during the reporting period. The USTUR computer system was modified to allow remote connection to the network for limited read only database access from anywhere in the world, with no compromise of security or the privacy of the registrants. Registrant personal information can only be accessed from within the Registries facility and with a correct and current password.

Database Files

A considerable amount of additional and previously unentered data was incorporated into the system, greatly enhancing its overall utility but also necessitating changes in the database structure by inclusion of additional fields to accommodate the health physics and medical information. This posed a significant problem as these data were not uniform among the several hundred registrants. For example, more than 60 different units were used by various laboratories over the years to characterize urinalysis results. Additionally, some cases, at least in part, have been reanalyzed radiochemically to ensure the accuracy and validity of the results, necessitating additional entries.

The USTUR database (Figure 1) consists of a number of different individual database tables linked by the unique four digit USTUR identification number. Each table stores specific information about the USTUR registrant cohort. For security reasons, linkage of this unique identification number to registrant personal identifiers exists only in the ADMIN table, which has highly restricted access.

The ADMIN table this year has been modified to add a new log table (ADMINLOG.DB) which traces and provides a record all of the activities within this database. The information in the Administration table or Administrative data base is the primary means of determining the status of the individual registrants, such as location, address, currency of release forms, birth date, whether living or deceased, and, if deceased, date of death, and similar personal information. This table contains the sole linkage with the USTUR identification number and various personal identifiers such as the name of the registrant and the social security number. The ADMINLOG.DB was developed to record and store changes in the primary data such as the deceased status and date of death, recording each transaction in a manner similar to an accounting tracking program. Each change will be recorded with the date, the time, the field, the original, and the new data. When the integrity of the information is questionable, the ADMINLOG will be used to retrack the data and its input, providing much greater accuracy and reliability of the data and facilitate its applicability to analytical research.

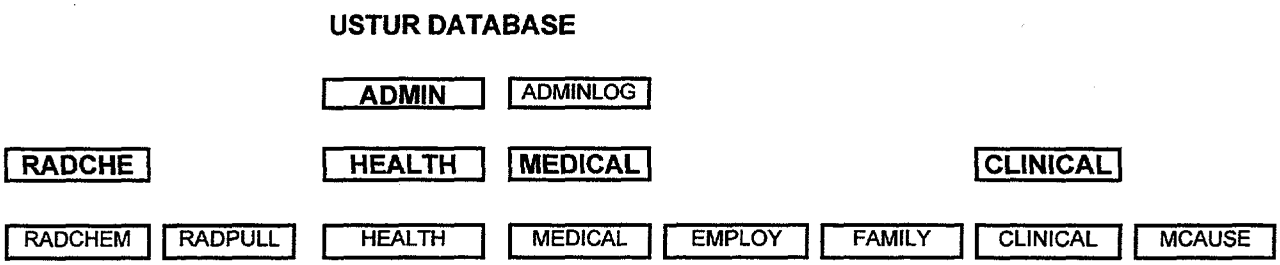
To ensure the accuracy and integrity of the radiochemical data as received from Los Alamos National Laboratory, and to ensure compatibility with that laboratory, a number of samples from various USTUR cases have been reanalyzed by the WSU laboratories. Both the new and original analytical data will be retained in the RADCHEM database.

The HEALTH database includes bioassay and dosimetry data for the individual registrant. Available data have now been entered into the database for all deceased registrants and the data have been randomly rechecked case by case for accuracy between the electronic data and the hard copy. Similarly, the MEDICAL database has been filled with available data from registrant files. Causes of death have been evaluated, coded according to the ICD-9 schema, and entered into the database.

World Wide Web

The USTUR database is available to researchers and the general public via the DOE Comprehensive Epidemiologic Data Resource which can be accessed through the World Wide Web address http://www.cedr.gov/. The USTUR also maintains its own home pages which are linked to CEDR. The Registries home page contains information including the complete text of the most recent Annual Report plus the Executive Summary from earlier reports, a history of the Registries, and a complete listing of Registries faculty and staff and telephone numbers and e-mail addresses. Complete Table of Contents for the USTUR home page is shown in Figure 2.

Figure 1. The USTUR Database



ADMIN: Administration database.
ADMINLOG: Log table of Administration data.
RADCHEM: Radiochemical data from LANL and others.
RADPULL: Radiochemical data from Pullman.
HEALTH: Health Physics
MEDICAL: Registrant personal medical information
EMPLOY: Registrant employment history.
FAMILY: Registrant family history.
CLINICAL: Registrants clinical information
MCAUSE: Registrants causes of death.

Figure 2. Contents of USTUR WWW Home Page

USTUR WWW HOMEPAGE (http://www.tricity.wsu.edu/htmls/ustur/page1.html)

- Questions and Answers about the Registries
- Publications Preface
  - Publication Request
  - Publications from 1968 to 1993
  - Publications from 1994 to 1995
  - Abstracts of Recent Peer Reviewed Publications
- Annual Report
  - 1993 Executive Summary
  - 1994 Executive Summary
  - 1995 Annual Report
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    - Organization Chart
    - Administrative accomplishments
      - Microfilming
      - Advisory Committee meeting
      - Color Brochure
      - Human Subjects Review
      - Manuscript Tracking System
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      - New Phone System for the campus
      - 376-6010 Disconnect
      - Advisory Committee on Human Radiation Experiments (ACHRE)
      - Registrant Renewal 1994-1995
      - The Long Range Plan
      - Record Archives
    - Database
    - Scientific papers
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      - Comparing Actinide Concentrations
      - The Russian-U.S. Registries Collaboration
      - Estimation of total actinide skeletal content from concentrations in individual bone samples collected at autopsy
      - Teeth as an Indicator of Total Skeletal Actinide
      - Postmortem Distribution of 238Pu in a Whole Body Donor 18 Years after Acute Inhalation Exposure
      - A Study of Actinide Microdose Distribution in Selected Bones using Electron Paramagnetic Resonance (EPR)
      - Radiochemistry Operations
      - Report of the Advisory Committee to the USTUR
      - Radiochemical Intercomparisons
      - Publications-Presentations-Awards
    - USTUR-Russian research collaboration

Figure 2. (Continued). Contents of USTUR WWW Home Page

History of Registries
Database System
National Human Radiobiology Tissue Repository
USTUR Radiochemistry
Genealogy of the USTUR
USTUR Faculty and Professional Staff
Registries Telephone Directory
Registries Information and Informed Consent

National Radiobiology Archives

THE NATIONAL RADIOBIOLOGY ARCHIVES

John J. Russell and Charles R. Watson[1]

Introduction

During the past fiscal year (1996), the U.S. National Radiobiology Archives (NRA) program operated by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy was transferred to the USTUR operations at WSU. The initial transfer included a limited collection of paraffin-embedded tissue blocks, microscope slides, clinical notes, pathologist observations, and several pieces of computer equipment. It is anticipated that the database and remaining computer equipment will be transferred to the Registries in fiscal year 1997.

The NRA is an archival program that was started in 1989 and whose original mission was to collect, organize, catalog data, laboratory notebooks, and animal tissue specimens from government (i.e. DOE and its predecessor agencies) sponsored radiobiology life-span studies performed at various National Laboratories and universities since the 1940's. As such the NRA is part of a greater international program that includes the European Radiobiology Archives and the Japanese Radiobiology Archives (Gerber, Watson, Sugahara and Okada 1996). These materials thus form a unique resource with great potential value for future studies. The NRA includes valuable archived records and specimens that are stored and maintained in a centralized facility and are available for additional future research and or analyses if and when needed. Although the studies were performed over many years and at different laboratories with differing data managing systems, the NRA has translated them into a more convenient set of Paradox relational database tables which can be distributed upon request.

The major thrust of the early studies was to determine the level, rate, and extent of the radiological and toxicological effects induced by ingested or inhaled radionuclides, including plutonium and other transuranics. Thus, over several decades, a variety of life-span studies using beagle dogs were initiated at the Argonne National Laboratory, University of California at Davis, Pacific Northwest National Laboratory, Inhalation Toxicology Research Institute, and the University of Utah. The results and many microscope slides from these life-span studies, totaling some 6000 dogs, have been transferred to the NRA and are now available to researchers.

[1]Pacific Northwest National Laboratory, Richland, Washington

Likewise, results from some 30,000 mice from studies comparing various strains have been transferred from Oak Ridge National Laboratory and Brookhaven National Laboratory. In addition, records, data, and many microscope slides from life-span studies on some 4,000 rats that were used for plutonium inhalation studies at Pacific Northwest National Laboratory and biokinetic and pathological data from experiments on more than 300 nonhuman primates have been added to the archive collection. Although the original archive collection at the NRA also included formalin and or alcohol-fixed tissues and thousands of radiographic films, concerns over the storage of such hazardous materials, coupled with budgetary constraints, led to proper disposal of these items which therefore were not transferred to the Registries with the other materials.

Like its sister program, the National Human Radiobiology Tissue Repository, materials from the NRA are made freely available to scientists and other investigators. Individuals interested in obtaining access to NRA materials -- i.e. slides, pathology data, original laboratory notebooks -- should contact the Registries directly, detailing their specific wants with respect to the archived materials. A brief description of the NRA collection follows:

NRA Animal Collection Summary Database

Argonne National Laboratory (ANL)

The ANL life span dog studies in the NRA collection include the 1960 ^{144}Ce, 1961 ^{137}Cs, and the 1968 ^{60}Co external gamma ray studies. These studies were designed to compare the toxicity of injected biologically soluble radioisotopes such as ^{137}Cs, which irradiate the whole body more or less uniformly, with injected biologically insoluble radioisotopes such as ^{144}Ce, which is preferentially retained in the phagocytic cells of the reticuloendothelial system including bone marrow, and whole body irradiation using an external gamma source. Data tables available from these studies include breeding history, kennel identification, body weight, biopsy, histopathology, and cause of death records for 688 experimental and 144 control animals.

Brookhaven National Laboratory (BNL)

Data tables from the radiation leukemogenesis studies performed by Dr. Eugene Cronkite on mice using low dose x or gamma irradiation have been given to the NRA. Likewise, data tables from Dr. Victor Bond's neutron induced leukemogenesis study in some 10,000 mice exposed to low dose rate neutrons of varying energies are also included in the NRA collection. However, since the BNL investigators are still actively working to complete their analyses of these experiments, these files are currently unavailable for external release.

Colorado State University (CSU)

These beagle dog studies were designed to evaluate the effects induced by either prenatal or early post natal exposure to whole body ^{60}Co

gamma radiation. Although the principal disease data are not SNODOG-coded, the data tables include histopathology, and cause of death data for 3360 life span and control animals.

Pacific Northwest National Laboratory (PNNL)

The PNNL life span dog studies initiated in 1959 were designed to evaluate the induction of cancer by the inhalation of plutonium in a variety of physicochemical forms including $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$. The Archives have detailed histopathology, clinical data, and an undetermined number of histopathology slides and paraffin blocks from 2176 life span and ancillary animals.

The PNNL rodent studies on the other hand were designed to define the shape of the dose-response curve for lung tumor induction in rats following inhalation of $^{239}PuO_2$. Data tables for 3631 young adult SPF Wister females, including 1070 sham-exposed controls, are available.

University of California at Davis (UCD)

The UCD life span dog studies were conducted using external exposure to x-rays and internal exposures to ^{90}Sr or ^{226}Ra. Tumor induction and life span shortening were the focus of the acute x-ray exposure experiments. Studies were also performed with strontium to evaluate its toxicity and health risks from ^{90}Sr fallout. In addition, life span studies with ^{226}Ra were designed to simulate the ingestion of radium by the radium dial painters. The Archives have individual health summary data, paraffin blocks, and histopathology slides from 1437 dogs, including 218 control animals, from the ^{90}Sr and ^{226}Ra studies.

Inhalation Toxicology Research Institute (ITRI)

The ITRI life span beagle dog studies began in the 1960's and included inhalation exposures to various radionuclides including ^{90}Sr, ^{144}Ce, ^{90}Y, ^{91}Y, and ^{137}Cs. In the 1970's, ITRI initiated experiments with ^{238}Pu and ^{239}Pu that were designed to help resolve the 'hot particle controversy'. The NRA holdings include individual summaries for some 1500 of these life span animals including 225 controls. Some studies and data analyses are still ongoing and these records and data files have been promised to the NRA when the research is completed.

Twelve separate rodent studies have been conducted at ITRI over the years and are in various stages of completion. Electronic data files and records of the following studies are scheduled for transfer to the NRA soon:

- Effects of Repeated Inhalation Exposure of Mice to Aerosols of $^{144}CeO_2$
- Effects of Repeated Inhalation Exposure of Mice to Aerosols of $^{239}PuO_2$
- Production of Liver Cancer and Chromosome Aberrations by Thorotrast and ^{239}Pu citrate

- Effects of Repeated Inhalation Exposure of Rats to Aerosols of $^{144}CeO_2$
- Effects of Repeated Inhalation Exposure of Rats to Aerosols of $^{239}PuO_2$
- Cytogenetic Effects of Inhaled $^{244}Cm_2O_3$ in Rats
- Pulmonary Carcinogenicity of Relatively Low Doses of Beta Irradiation from Inhaled $^{144}CeO_2$ in Rats
- Effects of Thoracic and Whole-Body Exposure of Rats to X-rays
- Effects of Combined Exposure of Rats to $^{239}PuO_2$ and Whole-Body X-Radiation
- Carcinogenicity of Inhaled $^{239}PuO_2$ and Beryllium Metal in Rats
- Effects of Inhaled $^{239}PuO_2$ and Cigarette Smoke in Rats
- Effects of Combined Exposure of Rats to Inhaled $^{239}PuO_2$ and a Chemical Carcinogen (NNK)

Lawrence Berkeley Laboratory (LBL)

Metabolism and toxicity studies on primates using ^{237}Np, ^{237}Pu, ^{238}Pu, ^{241}Am, and ^{90}Sr were carried out at LBL by Dr. Patricia W. Durbin. The study with ^{90}Sr was the most comprehensive of the five studies of long-term metabolism in the Rhesus monkey. The NRA holdings include individual animal summary data including uptake and other biokinetic information on bones, plasma, and excreta, from 192 animals. However, the data are sequestered until LBL has completed their analyses.

Oak Ridge National Laboratory (ORNL)

To date, two of the ORNL gamma ray life span studies on mice, one initiated in 1977 using 4728 animals and the second in 1987 using 5037 animals, have been donated to the NRA. The main focus of these studies was to evaluate the ability of gamma irradiation to induce cancer. The NRA hold individual summary information and histopathology data on these 9765 mice.

Data from a third study conducted before 1979, in which 19,200 RFM mice were exposed to a single exposure combination of ^{137}Cs followed by gamma irradiation at ten weeks, are also available.

University of Utah

In the early 1950's, the Radiobiology Laboratory at the University of Utah began a series of life span studies in dogs using a variety of radionuclides including: ^{239}Pu, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{90}Sr, ^{241}Am, ^{249}Cf, ^{252}Cf, ^{253}Es, and ^{224}Ra. These studies were designed to elucidate the health risks and other deleterious effects resulting from exposure to these radionuclides. The Archives have individual animal summary information and histopathology data on 1248 life span animals including 132 controls.

NRA Document Archives

Dr. William J. Bair Collection

This document collection, obtained after Dr. Bair's retirement from the Life Sciences Center at PNNL in April 1993, contains the supporting materials for the Hanford Sheep Studies, PNNL Beagle Inhaled Radionuclide Studies, Plutonium Inhalation Beagle Study, the Health, Environment and Safety Research Project, and the Hanford Life Sciences Symposia.

Colorado State University (CSU) Collection

This collection includes an incomplete set of Annual Reports, the final report to the Food and Drug Administration, excellent documentation of the CSU electronic database, and the support documentation for the transfer of the final electronic database to the NRA.

Dr. Miriam Finkel Collection

These documents describe work carried by Dr. Miriam Finkel at Argonne National Laboratory and were donated by Dr. Patricia Durbin, LBL, in October 1994. The Finkel Collection includes the 1960-1965 ^{226}Ra animal records, cage sheets, gross pathology, and final diagnoses. The gross pathology laboratory log books from several other studies are available:

- 1950-1951--MsTh, RdTh, Thx, and RdTh-Thx
- 1951--intravenously injected single dose ^{226}Ra
- 1951--intravenously injected single dose ^{239}Pu
- 1954--intravenously injected ^{45}Ca
- 1956--single dose intravenously injected ^{90}Y
- 1954--intravenously injected ^{90}Sr
- 1958--ingested ^{90}Sr
- No date-- ^{210}Po

There are no electronic or specimen data available for these studies at this time.

Inhalation Toxicology Research Institute (ITRI) Rodent Studies Collection

This collection currently consists of a finding aid document assembled by Dr. David Lundgren in April 1993. The document describes 12 studies conducted at ITRI beginning in 1972.

Lawrence Berkeley Laboratory (LBL) Non-human Primate Studies Collection

The materials in this collection are related to the ^{90}Sr, ^{238}Pu, and ^{241}Am studies conducted at LBL in primates. These materials, donated to the NRA in 1990, are being stored as a sequestered donation; the materials are not available for general access until release by LBL. The agreement between the NRA and Dr. Durbin states the LBL laboratory director must authorize access to these materials.

This sequestered collection consists of photocopies; all original data records and research materials remain in the custody of Dr. Durbin at LBL.

LBL Rodent Studies Collection

In October 1994, Dr. Edward Alpen prepared a finding aid to inventory the supporting documentation and specimens for the LBL rodent studies to be transferred to the NRA. These studies include 78 harderian gland life span experiments using 9800 animals.

Pacific Northwest National Laboratory (PNNL) Beagle Studies Collection

These documents are related to the PNNL life-span beagle studies of inhaled $^{239}PuO_2$, $^{238}PuO_2$, and $^{239}Pu(NO_3)_4$ conducted by Drs. James F. Park and Gerald E. Dagle. The materials available include animal clinical records, radiobioassay count sheets, and photocopies of the associated laboratory notebooks. The original laboratory notebooks are in permanent storage at the Battelle PNNL Records Center and are available upon request through the PNNL Records Management staff. This collection was transferred to the Document Archives in July 1995.

PNNL Rat Studies Collection

These documents are related to the PNNL low-level $^{239}PuO_2$ inhalation rodent studies conducted by Dr. Charles L. Sanders. The materials available include animal clinical records, radiobioassay count sheets, and photocopies of the associated laboratory notebooks. The original laboratory notebooks are in permanent storage at the Battelle PNNL Records Center and are available upon request through the PNNL Records Management staff. This collection was transferred to the Document Archives in June 1994.

PNNL Mouse Studies Collection

These documents are related to the PNNL low-level radon inhalation rodent studies conducted by Dr. Fred Cross. The materials available include animal clinical records, radiobioassay count sheets, and photocopies of the associated laboratory notebooks. The original laboratory notebooks are in permanent storage at the Battelle PNNL Records Center and are available upon request through the PNNL Records Management staff. This collection was transferred to the Document Archives in August 1995.

Dr. J. Newell Stannard Collection

This collection contains the supporting documentation for the comprehensive 2000 page history *Radioactivity and Health: A History* authored by Dr. J. Newell Stannard and originally published in 1988 by Battelle Press. Professor Stannard began donating these documents in 1989. Included in this collection are rare journal articles, *Vignettes of Radiation Workers* interviews recorded on videotape produced by the U.S. Department of Health and Human Services, and the original audio cassette tapes and unedited and edited transcriptions of personal interviews between Dr. Stannard and key individuals in the field of radiation research. The redacted transcripts of the interviews are available at the DOE Reading Room located in the library at Washington State University - Tri-Cities.

A finding aid document which describes the entire Stannard Collection is available upon request. The NRA Stannard Collection compliments the University of Tennessee Library Radiation Research Collection which contains Dr. Stannard's original writings.

Dr. Arthur H. Smith Collection

Transferred to the NRA in December 1992, this is a complete collection of articles from Dr. Smith's work in life span radionuclide exposure research with fowl, primarily chickens, and in rabbits at the University of California at Davis from 1948 through 1987. Also included are materials on radio-labeled fly migration studies.

Dr. Roy C. Thompson Collection

This collection contains the extensive collection of reference materials used by Dr. Thompson in writing his book, *Life-Span Effects of Ionizing Radiation in the Beagle Dog* which was published by Battelle Press in 1989. Documents include Pacific Northwest Laboratory Annual Reports, General Electric-Hanford Reports, and the *Reassessment of Radiation Dose in the Enewetok and Bikini Atolls, 1975 - 1983*. The Thompson Collection was transferred to the NRA in January 1993.

University of California at Davis Collection

The UC Davis Collection contains clinical records and supporting documentation for each beagle dog in the X-ray, ^{226}Ra, and ^{90}Sr, life span studies conducted at the Laboratory for Energy-Related Health Research (LEHR). These files include annual progress reports, and clinical records for both control and exposed animals. A typical folder contains a lineage chart, histopathology report, pathology report, all clinical work-ups, wholebody counts, electrocardiograms, and pictures/slides of the animal (or remarkable tissue growths) for the life of each animal. The X-ray folders include multiple samples of hair from each dog. This collection was shipped to the NRA in June 1992.

University of Rochester Collection

This is a comprehensive, bound collection from the Atomic Energy Commission sponsored research conducted at the University of Rochester School of Medicine work between 1943 and 1962. This collection also includes portraits of Drs. Stafford L. Warren and Dr. Charles R. Dunham.

Conclusion

The NRA document collections are complemented by the NHRTR collection of books, reports and other materials representing the reference collection of the radium dial painter studies carried out at Massachusetts Institute of Technology and later, Argonne National Laboratory. Taken together, the NHRTR and NRA document collections and library holdings constitute an important and unique radiobiological resource of considerable magnitude. Future plans call for consolidation and cataloguing of these collections, as well as augmentation through an active program of solicitation. The NRA has already received some documents from Professor Herman Cember, and are actively considering suitability and relevance of acquisition of other collections, such as the reprint collections of the late Professor E. Dale Trout and Herbert M. Parker.

References

Gerber, G. B., Watson, C.R.; Sugahara, T.; Okuda, S. International Radiobiology Archives of Long-Term Animal Studies, Vol. 1, Descriptions of Participating Institutions and Studies. Report DOE/RL-96-72. U.S. Department of Energy, Richland, WA. July 1996.

National Human Radiobiology Tissue Repository

NATIONAL HUMAN RADIOBIOLOGY RESEARCH TISSUE REPOSITORY

John J. Russell

Active Collaborations

At the request of Dr. Gary Kramer at the Human Monitoring Laboratory, Health Protection Bureau, Ottawa, Ontario, Canada, the USTUR has agreed in principle to the loan of a nearly complete skeleton of a former radium dial painter for use as a calibration phantom. The skeleton identified as Argonne National Laboratory (ANL) case # 01-145 was found to most closely fit the requirements set forth in the request. This dial painter, a female, was born in 1900 and was first exposed to Ra at the age of 18; she died in 1957. At the time of death, this case had a measured ^{226}Ra burden of ~ 230 kBq (6.3μCi) and also had a head carcinoma. The estimated systemic intake for ^{226}Ra and ^{228}Ra were previously calculated by Dr. Robert Rowland at Argonne National Laboratory using the modified ICRP 20 Retention Function as 37 MBq (998 μCi) and 8.4 Mbq (227 μCi) respectively, producing a total integrated lifetime skeletal dose of 1.58 and 0.36 Gy (158 and 36 rad), respectively, from these isotopes.

A second collaborative study that the Registries are involved in is with Drs. Ray Lloyd and Scott C. Miller at the University of Utah who are attempting to develop a tumor predictor model based on experimentally derived biokinetic, biological, dosimetric and clinical data. When completed, the model will predict the risk of Pu induced skeletal tumors, their latency period, anatomical sites and frequencies as functions of radiation dose or dose rate at specific skeletal sites. To aid in these studies, the Registries will supply selected bone samples from 2 to 15 previously radiochemically analyzed USTUR cases to compare with their existing dog data.

Dr. James Humphrey, Histology Service Manager, Biomedical Research, AEA Technology, Harwell, UK and Dr. Yhichi Ishikawa, a visiting scientist there, are carrying out microdosimetry studies and have requested samples of testis from USTUR 1053 if and when these become available, and a few water-jet washed samples of trabecular bone from any routine USTUR case. USTUR Case 1053 is an elderly male who was administered Thorotrast for diagnostic purposes several decades ago.

Registrant Deaths

During the reporting period, notification was received of only eight registrant deaths, the same as the statistical prediction based on age of about 8 cases annually. All were routine autopsies, and tissues from all but one of these cases have been received, and, in accordance with established procedures, divided into approximately two equal portions, one of which was forwarded to the laboratory for radiochemical analysis and the other retained by the NHRTR. Tissues from one case were declined because of a potentially positive HBV analysis.

Table 1 displays the calculated number of expected deaths per five year date of birth period based on the conditional probabilities of death statistics for the United States in 1990. The table also reveals the age distribution of the living USTUR registrant cohort; the majority of the remaining living USTUR registrants are greater than sixty years of age, and more than a third are older than 70.

Table 1. Predicted and Actual Number of Deaths in the USTUR Living Registrant Cohort.

Birth Year	No. Living	[qx]*	Expected Deaths in 5y Period	Actual Deaths 10/1/94-9/30/95	Actual Deaths 10/1/95-9/30/96
1906-1910	13	0.41080	5.34		
1911-1915	29	0.28270	8.20	1	1
1916-1920	50	0.19190	9.59	1	2
1921-1925	70	0.12780	8.59	4	4
1926-1930	61	0.08750	5.34	1	1
1931-1935	24	0.05600	1.34		
1936-1940	19	0.03380	0.64		
1941-1945	7	0.02160	0.15		
1946-1950	7	0.01470	0.10		
1951-1955	2	0.01150	0.02		
1956-1960	2	0.00930	0.02		
Unknown	8				
Total as of 9/30/96	292		39.33	7	8

*Conditional Probability of Deaths in the United States in 1990.

Radiochemistry Operations

RADIOCHEMISTRY OPERATIONS

Royston H. Filby, Samuel R. Glover, Dorothy B. Stuit

Background

In February 1994, responsibility for the radiochemical analysis functions of the United States Transuranium and Uranium Registries (USTUR) was transferred from Los Alamos National Laboratory (LANL) to Washington State University. During the period February 1 through September 30, 1994, the physical facilities were identified at the Nuclear Radiation Center on the Pullman campus and the necessary modifications and plans for remodelling (tissue ashing area - Room 215) were finalized. Equipment for the project was purchased and delivered and the core faculty and staff were appointed.

To expedite the startup of the radiochemistry operations at WSU as well as to minimize duplication of effort and possible intercomparison problems, the analytical procedures that had been in use at LANL were adopted. This was in accord with the specific recommendations of the USTUR Advisory Committee put forth in their 1994 meeting (Kathren, Harwick, and Markel, 1995). As part of the initial validation and QA/QC program, a three laboratory intercomparison of alpha spectrometry methods was carried out with LANL and the University of Washington (UW) was begun and successfully completed.

A total of 2004 bottles of acidic tissue solutions from both finished and incomplete cases was transferred from LANL to WSU during the summer of 1994, but without adequate documentation as to their analytical status. During the previous reporting period (October 1, 1994 to September 30, 1995) the LANL solution status was determined, radiochemical methods were refined and validated and a complete set of radiochemical procedures was issued as the USTUR Radiochemistry Project Radiochemical Analysis Procedures Manual. This manual was updated in 1996 as procedures were refined or changed (See Appendix H).

Radiochemistry Staff and Laboratory Facilities

No changes in staffing the USTUR Radiochemistry Project were made during the reporting period. However, in anticipation of budget reductions for FY97, the radiochemistry staff was reduced from 5.8 to 4.75 FTE. This was accomplished by elimination of one Project Associate (faculty) position and one Research Assistant position, effective October 1, 1996, and by reducing the fraction of appointment of the Research Technologist II from half to quarter time.

The Registries occupy approximately 2060 square feet of prime laboratory space within the Nuclear Radiation Center on the Pullman campus of WSU, excluding office space assigned to the graduate research assistants and project director. About half this space is devoted to radiochemical separations, including wet ashing and electrodeposition in two laboratories, 600 and 400 square feet respectively. The smaller of these laboratories contains two six foot hoods, and the larger a single six foot hood. Tissue sample preparation, including drying and ashing, is carried out in a somewhat smaller 380 square foot laboratory which was remodeled for this purpose in February 1995. A 208 square foot dedicated radiochemistry laboratory is used for storage and preparation of radioactivity standards and tracer solutions. The alpha spectrometers and associated computer occupy about half the area (125 square feet) in a counting room and instrumentation laboratory shared with the Nuclear Radiation Center. There are two small radiochemist offices (80 and 60 square feet) and a 200 square foot sample storage room. In addition, there is sample storage space available in the lower level of the facility.

There were no significant changes to the laboratory facilities during the reporting period. Severe corrosion of fume hoods used for acid digestion of samples was observed and all hoods were coated with an acid-resistant paint. This fix has proven to be very effective in reducing acid corrosion and has significantly improved the laboratory facilities. All USTUR laboratories were repainted to reduce contamination from peeling paint on ceilings and walls. However, a request to the WSU Central Administration to update fume hoods and to provide two additional hoods was not funded. During the reporting period, the Kinetic Phosphorescence Analyzer used for low level uranium analysis obtained from LANL was found to be malfunctioning and was repaired by the manufacturer; a new Virtis Freeze Dryer was obtained from the Department of Chemistry. A list of major equipment for the Project is shown in Table 2.

Objectives for the Reporting Period

The overall objectives for the reporting period were to:

1. Continue validation of methods used in the USTUR Radiochemistry Project, including analysis of relevant existing National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) and the proposed bone SRM;

2. Complete the re-analysis of the solutions provided by LANL for unfinished cases;

3. Analyze solutions provided by LANL from cases in progress, but not analyzed at LANL;

4. To begin analyses of the backlog of unanalyzed donor tissues at the NHRTR.

Specific Objectives for the Reporting Period

1. Complete the analysis of LANL solutions of cases in progress. Many of the LANL solutions required re-analysis because of poor recoveries during analysis at LANL. Other solutions were from cases for which samples had been ashed and dissolved but no radiochemical analyses had been performed.

2. Begin radiochemical analyses of the backlog of routine and whole-body cases at the NHRTR.

3. Continue improvement in the QA/QC Program through addressing the recommendations of the 1995 USTUR Advisory Committee Report.

4. Analyze the new proposed Human Bone Ash SRM issued by NIST and participate in the Round-robin Certification Program.

5. Revise and update the Radiochemical Analysis Procedures Manual.

6. Develop and implement new methods of radiochemical separation for use by the USTUR Radiochemistry Project.

7. Extend the analytical capability of the USTUR Radiochemistry Project to non-alpha spectrometry techniques of actinide determination.

Accomplishments

1. Analysis of LANL Solutions

Completion of radiochemical analysis of tissue solutions prepared by LANL prior to transfer of the program to WSU is in progress (Table 3). Many of the LANL solutions required re-analysis because of poor recoveries during analysis at LANL. Other solutions were from cases for which samples had been ashed and dissolved but for which radiochemical analyses had not been performed.

During the previous reporting period 54 analyses had been made of LANL solutions from cases 0231, 0469, and 0637. Approximately 200 samples from various cases which required re-analysis or which had not been analyzed remained and were completed during the current reporting period. The status of the LANL solutions at the end of the reporting period is shown in Table 3.

2. Analyses of New Cases

Analyses of a number of new cases was initiated. Analyses of tissues from USTUR Case 0841 for uranium and thorium was begun in the previous reporting period, although only the uranium determinations were completed. New cases begun during the reporting period are shown in Table 4.

USTUR cases 0852, 0855, and 0856 are individuals with possible acute inhalation exposures to ^{241}Am or mixed ^{241}Am and ^{239}Pu from whom excreta samples were obtained because of the unique opportunity these cases presented for determination of biokinetic parameters. The two whole-body cases (Cases 0269 and 1028) have been received and soft-tissue samples for Case 0269 have been ashed.

3. Validation of Radiochemical Procedures

To validate the transfer of the radiochemical analysis program of the USTUR from LANL to WSU, four intercomparison programs were completed during the previous reporting period and the results of these intercomparisons were reported in the previous Annual Report (Kathren, Harwick, and Markel, 1995). A complete QA/QC Report for FY 96 is included as Appendix D. Recommendations concerning further QA/QC procedures were made at the 1995 USTUR Advisory Committee meeting held in October, 1995, and were addressed during the current reporting period as indicated below:

Recommendation:

Data Quality Objectives and Analytical Requirements: As a minimum, accuracy and precision requirements should be established for each project prior to initiation of work.

Action:

Adopt ANSI N13.30 for establishing minimum acceptable accuracy and precision at specific activity levels for each project. Cases are now discussed with USTUR staff before analyses are begun.

Recommendation:

Documented Procedures: Each procedure should be reviewed by experts to assure that a competent analyst could execute the instructions and satisfactorily meet the stated objectives of the process.

Action:

Most procedures currently used have been adapted from LANL methods and have hence been reviewed previously. All modifications to procedures and all new procedures are evaluated by each member of staff with final review by the Director. Procedures are not revised and adopted until carried out in the laboratory.

Recommendation:

Quality Assessment: The Registries should establish a means of conducting measurement quality assessments. Assessment of process quality should be serviced by internal or external experts. In either case, quality assessment personnel must be independent of routine measurement process to provide independent evaluations.

Action:

Quality Assessment in the USTUR Radiochemistry Project is conducted through:

a) Analysis of blanks for each nuclide for each sample batch;

b) Analysis of standard solutions (from NIST tracers) with sample batch;

c) Analysis of SRM 4351 and 4352;

d) Control charts for blanks and spiked samples.

In addition, submission of blind samples prepared by a person outside the USTUR organization was discussed at the Advisory Committee meeting and it was agreed to implement this recommendation during the next reporting period. Professor Sue B. Clark, Department of Chemistry, WSU, agreed to provide external QC samples prepared from NIST SRM radionuclide solutions.

Recommendation:

External Measurement Assurance Programs: In addition to verifying analytical methods with reference materials, the Registries radiochemistry group should participate in appropriate external measurement assurance programs (MAPs).

Action:

Application for enrollment in the DOELAP program is in process, as is participation in the NIST Bone Intercomparison and Standardization. Pu and Am analyses are complete. USTUR - Russian intercomparisons are under development.

Recommendation:

Reference Materials: Five or more replicate analyses should be used to adequately evaluate the accuracy and precision of a method.

Action:

Five samples of SRM 4351 and 4352 were analyzed in FY 1996 and the data are reported in the QA/QC Report (Appendix D).

Recommendation:

Reference Method: A guaranteed reference sample dissolution, radiochemical purification and measurement method should be established to help validate new methods and to be used for special or high visibility samples.

Action:

Sodium bisulfate fusion procedure has been added to dissolution procedure (USTUR 100).

4. Analysis of Human Bone Standard Reference Material.

As part of the QA/QC program for the USTUR Radiochemistry Project, the laboratory participated in the analysis of a new SRM, Human Bone, which will be eventually certified for actinide radionuclides. During the reporting period, the analyses were completed for plutonium and americium in the proposed SRM. These are reported in the QA/QC Report (Appendix D). Analyses of the SRM for uranium and thorium are in progress.

5. USTUR Radiochemistry Project Policies and Procedures Manual.

The radiochemical procedures adopted by the USTUR Radiochemistry Project were based on the procedures developed at LANL and described in LA-10300-M (Gautier, 1995). However, a number of changes were made in the radiochemical separation methods and major changes were made in the alpha spectrometry methods. These procedures were incorporated into a USTUR Radiochemistry Policies and Procedures Manual, the initial version of which was completed in September 1995. The procedures cover all aspects of the analytical program from receipt of the sample at WSU to reporting of data, including QA/QC procedures. This manual was reviewed and revised during the current reporting period and a completely updated version was distributed at the 1996 USTUR Advisory Committee meeting.

6. Develop and Implement New Methods of Radiochemical Separation for Use by the USTUR Radiochemistry Project.

Several research and development projects were started during the previous reporting period with the objective of improving existing USTUR procedures for the determination of actinide elements in human tissues by replacing ion-exchange separation methods with faster and less waste-producing extraction chromatography methods. These projects are listed below along with the surnames of the principal investigators:

Development of a Method for the Determination Of Thorium Isotopes (Stuit/Qu)

An ion exchange method was developed for $^{228/232}Th$ determination in tissues. The procedure was integrated with the existing method used for uranium isotopes and applied to the analysis of tissues from case 0841. This method was completed November, 1995.

Optimization of Electrodeposition Parameters (Glover)

Several difficulties were experienced in the electrodeposition of actinides on the steel planchets used in the electrodeposition cells. In particular, the use of ammonia gas for adjusting the pH of the sulfuric acid medium to pH 2.0 was found to be cumbersome and unnecessary and could be replaced with a sodium bisulfate/sulfuric acid system. A complete evaluation of all parameters (pH, time, current, etc.) was undertaken using a chemometric approach to obtain optimum parameters for each actinide.

This project was completed in September, 1996, and a paper describing this work has been submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and for publication in the peer reviewed *Journal of Radioanalytical and Nuclear Chemistry*.

Development Of Extraction Chromatography Method For Actinides In Soft Tissues (Filby, Moody).

The USTUR ion-exchange and solvent extraction (DDCP for Am) methods for actinides generate large amounts of chemical waste along with some organic mixed waste. This research project focused on developing methods which are more rapid and which generate less waste than the ion-exchange methods for Pu, U and Th and the solvent extraction method for Am.

Extraction chromatography methods were developed for the actinides (Pu, Am, U, and Th) using combinations of EICHROM TRU and TEVA resins. The four actinides were pre-concentrated on a TRU column and each actinide was separated by elution into a TRU and TEVA column in tandem with the first column. This procedure was shown to give excellent results for soft tissues and the method is a candidate method to replace the ion-exchange - solvent extraction methods for soft tissues. The method was validated by analysis of previously analyzed LANL and USTUR samples and with NIST SRM 4351 (Human Lung) and SRM 4352 (Human Liver).

This project was completed in September, 1996. The work on the soft tissue analysis was submitted as an M.S. Thesis in Chemistry by Cheryl Moody in September, 1996. A paper has been submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and for publication in the peer reviewed *Journal of Radioanalytical and Nuclear Chemistry*.

Use of the EICHROM Actinide Resin for Preconcentration of Actinides from Human Tissues (Filby, Qu).

Another approach to reducing the time of analysis and the volumes of radioactive and mixed waste generated in the determination of actinides in human tissues was to use the new Actinide Resin for pre-concentration of actinides followed by either ion-exchange or extraction chromatography using TRU and TEVA resins. The Actinide resin was found to be very effective in pre-concentrating Pu and Am from solutions containing high loadings of soft tissue or bone ash. This project was completed for Am and Pu in September, 1996, and work continues for the Preconcentration of U and Th. This work has been validated with solutions previously analyzed by LANL and the USTUR and by analysis of the NIST SRMs 4351 and 4352. This work was submitted as an M.S. Thesis in Chemistry by Hongguo Qu in September, 1996, and presented orally at the 1996 Bioassay Conference in September, 1996, in San Francisco. The method validation component has been submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and for publication in the peer reviewed Journal of Radioanalytical and Nuclear Chemistry.

Determination of Actinides in Urine Bioassay Samples (Stuit)

Methods for the determination of Pu and Am in urine samples was begun during the reporting period. A number of pre-concentration procedures were tried, including the EICHROM Actinide Resin (was found to be unsatisfactory) and these methods are still under development.

7. Development of New Analytical Capabilities for the USTUR.

Development of KPA Method for Determination of Uranium in Urine (Stuit, Glover).

The Kinetic Phosphorescence Analyzer (KPA) unit, as received from LANL was inoperable and completely refurbished by the manufacturer, Chemcheck Inc. A KPA method was developed for very low-level U determination in urine as a complement to the alpha spectrometry method for U radionuclides. This method was successfully used for urinalyses in a special study of residents in an area with a potentially contaminated water supply carried by the State of California and the Agency for Toxic Substances and Disease Registry (ATSDR) (See section on Administrative Activities, supra). This project was completed in October, 1996.

High Resolution Alpha Spectrometry for Determination of $^{239}Pu/^{240}Pu$ Ratios in Human Tissues (Glover, Filby, LaMont).

Determination of the 239 to 240 isotopic ratio of plutonium can only be achieved with specialized techniques such as mass spectrometry that are impractical for routine analyses. Conventional alpha spectrometry used for determination of plutonium in human tissues does not have adequate resolution to separate the complex alpha spectra of ^{239}Pu and ^{240}Pu. A high resolution detector has been used and a software program has been developed to deconvolute the combined five-peak multiplet. This program has been evaluated on synthesized ^{239}Pu plus ^{240}Pu spectra and provides excellent deconvolution for mixtures with ^{240}Pu activities typical of occupational exposures. The method is suitable for the determination of the isotopic ratio in USTUR samples, and opens a new dimension of analytical and dosimetric capability.

This project is scheduled for completion in June, 1997. This work was carried out as an undergraduate research project by Steve LaMont who will give an oral status report at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and submit same for publication in the peer reviewed *Journal of Radioanalytical and Nuclear Chemistry*.

Determination of $^{239}Pu/^{240}Pu$ Ratios in Human Tissues Using Combined Alpha Spectrometry and Fission Track Analysis (Filby, Love)

The alpha spectrometry system used to maximize counting efficiency for determination of Pu in human tissues cannot separate the complex alpha spectra of ^{239}Pu and ^{240}Pu. Typically this ratio can only be measured at low activity levels by isotope-ratio mass spectrometry. In this research, $^{239+240}Pu$ is determined by conventional alpha spectrometry using ^{238}Pu as the tracer for yield determination instead of ^{242}Pu, which has a high fission cross section. In a deviation from the normal electrodeposition method, vanadium planchets are used instead of stainless steel to avoid high induced activity following neutron irradiation. After determination of $^{239+240}Pu$ by absolute activity measurement, the ^{239}Pu is determined by fission track analysis (FTA) using Lexan foils as fission fragment detectors. After irradiation, the detectors are developed using 6M NaOH and the tracks counted using a microscope and video camera/display. The method is suitable for ^{239}Pu activities as low as 10 mBq (0.5 dpm) under these conditions.

This project completion is scheduled for May, 1997. A report of this work has been submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and will be submitted for publication in the peer reviewed *Journal of Radioanalytical and Nuclear Chemistry.*

Combined Neutron Activation Analysis and Alpha Spectrometry for Th Isotope Determination (Glover)

Although alpha spectrometry is typically used for determination of ^{228}Th, ^{230}Th and ^{232}Th in human tissues, the detection limits for ^{232}Th are significantly poorer because of the long half life of this isotope. This difficulty can be overcome by a two stage process, first utilizing alpha spectrometry to determine ^{230}Th and ^{228}Th using ^{229}Th as a yield tracer following electrodeposition on vanadium disks. Neutron activation analysis is then used for ^{232}Th determination.

This project was completed in October, 1996, and the work submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and for publication in the peer reviewed *Journal of Radioanalytical and Nuclear Chemistry.*

Determination of ^{232}Th in Human Tissues by Radiochemical Neutron Activation Analysis (Glover)

Radiochemical neutron activation analysis (NAA) provides significantly lower detection limits for ^{232}Th in human tissues as compared with instrumental NAA. In this technique developed for low-level thorium determination in human tissues, thorium is separated from the sample and the yield of the separation is determined using ^{227}Th separated from ^{227}Ac. NAA is then used to determine ^{232}Th. This work has been submitted for oral presentation at the Fourth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, Hawaii, April 6-11, 1997, and for publication in the peer reviewed *Journal of Radioanalytical and*

Nuclear Chemistry.

Determination of Toxic Trace Elements in Human Tissues (Glover)

USTUR whole-body cases previously analyzed for actinides represent a valuable sample resource for the determination of other toxic elements to assess occupational exposure of individuals to these elements, or for determination of the distribution of these elements within the human body. Analytical methods have been developed for the determination of a number of these elements by a combination of neutron activation analysis and inductively coupled plasma emission spectrometry (ICP-AES). Detection limits have been established and the blank contributions by reagents to each element have been assessed to determine which elements can be determined in previously analyzed USTUR cases and which need to be determined in new cases using high-purity reagents during sample decomposition. This project is now in progress with a projected completion date of September, 1998.

Determination of ^{239}Pu in Low Activity Samples of Human Tissues by Fission Track Analysis (Filby, Love)

A fission track analysis (FTA) method for measurement of levels of ^{239}Pu below the currently achievable level of 0.7mBq (0.02pCi) accomplished by alpha spectrometry is being developed. Initially Suprasil quartz was used as track detector but the high background from U impurities in the quartz and reagents resulted in poor detection limits. Both CR-39 and Lexan polycarbonate plastics were tried; Lexan appears to show the best promise for reducing detection limits below 0.7 mBq (0.02 pCi). Use of ultrapure reagents in all stages of sample preparation will lower detection limits but clean room facilities are needed for ultralow level analysis. This project is ongoing.

References

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Kathren, R. L.; Harwick, L. A.; Markel, M. J.; Eds. United States Transuranium and Uranium Registries Annual Report October 1, 1994 - September 30, 1995. USTUR-0049-95. Richland, Washington.

Table 2. Major Equipment for the USTUR Radiochemistry Project

Equipment Item	Room and Use	Current Status
20 cu.ft. Capacity drying oven, VWR 1685, with ramp and dwell temperature programming	Room 215. Drying of wet tissue samples	installed 3/95
8.0 cu.ft. capacity muffle furnace, BlueM 52641, with ramp and dwell temperature programming to 1200°C	Room 215. Ashing of dried tissues to 450°C	installed 3/95
Class II A/B3 Biosafety cabinet with UV sterilization, NuAire NU 426-600	Room 215. Preparation of tissues for ashing	installed 8/94
Alpha spectrometry system; 32-unit chamber spectrometers, ORTEC Octete system	Room 120. Counting of electrodeposited dsks	installed 8/94
Electrodeposition system, 8-unit Protek DC power supply system with constant current and voltage	Room 114	installed 2/95
PERALS Instrument	Room 114	acquired 3/96
Kinetic Phosphorescence analyzer (KPA)	Room 114	repaired 6/96
Virtis Freeze Dryer	room 114	acquired 6/96

Table 3. LANL Solutions Analyzed from Incomplete Cases

Case Number	Number of Samples	Number of Analyses	Case Status
0231	2	2	complete
0260	4	4	complete
0262	131	197	complete
0469	17	30	complete
0579	6	6	complete
0637	22	22	complete
0644	13	26	complete
0677	5	6	complete
0769			returned to NHRTR
0775	9	15	complete
0778	7	11	complete
0779	3	3	complete
TOTAL	**219**	**322**	

Table 4. New Cases for Radiochemical Analysis

Case Number	Status of Samples	Analyses	Case Status	Analytes
0269	tissues received	in progress	in progress	Pu, Am
0841	11 samples	22 analyses	completed	U, Th
0852 (urinalysis)	5 samples	10	completed	
0855 (urinalysis)	1 sample	1	completed	
0856 (urinalysis)	1 sample	1	completed	
1028	some tissues received		in progress	U

Scientific Progress

RADON DOSIMETRY STUDY

Shiping Bao and Antone L. Brooks[2]

Introduction

Radon-222 is responsible for more than 40% of the total background radiation dose and 90 percent of the background radiation dose to the human respiratory tract (NAS/NRC 1988). Radon-222 exposure at high levels produces biological changes that are postulated to be important during the process of cancer induction. In experimental systems, exposure to ^{222}Ru and its progeny both *in vivo* and *in vitro* has been shown to induce mutation, chromosome damage, cell transformation, cell killing, and changes in the immune system.

Radon-222 has been shown to induce lung cancer in uranium miners and in experimental animals. From these data it has been possible to provide rather accurate estimates of the risk from high levels of radon exposures in a mine environment. Radon exposure in homes has been evaluated in many studies. Because of the low doses, it is difficult to quantitate an excess risk associated with home exposures.

To adequately link radiation exposure in the mine environment to risk in other environments, it is essential to understand the relationship between the radiation exposure and effective radiation dose to critical respiratory tract epithelial cells. There have been measurements made in the mine and home environments and these measurements linked to mathematical models developed to describe the relationship between exposure and dose. These models depend on the knowledge of a range of physical and biological factors. The models have resulted in the development of software to evaluate dose as a function of aerosol characteristics. Because of the short half-life of radon and its daughter products, it has been difficult to directly measure the deposition and distribution of radon and its progeny and make the estimates of radiation dose to respiratory epithelial cells. In this research, chromosome damage was used as a biological dosimeter to help validate the physical models and provide an estimation of radiation dose to the respiratory tract cells. Such biological dosimeters could have wide applications for the damage induced by other α-emitters, especially plutonium.

Methods, Results and Discussion

Male Wistar rats and female F-

[2]Department of Environmental Science and Regional Planning, Washington State University at Tri-Cities.

344 Fischer rats, 4-6 weeks old, were used in these studies. Animals were exposed to both graded external doses of ^{60}Co gamma rays (0.0, 1.0, 2.5, 5.0 Gy, 4 rats/group) and radon (0.0, 60, 262, 564 WLM, 4 rats/group). Methods were developed to isolate and culture nasal epithelial cells, tracheal epithelial cells, deep lung epithelial cells and deep lung fibroblasts concurrently after exposure (Bao et al. 1997). The frequency of radiation induced micronuclei was determined in each tissue after a short term cell culture (3-4 days). All slides were coded prior to scoring. Statworks computer software was used to estimate the intercept, slope, and standard error to characterize the dose-response relationship in each tissue.

Over the radiation doses tested, the frequency of micronuclei in the respiratory tract cells increased linearly with both ^{60}Co and Exposure. There was no significant division delay induced by radiation. No significant differences were found in the frequencies of micronuclei induced in the nasal epithelial cells isolated from either female Fischer 344 or male Wistar rats. Fibroblasts cultured in different media and isolated from either female Fischer 344 or male Wistar rats also showed a similar frequency of micronuclei. Dose-response relationships from both ^{60}Co and radon exposures are summarized in Table 5.

The usefulness of biological dosimetry has been well established in human blood lymphocytes and in the liver for internally deposited radioactive materials. The ability to use biodosimetry to convert exposures in WLM to dose in mGy will be very useful in risk assessment and is dependent on a number of factors including the sensitivity of the tissue for the formation of micronuclei and the deposition, retention and local dose to the cells from the radon progeny in the different regions of the respiratory tract. This biodosimetry conversion is not only useful in radon study, but also can be used to others α-emitters, such as plutonium.

A table was constructed to establish relationships between radon exposure (WLM) and total radiation dose (mGy). Two methods were used to estimate these relationships (Table 6): damage approach and RBE/cell sensitivity approach. Both approaches used 0.79 mGy / WLM derived from deep lung fibroblasts studies as a basis for the calculations (Brooks et al. 1994, 1995 and Khan et al. 1994). The slopes of the exposure-response relationships for induction of micronuclei by radon were used in the damage approach. In this approach, we assumed that the high-LET radiation sensitivity of different regions of respiratory cells was equal, and the radiation responses were only related to doses. In the RBE/cell sensitivity approach, the slopes of the dose-responses from ^{60}Co exposure were used as an indication of the differences in the cell sensitivity to low-LET radiation.

For ^{60}Co exposure, each respiratory tract cell population received a similar dose, the differences in response would be only related to the differences in the sensitivity of the different cell types. These data were combined with the RBE reported (Brooks, et al. 1994) which compared the sensitivity of acute ^{60}Co exposure with that from radon in both CHO cells and deep lung fibroblasts. This RBE/cell sensitivity approach contains the assumption that the relative sensitivity for the induction of micronuclei is the same for high and low LET radiation.

The ultimate goal for both approaches was to calculate the relationship between dose and exposure (mGy/WLM) for all cells studied in the respiratory tract. For both approaches, the nasal epithelial cells received the lowest dose/exposure (0.24-0.31) mGy/WLM and the deep lung epithelial cells received the highest (0.96-1.90) mGy/WLM (Table 6). This research demonstrated that biological dosimetry can be very useful in determining the distribution of dose and damage in the respiratory tract following inhalation of radon or other environmental pollutants.

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Table 5: ^{60}Co and Radon Induced Micronuclei in Rat Respiratory Tract Cells

Cell Type	Exposure	Intercept ± SE[1]	Slope ± SE[2]
Nasal epithelial cells	^{60}Co	106 ± 9	22.9 ± 3.3
Tracheal epithelial cells	^{60}Co	88 ± 7	32.8 ± 2.4
Deep lung fibroblasts	^{60}Co	42 ± 22	76.2 ± 7.9
Deep lung epithelial cells	^{60}Co	11 ± 26	92.2 ± 9.2
Nasal epithelial cells	Radon	92 ± 6	0.11 ± 0.02
Tracheal epithelial cells	Radon	110 ± 18	0.34 ± 0.06
Deep lung fibroblasts	Radon	50 ±15	0.28 ± 0.05
Deep lung epithelial cells	Radon	110 ± 16	0.67 ± 0.05

[1] Micronuclei / 1000 Binucleated Cells.
[2] Micronuclei / 1000 Binucleated Cells / Gy (^{60}Co) or WLM (Radon).

Table 6: Calculation of Dose (mGy)/Exposure (WLM)

Damage approach

Cell Type	Radon responses[1]	Relative value	mGy / WLM
Deep lung fibroblasts	0.28	1	0.79
Nasal epithelial cells	0.11	0.39	0.31
Tracheal epithelial cells	0.34	1.2	0.95
Deep lung epithelial cells	0.67	2.4	1.90

RBE / Cell sensitivity approach

Cell Type	^{60}Co[2]	RBE	High LET damage	Relative Value	mGy / WLM
Deep lung fibroblasts	76.2	10.9	831	1	0.79
Nasal epithelial cells	22.9	10.9	250	0.30	0.24
Tracheal epithelial cells	32.8	10.9	358	0.43	0.34
Deep lung epithelial cells	92.2	10.9	1005	1.21	0.96

[1] Micronuclei / 1000 Binucleated Cells / WLM.

[2] Micronuclei / 1000 Binucleated Cells / Gy.

THE RUSSIAN-US REGISTRIES COLLABORATION

Ronald E. Filipy

Introduction

A collaborative research program has been established between scientists of the USTUR and scientists of the Dosimetry Registry of the Mayak Industrial Association (DRMIA), operated by Branch No. 1 of the Institute of Biophysics, Ozersk, Russian Federation. Both Registries collect and analyze tissues of workers who were occupationally exposed to actinide elements while working at nuclear facilities in their respective countries.

Results from the first year of the program were discussed in the USTUR Annual Report last year (Filipy 1996). There were many similarities in the operations of the two Registries with major differences primarily in radiochemical analytical methods. Those similarities and differences were discussed in a report by Suslova et al. (1996). In the spring of last year, a proposal to extend the collaborative program was submitted to the U. S. Department of Energy Office of International Health Programs. The proposal was subsequently approved for funding as a three-year program and preparations are underway for continuation of the collaborative research.

The proposal contains 12 major tasks to be completed during the three-year period. A brief description of each of those tasks follows. Performance of most of the tasks has been an objective of the USTUR from its inception and these proposed tasks represent an extention of the work outlined in the long-range plan of the USTUR (Kathren and Russell 1995).

1. Comparison of radioanalytical methods.

This task includes intercomparisons of radiochemical analytical methods currently in use by both Registries via a series of performance evaluations with split samples from both laboratories and, ultimately, with standard reference materials prepared by the U. S. National Institute of Standards and Technology.

2. Establishment of a common database format.

It will be necessary to agree on a common database format that can be used for data of both Registries to complete the remainder of the tasks, below.

3. Standardization of tissue sampling methods.

A standardized tissue sampling protocol will be developed based, in part, on evaluation and comparison of tissue sampling methods used by the two Registries for autopsies. The evaluation will consider specific tissues and organs sampled, mass of the sample, and specific anatomic structures to be included in the sample, thus improving the capability for more exact data comparisons.

4. Coordination of radioanalytical methods.

An effort will be made to standardize analytical methods used by both laboratories with respect to ashing methods, actinide separation techniques, spectroscopy methods, and data recording. Periodic split sample intercomparisons will be conducted to verify compatibility of analytical data.

5. Characterization of workplace aerosols.

Aerosols in the workplaces at the Mayak facility will be characterized with respect to particle size distribution and in vitro solubility for the purpose of more accurately predicting their inital deposition in the lungs of workers. Records of USTUR registrants will be reviewed for the same kinds of information.

6. Lung:lymph node:systemic biokinetics.

This task involves establishment of transfer coefficients, based on the systemic:lung:lymph node activity ratios measured by both Registries, to describe the transfer of various plutonium and americium compounds from the lung to the blood. The coefficients will be compared with those used in models of the International Commission on Radiological Protection (ICRP 1994).

7. Systemic organ biokinetics.

This task will require evaluation of the relationships between actinide concentrations in individual organs of the body and total body burdens of the actinides in healthy workers as well as in those with health impairment, specifically those with liver diseases.

8. Lung and systemic biokinetics vs excretion rates.

The actinide contents of the lungs and body organs at autopsy will be related to the long-term, temporal pattern of urinary excretion and the relationship will be compared to that predicted by the ICRP (1994).

9. In-vivo counter calibrations.

The in vivo counter used by the DRMIA will be calibrated and its performance evaluated against that of similar facilities in the U. S. by exchange of phantoms to characterize its past and future sensitivity for assessing intake of actinides by Mayak workers.

10. Translation of Russian documents.

Previously classified Russian documents regarding plutonium biokinetics and dosimetry will be translated into English for publication in the open scientific literature.

11. Tissue autoradiography.

Autoradiographs will be made from tissues collected by both Registries to determine the spatial and temporal distributions of plutonium, primarily in the lungs, lymph nodes, and livers of occupationally-exposed workers.

12. Biomarker assays.

This task will involve initiation of biomarker assays on tissues of plutonium workers, including the fluorescence in-situ hybridization (FISH) assay and glycophorin A (GLA) analysis, to detect radiation-induced chromosomal translocations in periperal blood lymphocytes and erythrocytic stem cells, respectively.

Advantages

There are a number of advantages from a collaborative research effort between the USTUR and DRMIA scientists. The USTUR and the DRMIA have post mortem data from more than 350 and more than 750 deceased registrants, respectively, although specific data for the various individual cases differ in many instances, limiting comparisons. Collaboration would increase the number of cases available for study by a factor of four for already deceased registrants relative to the number of USTUR cases. In addition to enhanced statistical power for data analysis, data comparisons of the two Registries might also enable certain otherwise unrealizable goals such as dose-dependence or dose-independence of biokinetic parameters to be achieved.

Actinide deposition levels in past DRMIA cases were much higher than those of the USTUR cases; estimated actinide body burdens of USTUR cases at the time of death generally range from 40 to 300 Bq with a few cases falling outside this range. Those measured by the DRMIA range between approximately 40 Bq to 175 kBq. Combination of data from the two Registries will also result in a greater heterogeneity of the worker population; the DRMIA have data from many female workers while the USUTR database contains data from only a few females.

The proposed program has obvious direct applicability to validation and improvement of radiation protection standards for actinides and to the better understanding of the biokinetics and dosimetry of the actinides in man. The results of this research will also be in direct support of epidemiologic and radiation effects studies conducted in conjunction with this dosimetry program.

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A COMPARISON OF THE DISTRIBUTIONS OF ACTINIDE ELEMENTS IN SELECTED TISSUES AND ORGANS OF HUMANS AND BEAGLE DOGS

Ronald E. Filipy and Yong C. Ford

A number of experiments have been performed in which beagle dogs were exposed (by inhalation) or injected with actinide elements (Thompson 1989). The objectives of those experiments were to investigate the biokinetics of the actinides in mammalian systems and to evaluate their biological effects. Radiation protection standards for the actinide elements in humans were largely based on those animal experiments with the assumption that interspecies differences in uptakes and retention would be minimal. One of the stated purposes of the United States Transuranium and Uranium Registries is to make interspecies comparisons of actinide biokinetics and radiation doses between experimental animals and humans (Kathren 1989; 1994a; 1994b); that is the subject of this report.

Many of the actinide contents of human soft tissues used in this report were published previously (Filipy et al. 1994; Filipy and Kathren 1996). Tissues or organs studied included the skeleton, liver, spleen, kidneys, testes, thyroid gland, skeletal muscle, brain, and pancreas. Actinides considered were ^{241}Am, ^{238}Pu, and $^{239+240}Pu$ in humans and $^{238}PuO_2$, $^{239}PuO_2$, and $^{239}Pu(NO_3)_4$ in beagle dogs. The human skeletal actinide contents were estimated by the method discussed in the last USTUR Annual Report (Filipy 1996).

Beagle dog skeletal contents were estimated on the basis of the mean concentration in the bones analyzed from each dog. Data from beagle dog experiments, performed at Pacific Northwest Laboratories, were provided by the National Radiobiogy Archives.

Concentrations of the actinides in each individual tissue or organ were divided by the concentration in the liver of the same organism to provide tissue-to-liver concentration ratios. Tissue concentrations were related to those of the liver because the liver is a major reservoir of actinides in the body, its actinide content presumably reflects the entire systemic content relatively well, and reasonably reliable clearance rates from the human liver have been proposed (ICRP 1993). The clearance rates from the livers of the beagle dogs have been quite well characterized by the use of serial sacrifices following an acute exposure (Park et al. 1990; 1991; Dagle et al. 1996).

For each nuclide or chemical form of the nuclide in each tissue, tissue:liver ratios were determined to be log-normally distributed. A geometric mean (GM) of each set of ratios was calculated with the associated geometric standard deviation (GSD). Any values of the data set which were above or below two GSD from the GM were eliminated as statistical outliers and the GM and GSD were recalculated. The latter values (Table 7) were the main parameters used in the comparisons of human and beagle tissue concentrations. The Student's t-test for independent variables was performed to compare mean concentration ratios where differences were suspected. Logarithms of the tissue:liver concentration ratios, excluding statistical outliers, were related to the residence times (time, in years, between exposure or potential exposure and death) and the slopes of the regression lines are also included in Table 7. A t-test, performed as part of the regression, gave the probability that the slope of the regression line was not significantly different from zero.

In general, tissue actinide contents related to liver contents in the beagle dogs were very similar to those of the human cases with respect to the tissues studied. A rigorous statistical analysis of the data has not yet been performed, although t-tests with selected pairs of mean concentration ratios indicated that there were few, if any, statistical differences between concentration ratios for all nuclide forms or between species. Concentration ratios for most tissues studied ranged over three orders of magnitude, reducing statistical sensitivity.

Mean skeleton:liver concentration ratios for plutonium were essentially the same between species. The mean ratio for americium was slightly greater than the others; however, it was not statistically different from the others. Slopes of lines relating the skeleton:liver concentration ratios to residence times were positive for americium and plutonium in humans and all three were negative for plutonium in the beagle dogs. Only two of the slopes were statistically different from zero, that for $^{239+240}Pu$ in humans and that for $^{238}PuO_2$ in the beagles. Positive slopes indicated that liver clearance was more rapid than skeletal clearance, a slope of zero indicated no difference in the clearance rates from the two organs, and a negative slope indicated faster clearance from the skeleton than from the liver.

Mean testes:liver concentration ratios were essentially the same for all actinides and chemical forms in both species. The overall average geometric mean was approximately -1.5 for a numerical ratio of 0.03. According to the ICRP models (ICRP 1986), the initial uptake of the actinides by human testes is 0.035% of the systemic burden.

Using organ weights of Reference Man (ICRP 1975), this would result in a testes:liver concentration ratio of 0.04, very close to the mean ratio in this report. It is interesting that the slopes of all ratios vs residence times were positive, indicating a clearance rate slower than that for the liver. In a previous report (Filipy and Kathren 1996), a retention half-time of nearly three times that of the liver was reported and data presented in this report tend to support a longer retention time in testes than in liver. For $^{238}PuO_2$ and $^{239}Pu(NO_3)_4$ in beagles, the slopes were significantly greater than zero.

The spleen:liver concentration ratio that stands out from the rest is that for $^{239}PuO_2$ in beagle dogs although it is not statistically significantly different from the others. Mean ratios for the spleen relative to liver were generally greater than those for all the other tissues studied indicating that the actinide concentration in the spleen was second only to that of the liver. This was also noted in other reports (Filipy et al. 1994, and Filipy and Kathren 1996). Since the spleen is part of the reticuloentothelial system of the body, the accumulation was probably carried there as particulate plutonium by circulating macrophages. $^{239}PuO_2$ was the least soluble of the plutonium compounds to which the beagles were exposed and, therefore, the most likely to be carried by macrophages. The slopes of the spleen:liver ratios vs residence times were all negative although only two of them were significantly less than zero, those for $^{238}PuO_2$ and $^{239}Pu(NO_3)_4$.

The mean tissue:liver ratios for the kidneys, thyroid glands, heart, skeletal muscle, brain, and pancreas were all very similar with only a few means that stood out from the rest. The mean ratios for americium in the human heart and skeletal muscle were slightly higher than those for plutonium in either the human or beagle cases and this was noted in a previous report (Filipy and Kathren 1996). At first glance, the mean ratio for $^{239}PuO_2$ in beagle thyroids appeared higher than the rest; however, the large variance associated with the mean precluded a statistically significant difference.

In general, more of the slopes of regression lines through the beagle dog data were significantly different from zero ($p < 0.05$) than for the human data. This was attributable to the larger number of beagle cases than human cases as the variances associated with means of those data were similar to those for humans.

Mean tissue:liver concentration ratios were the parameter of choice for comparison of human and beagle tissue actinide contents for a number of reasons:

1. It was not possible to estimate tissue actinide clearance rates from individual tissues of the human subjects because of a lack of information about initial uptake and about the relative content in a given tissue at any given time after exposure.

2. Most of the slopes of regression lines relating tissue:liver concentration ratios and residence times were not statistically different from zero ($p < 0.05$) and, if they were different, the slope was very small so that the mean ratios adequately reflected the ratio at any time after exposure.

3. The life spans and residence times of the beagle dogs were considerably shorter than those for humans; residence times of the dogs were less than 15 y while there were human cases with residence times greater than 40 y.

Conclusion

For the beagle dogs, data are available for construction of individual tissue retention curves based on initial lung deposition and the data in Table 1 indicate that those curves would also be useful in modeling the biokinetics of plutonium in humans. Use of those models could result in reasonable estimates of radiation doses to all of the tissues or organs studied. More significantly, plutonium distribution and retention in the tissues of the beagle dog appear to reasonably approximate plutonium biokinetics in man, as stated by Singh and Wrenn (1989).

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Table 7. Selected parameters describing tissue:liver concentration ratios for americium and plutonium in beagle dogs and human subjects.

	Human Cases			Beagle Dog Cases		
	^{241}Am	^{238}Pu	$^{239+240}Pu$	$^{239}PuO_2$	$^{238}PuO_2$	$^{239}Pu(No_3)_4$
Skeleton:Liver Ratios[a]						
No. of Cases	74	NC[b]	137	119	136	123
Geometric Mean[c]	-0.064		-0.71	-0.99	-0.55	-0.46
GSD[d]	0.46		0.27	0.80	0.39	0.25
Slope[e]	0.006		0.006	-0.012	-0.017	-0.005
P[f]	0.29		0.028	0.50	0.019	0.29
Testes:Liver Ratios						
No. of Cases	20	9	41	59	71	52
Geometric Mean	-1.2	-1.7	-1.5	-1.5	-1.7	-1.7
GSD	0.89	0.43	0.42	1.2	0.43	0.34
Slope	0.0048	0.0043	0.010	0.038	0.015	0.017
P	0.87	0.84	0.25	0.27	0.091	0.095
Spleen:Liver Ratios						
No. of Cases	35	31	59	118	129	120
Geometric Mean	-0.88	-1.1	-1.1	-0.15	-0.80	-0.96
GSD	0.56	0.44	0.35	0.38	0.39	0.32
Slope	-0.011	-0.012	-0.0022	-0.0069	-0.019	-0.015
P	0.34	0.23	0.70	0.38	0.013	0.016
Kidney:Liver Ratios						
No. of Cases	34	18	56	124	131	120
Geometric Mean	-1.2	-2.0	-1.8	-1.8	-1.3	-1.2
GSD	0.50	0.41	0.54	1.0	0.33	0.33
Slope	-0.0022	-0.0091	-0.015	0.038	-0.021	-0.023
P	0.91	0.53	0.11	0.083	0.0010	0.0
Thyroid:Liver Ratios						
No. of Cases	17	4	32	122	125	111
Geometric Mean	-0.89	-2.0	-1.6	-0.33	-0.91	-1.0
GSD	0.64	0.48	0.70	1.30	0.51	0.37
Slope	0.014	NC	-0.010	0.019	-0.0069	0.014
P	0.48	NC	0.52	0.49	0.49	0.055
Heart:Liver Ratios						
No. of Cases	6	6	13	41	43	24
Geometric Mean	-1.1	-2.0	-1.8	-1.7	-1.8	-2.0
GSD	0.46	0.45	0.42	1.1	0.58	0.20
Slope	-0.014	0.0004	-0.0009	0.11	-0.13	-0.027
P	0.61	0.99	0.95	0.15	0.0	0.15

Table 7 (continued). Selected parameters describing tissue:liver concentration ratios for americium and plutonium in beagle dogs and human subjects.

	Human Cases			Beagle Dog Cases		
	^{241}Am	^{238}Pu	$^{239+240}Pu$	$^{239}PuO_2$	$^{238}PuO_2$	$^{239}Pu(No_3)_4$
Skeletal Muscle:Liver Ratios						
No. of Cases	7	5	12	122	130	120
Geometric Mean	-1.2	-2.0	-1.9	-2.0	-2.2	-2.2
GSD	0.57	0.62	0.35	0.95	0.37	0.36
Slope	0.034	0.028	0.0	-0.028	0.0030	0.021
P	0.24	0.55	0.99	0.16	0.65	0.0020
Brain:Liver Ratios						
No. of Cases	9	NC	11	112	120	121
Geometric Mean	-1.7		-1.7	-2.1	-2.5	-2.3
GSD	0.80		0.68	1.4	0.48	0.35
Slope	-0.038		-0.024	0.10	0.023	0.0061
P	0.13		0.14	0.010	0.041	0.40
Pancreas:Liver Ratios						
No. of Cases	5	NC	6	120	129	107
Geometric Mean	-1.3		-1.8	-0.79	-1.7	-2.0
GSD	0.74		0.64	1.0	0.62	0.31
Slope	0.0009		-0.0030	-0.059	-0.057	-0.0091
P	0.97		0.83	0.005	0.0	0.14

[a]Skeleton-to-liver concentration ratios for humans include data from Russian cases (Filipy 1996).
[b]Not calculated because of insufficient data.
[c] Geometric mean of logarithms of tissue-to-liver concentration ratios.
[d]Geometric standard deviation of the mean concentration ratios
[e]Slope of the regression line relating the logarithms of concentration ratios to residence times (time between exposure and death).
[f]Probability that the slope of the regression line was not significantly different from zero.

CAUSES OF DEATH IN USTUR REGISTRANTS

Baruch Gold and Ronald L. Kathren

Since its inception in 1968, the USTUR has acquired data on more than 300 deceased individuals with known or possible intakes of the actinide elements. This cohort includes a group of about 50 British cases and a smaller group of Los Alamos cases that predated the establishment of the Registries; the remaining 260 cases were individuals who had enrolled in the USTUR. Although this cohort of 260 cases is small and biased because it is self selected and includes registrants who enrolled after having being diagnosed with terminal cancer, it was nonetheless considered important to determine and evaluate the causes of death in the deceased registrant population to see if there were any obvious anomalies with respect to cause of death, recognizing that because of the inherent bias in the cohort, only very general and inferential conclusions might be drawn from the data.

The causes of death of 260 deceased registrants who had enrolled in the USTUR were examined. The group was homogeneous in that it was essentially all male, and thought to be all Caucasian, and reasonably uniform with respect to socioeconomic status and lifestyle. From available data in the USTUR data base, it was possible to establish the cause of death with virtual certainty in 244 of the 260 cases (94%). The availability of autopsy reports and death certificates for this cohort is shown in Table 8; in addition virtually all had partial medical records or letters. The cause of death for each individual deceased registrant was determined by direct examination of the available records in each deceased registrant's file by an experienced physician (BG) with specific expertise in occupational and nuclear medicine and coded according to the ICD-9 system.

Although neither autopsy results nor death certificates were available for 24 cases, it was possible to establish the cause of death for 16 of these cases through other medical records in the file. Because of the biased nature of the deceased Registries cohort, no calculation of standard mortality ratios (SMRs) or similar quantitative analysis was performed.

Both death certificates and autopsy reports were available for nearly half of the registrants (127) in the cohort, so it was possible to evaluate the correlation between the causes of death recorded on the death certificate with those determined from autopsy. Each of the

127 cases was scored as E (Established) when there was a good or complete match between the autopsy report and the death certificate; L when the correlation between the two was low, and N when there was no correlation. The results showed an unexpected and surprisingly good correlation; 113 of the subcohort of 127 cases (89%) were scored as E, 7 (5.5 %) as L and only 6 (4.7%) cases as N. In one case, the cause of death was omitted from the death certificate. The very high correlation between the autopsy diagnosis and the death certificate is this cohort is clearly different from the general population and may be an artifact, explainable at least in part by the fact that the attending physicians were by and large aware that the deceased was a former nuclear worker and a participant in a research study which involved an autopsy determination of the cause of death. Hence the attending physicians may have given these cases special consideration such as additional consultations with specialist colleague, or even delayed completion of the death certificate until the results of the autopsy were made known to them. The implications of this observation for the conduct of epidemiologic investigations is obvious.

Mean age at death for the 260 registrants was 62.05 years. The mean age at death for those dying from cancer was not appreciably different from those dying from heart disease, 63.05 years as compared with 64.12 years. It should be borne in mind that these 260 cases represent the first one-third or so of the total Registries cohort to die, and that the age distribution among the remaining living cohort is heavily skewed towards persons now in their 70's and 80's; well over half of the active living registrants are $\geq$ 70 years of age, and about one in seven is older than 80. Thus, when the entire Registries cohort has died, the mean age at death is projected to be at least a decade greater than in this first group of 260.

Specific causes of death among the cohort of 260 are tabulated in Table 9. Again, it should be stressed that the USTUR cohort is a self selected group of voluntary tissue donors who typically enroll in the program in advance of death sometimes after having been given a diagnosis of cancer. Thus it is understandable and expected that there will be a higher incidence of cancer in this small cohort. Another important source of bias relates to the cohort itself; as these individuals were essentially all workers at various nuclear sites, they would expectedly exhibit the healthy worker effect. Moreover, the deceased registrants do not represent the entire USTUR cohort, which includes another approximately 440 living registrants. A preliminary review of the age distribution of the living cohort suggests that the median life span for the entire registrant cohort as a group is significantly greater than for the population as a whole, which in part may be reflective of the healthy worker effect. Thus, although some general conclusions can be made from the data, because of the biased nature of the cohort, statistical comparison of causes of death in this cohort with the general population, or indeed with any other group is clearly inappropriate.

Incidental findings in the 206 cases with autopsy reports included 5 prostate carcinomas, 2 each bladder, colon and lung carcinoma, and seminoma, and one each chromocytoma, kidney cancer, and papillary cancer of the thyroid. There were three benign adrenal adenomas and a single benign thyroid adenoma, along with one liver cirrhosis and one observation of thyroiditis.

In reviewing the causes of death among the cohort of 260 deceased registrants as presented in Table 9, perhaps the most remarkable observation is that it is largely unremarkable. Possibly other than brain tumors, which are discussed below, there are no grossly elevated causes of death. Accidental death and suicides appear somewhat elevated relative to what would be expected from the general population, but not significantly so. Leukemias, considered by many to be the malignacies most easily induced by exposure to ionizing radiation, are not significantly different than what would be expected in the general population.

There are, however, four groups of cancers that merit further attention because of their known or suspected association with exposure to ionizing radiation and especially, plutonium and americium: lung carcinomas (28 cases), mesothelioma (6 cases), brain tumors (7 cases) and bone cancer (1 case). The lung cancer cancer deaths, not unexpectedly, essentially all occurred in smokers, and this number, 28 of 87 cancer deaths (32 %) is not appreciably different from the fraction of lung cancer deaths in the general population. Although smoking data are not available for the entire cohort, those data that are available suggest that the percentage of heavy smokers among the cohort was at least 60%. As the 260 cases in this cohort were largely males with opportunity for exposure to plutonium, and indeed were found to have small lung depositions of plutonium in their lungs in a number of instances, the data thus suggest that there is no significant potentiation between smoking and low level inhalation exposure to plutonium.

Pleural mesothelioma is a well recognized disease associated with asbestos exposure, and beryllium. It is not known how many of the cohort generally or the mesothelioma cases specifically worked with or were exposed to these materials. However, six cases is somewhat greater than might be expected within a cohort of this size from the general population, and, although not necessarily significant, it therefore might be well to consider this in future observations. Despite the linkage of plutonium and americium exposure in experimental animals with osteosarcomas, albeit at much higher doses than experienced by this cohort, only a single case of osteosarcoma was observed. This is well within the expected range for a normal or general population of this size.

The seven deaths from brain tumors observed in the USTUR cohort are clearly suspiciously greater than might be expected, even from a biased and self-selected sampling of actinide workers. This cause of death merits specific examination in view of the study of Wilkinson et al. (1987) in Rocky Flats workers which might be considered suggestive of an association between plutonium exposure and brain tumors.

Six of the seven brain tumors in the Registries cohort were astrocytomas (glioblastoma multiformae). In one case, diagnosis was equivocal, and the primary tumor site may have been kidney. Histopathology slides are, unfortunately, not available for this case. All six cases were former Rocky Flats workers. This in itself appears significant inasmuch as most of those in the cohort - about three-fifths - were workers from other DOE sites. There appeared to be no relationship between plutonium or other actinide deposition and astrocytomas, nor between external exposure and astrocytomas. Similarly, no other common occupation factor other than employment at Rocky Flats was apparent.

The lack of brain tumors among workers from other sites lends support to the hypothesis that the excess in brain tumors among Rocky Flats workers observed by Wilkinson and his colleagues (1987) is not attributable to exposure to plutonium or other actinides *per se* or to external radiation but rather may be attributable to a factor unique to Rocky Flats. In fact, the six cases in the Registries cohort may overlap the cases studied by Wilkinson. Futher study of these cases is in progress.

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Table 8. Autopsy and Death Certificate Availability in USTUR Deceased Cohort

Type of Data in File	Number of Cases
Autopsy report	206
Death certificate	154
Both	127
Neither	24

Table 9. Causes of Death Among USTUR Registrants

Cause of Death	ICD-9-CM	Number
All Causes		244
All Cancers	150-205	87
Esophagus	150	2
Stomach	151	4
Colon	153	4
Rectum	154	3
Liver	155	4
Pancreas	157	3
Respiratory Tract	160-163	36
Larnyx	161	2
Lung	162	28
Mesothelioma	163	6
Bone	170	1
Melanoma	172-173	4

Table 9 (Continued). Causes of Death Among USTUR Registrants

Cause of Death	ICD-9-CM	Number
Prostate	185	7
Bladder	188	2
Kidney	189	4
Brain/CNS	191-192	7
Lymphopoietic and Hematopoietic	200-209	6
Lymphoma	202	2
Multiple myeloma	203	1
Leukemia	204-207	3 (1 CLL)
Blood forming organs	280-289	1
Neurological	290-335	7
Arteriosclerotic Heart Disease	414	80
Other Circulatory	414	2
Pulmonary embolism	415	4
Myocarditis	420	1
Cardiomyopathy	425-429	9
Diffuse arteriosclerosis	433	1
CVA	436	8
Vascular diseases	441-452	3
Pneumonia	486	5
COPD	496	10
Intestinal	557	1

Table 9 (Continued). Causes of Death Among USTUR Registrants

Cause of Death	ICD-9-CM	Number
Liver disease	571-573	4
Aspiration	934	1
Sepsis	38	2
Accidents	923-928	11
Car/Road		7
Suicide	958	7

URANIUM IN THE TISSUES OF TWO WHOLE BODY DONATIONS TO THE USTUR

Ronald L. Kathren

Knowledge of the uranium distribution in the tissues of the whole body is essential to full understanding the biokinetics and to the development of sound and accurate biokinetic models for protection purposes. Despite a long history of human involvement with uranium, and numerous biological studies that began with work of Gmelin early in the nineteenth century, the biokinetics of uranium are not fully understood, nor has the distribution of uranium in the tissues been well established. Current biokinetic models and parameters have largely been derived from animal studies augmented by follow-up of acidental exposures or observations of worker populations.

There have been a number of studies in which the uranium content of specific tissues from a number of individuals was measured postmortem. The usual practice is for an investigator to obtain a number of samples of a specific tissue (e.g. liver) from a given location and analyze these for their uranium content. From these several studies, Reference Man data for environmental or endogenous uranium in tissues have been derived. However, no studies in which the uranium content of all the tissues from a single individual was measured are known to have been performed. Thus the relative deposition of uranium in the various tissues and organs has never been determined for a single individual. The importance of this is underscored by the fact that the organ ratios for uranium content given in the Reference Man publication differ from empirical studies in which several tissues were analyzed at autopsy (ICRP 1975; Fisenne and Welford 1986; Kathren et al. 1989).

Two whole body donations to the USTUR, Cases 0213 and 0242, were selected for analysis for uranium. Both cases have been described in detail in an earlier publication of the USTUR (Kathren et al. 1994). USTUR Case 0213 was a 68 year male who died of lung carcinoma in 1984. He had a history of 20 pack-years of cigarette smoking, and had incurred a number of acute accidental inhalation exposures to plutonium during the early years of his employment (1945-57), but had no known occupational exposure to uranium. USTUR Case 0242 was a 78 year old male who died from coronary artery disease in 1987. He was a nonsmoker who had suffered acute exposure to airborne plutonium and one skin contamination 35-40 years prior to death. He had no known occupational exposure to uranium. Both cases were long time residents of the Los Alamos, NM, region, and, as neither had a history of occupational exposure to uranium, are likely to be representive of the general population in the region with respect to their intake of uranium.

Tissues were prepared for radiochemical analysis for plutonium as described elsewhere by McInroy and coworkers (1985). Aliquots of the solutions thus prepared were taken and analyzed for uranium by kinetic phosphorescence analysis (KPA) according to the method described by Bushaw (1984). Analyses were carried out by Edward Gonzales at Los Alamos National Laboratory, and the results shown in Tables 10 and 11.

Preliminary review of the data in Tables 10 and 11 indicates, not unexpectedly, that the skeleton is the primary depot of uranium. For Cases 0213 and 0242, mean concentrations of uranium in the bone were 4.8 and 5.8 ng/g wet weight, in close agreement with the Reference Man value of 5.9 ng/g. There was, however, considerable variation in concentration among the individual bones, and no indication that concentration was inversely proportional to bone ash fraction as has been observed for plutonium and americium (Kathren, McInroy and Swint 1987). Somewhat surprisingly, uranium was well distributed among the soft tissues as a whole, and concentrations among the tissues were quite variable (Figure 3). The largest concentrations were found in the tracheobronchial and other pulmonary related lymph nodes, indicative of uranium bearing particulate clearance from the lungs. Case 0242 showed an unexpectedly elevated concentration of uranium in the thyroid for which there was no obvious cause or explanation. Concentrations in liver were lower than for most soft tissues. The amounts of uranium in liver were less than those in kidney, and thus more consistent with Reference Man data rather than the observations of Fisenne and Welford (1985) in New York City residents and in a single occupationally exposed USTUR case (Kathren et al. 1989).

Acknowledgments

Radiochemical analyses were performed by Edward Gonzales at Los Alamos National Laboratory, and his contribution to this work is gratefully acknowledged. WSU graduate student Elaine Marshall assisted with the organization and collation of the data and will carry out a more complete analysis of the data as part of the requirements for the degree of Master of Science in Environmental Science and Regional Planning and for future publication in the peer reviewed scientific literature. Richard E. Toohey and James F. McInroy also provided helpful comments.

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Figure 3. Uranium Concentrations in the Soft Tissues of USTUR Cases 0213 and 0242 and Reference Man

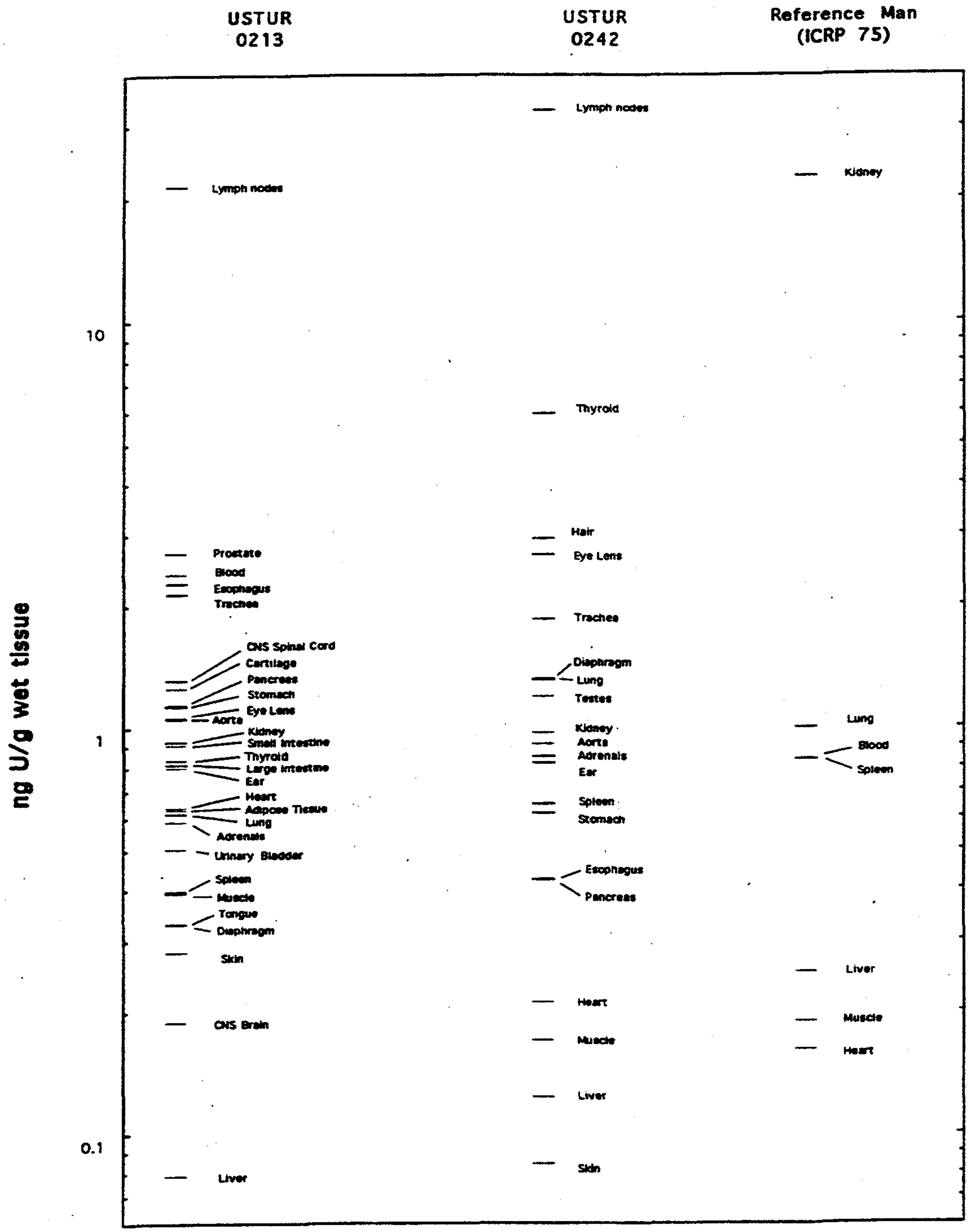

Table 10. Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Soft Tissues						
Adrenal R	16.4	0.1	27.4	1.60	1.67	342.25
Adrenal L	27.3	0.1	13.4	0.80	0.49	148.89
Aortic arch	45.3	1.0	47.6	2.00	1.05	48.55
Bladder	75.0	0.7	37.8	1.75	0.50	58.19
Blood	232.6	-----	557.6	18.00	2.40	-------
Cerebellum	126.0	2.1	71.0	4.00	0.56	33.79
Cerebrum	955.7	13.1	133.4	11.00	0.14	10.22
Costal cart R	187.9	4.6	235.2	8.80	1.25	51.47
Diaphram R	184.0	1.6	78.2	4.00	0.43	48.00
Diaphram L	217.9	1.8	66.5	2.40	0.31	36.96
Ear R	25.4	0.3	23.1	1.80	0.91	70.06
Ear L	23.8	0.3	16.7	1.60	0.70	57.59
Esophagus	41.3	0.7	94.3	6.00	2.28	140.78
Eyes	15.6	0.2	16.6	1.40	1.06	103.75
Fat - mesenteric	36.7	0.2	17.6	1.00	0.48	103.53
Fat - stomach	66.8	0.2	54.0	2.00	0.81	234.61
Heart	318.3	3.2	202.9	6.00	0.64	62.82
Intestine - small	929.0	7.9	841.5	26.00	0.91	105.98
Intestine - large	827.0	5.0	674.0	21.00	0.82	134.00
Kidney L	364.3	1.8	322.9	9.20	0.89	183.48
Kidney R	305.6	2.3	303.6	10.50	1.00	133.74
Liver	2604.0	28.8	205.5	21.00	0.08	7.13
Lung R	867.0	8.6	443.5	15.00	0.51	51.39
Lung L	643.0	6.8	572.3	18.00	0.89	84.53
Meninges	31.4	0.6	39.0	2.00	1.24	61.84
Pancreas	170.9	0.9	194.4	12.80	1.14	226.09
Penis	47.8	0.6	61.6	3.60	1.29	100.98
Prostate	20.4	0.3	55.3	2.40	2.71	172.75
Salivary glands	14.5	0.1	17.3	1.00	1.19	123.43
Scrotum	147.3	1.1	42.2	3.20	0.29	39.77
Spinal cord	29.4	0.4	41.8	2.40	1.42	116.11
Spleen	236.3	3.2	94.1	4.50	0.40	29.39

Table 10. Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Stomach	226.2	1.8	218.0	10.50	0.96	124.57
Stomach scraps	77.6	1.1	107.1	4.40	1.38	98.28
Thyroid	23.7	0.3	19.7	1.40	0.83	65.80
Tongue	114.4	1.3	38.0	3.00	0.33	30.38
Trachea	128.3	4.2	279.4	9.00	2.18	66.37
Trachea scraps	48.7	-----	102.9	3.75	2.11	-------
LN - TB1	3.6	-----	89.0	3.50	24.72	-------
LN - TB2	2.2	-----	62.5	2.75	28.40	-------
LN - TB3	5.0	-----	84.7	3.75	16.94	-------
Muscle head	564.4	6.7	423.6	14.40	0.75	63.41
Muscle R upper arm	868.6	8.5	407.8	12.00	0.47	48.08
Muscle R forearm	575.3	5.8	305.6	8.80	0.53	52.42
Muscle R hand	184.7	1.3	134.0	6.40	0.73	103.08
Muscle L upper arm	763.0	7.5	567.5	12.50	0.74	75.67
Muscle L forearm	529.2	5.3	615.5	16.00	1.16	116.58
Muscle L hand	164.8	1.8	218.3	6.00	1.33	119.30
Muscle R front 1	405.5	4.4	126.2	6.40	0.31	29.00
Muscle R front 2	1084.2	10.3	151.6	8.00	0.14	14.75
Muscle R front 4	164.5	1.4	131.0	5.60	0.80	92.23
Muscle L front 1	528.3	4.5	380.4	12.00	0.72	84.91
Muscle L front 2	370.2	2.9	241.2	6.00	0.65	83.76
Muscle L front 3	343.3	3.4	233.7	8.00	0.68	69.55
Muscle L front 4	416.6	5.4	354.0	9.20	0.85	65.31
Muscle R back 1	722.3	6.7	540.4	14.40	0.75	80.42
Muscle R back 2	562.9	9.9	558.5	12.00	0.99	56.41
Muscle R back 3	617.8	6.9	347.2	8.80	0.56	50.18
Muscle L back 1	543.0	5.0	394.1	12.40	0.73	79.46
Muscle L back 2	326.7	3.7	385.3	9.50	1.18	105.55
Muscle L back 3	704.9	7.1	471.1	13.50	0.67	66.82
Muscle L back 4	1632.1	13.9	484.8	10.80	0.30	34.93
Muscle R thigh 1	2094.5	20.8	445.0	12.50	0.21	21.39
Muscle R thigh 2	1773.1	17.3	590.4	16.80	0.33	34.11
Muscle L thigh 1	1262.5	11.8	320.6	9.60	0.25	27.27
Muscle L thigh 2	1526.8	13.3	456.2	13.50	0.30	34.30
Muscle R calf 1	1034.2	5.5	356.4	9.50	0.35	65.16
Muscle R calf 2	1145.5	7.9	554.0	15.00	0.48	70.22
Muscle L calf 1	470.1	3.9	242.4	7.20	0.52	61.85

Table 10: Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Muscle L calf 2	635.0	6.0	278.4	7.20	0.44	46.10
Muscle R foot	363.1	3.5	341.1	9.00	0.94	98.58
Muscle L foot	303.4	2.1	749.2	12.80	2.47	353.40
Muscle R leg Scraps	36.9	0.6	76.8	2.80	2.08	128.07
Skin head	811.8	6.4	191.1	5.60	0.24	29.77
Skin R upper arm	299.5	1.2	132.6	9.60	0.44	106.97
Skin R forearm	187.6	1.1	124.8	4.00	0.67	115.56
Skin R hand	163.5	1.3	108.6	3.60	0.66	83.54
Skin L upper arm L	370.6	1.9	157.3	4.50	0.42	83.66
Skin L forearm	165.8	1.4	95.2	2.80	0.57	70.49
Skin L hand	173.0	1.4	654.8	32.80	3.79	467.71
Skin L front 1	316.9	0.9	-----	-----	-----	-----
Skin L front 2	308.4	1.7	362.3	8.50	1.18	213.09
Skin L front 3	423.0	1.5	308.5	8.00	0.73	205.63
Skin R front 2	363.6	1.2	413.5	12.00	1.14	333.48
Skin R front 3	254.8	1.3	97.3	5.60	0.38	76.00
Skin L back 1	1633.0	8.7	140.3	7.50	0.09	16.13
Skin L back 2	463.0	2.5	117.8	4.80	0.25	46.73
Skin R back 2	492.1	3.0	237.1	7.20	0.48	78.26
Skin R back 3	2149.0	11.9	493.5	12.80	0.23	41.65
Skin R back 4	558.0	3.6	332.7	8.80	0.60	91.91
Skin L thigh 1	858.0	5.9	231.7	8.00	0.27	39.40
Skin L thigh 2	912.7	3.6	440.8	12.40	0.48	122.44
Skin L calf 1	355.2	2.6	118.3	4.00	0.33	46.22
Skin L calf 2	205.0	1.3	179.8	5.20	0.88	138.34
Skin R foot	247.7	2.1	195.0	5.50	0.79	92.39
Skin L foot	283.6	2.6	479.2	11.20	1.69	184.31
Bones						
Capitate	6.4	1.8	50.6	2.00	7.92	27.62
Clav acromion R	12.7	3.3	53.3	1.80	4.19	16.14
Clav shaft R	13.9	6.1	111.7	3.60	8.04	18.28
Coccyx	6.2	0.7	48.6	1.80	7.84	70.43
Fibula DE	15.9	4.4	102.0	3.60	6.44	23.30
Fibula DS	35.4	16.4	168.9	6.50	4.78	10.29
Fibula PE	21.5	4.0	111.4	4.00	5.19	28.14
Fibula PS	31.9	17.1	166.1	5.50	5.21	9.70
Hamate	5.3	1.4	30.0	1.20	5.68	21.13

Table 10. Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Hand phalynx d1	1.7	0.4	177.7	1.40	102.71	423.05
Hand phalynx d2	0.8	0.2	10.9	0.60	13.61	45.38
Hand phalynx d3	1.2	0.3	48.3	1.60	39.62	161.13
Hand phalynx d4	1.0	0.3	10.8	0.60	10.58	38.54
Hand phalynx d5	0.7	0.2	160.3	1.20	222.67	843.79
Hand phalynx m2	2.5	0.9	25.4	0.90	10.12	28.54
Hand phalynx m4	2.7	1.1	13.7	0.70	5.07	13.08
Hand phalynx m5	1.4	0.5	14.4	0.70	10.69	28.86
Hand phalynx p1	4.2	1.1	45.0	1.80	10.63	40.91
Hand phalynx p2	6.0	1.9	33.0	1.40	5.51	17.01
Hand phalynx p3	7.4	2.9	51.2	3.00	6.88	17.60
Hand phalynx p4	5.8	2.0	21.6	1.40	3.73	11.04
Hand phalynx p5	3.2	1.2	22.4	1.20	7.09	19.31
Hand sesamoid	0.1	0.1	20.2	1.20	202.20	288.86
Humerus DE	50.9	19.4	176.5	5.50	3.47	9.09
Humerus DS	51.7	29.1	209.6	6.00	4.05	7.20
Humerus PS	77.7	34.3	448.5	12.50	5.77	13.07
Humerus, PE	76.8	14.9	190.8	5.60	2.48	12.82
Iliac body	168.6	41.9	402.0	20.00	2.38	9.61
Iliac crest	50.1	10.8	110.5	4.50	2.21	10.27
Ischium	242.0	57.3	939.0	26.00	3.88	16.38
Lunate	3.4	0.9	54.0	1.80	15.70	59.34
Mandible w/o teeth R	42.9	21.8	149.9	12.50	3.49	6.87
Maxilla w/o teeth	43.8	15.9	245.5	52.50	5.61	15.49
Metacarpal 1	9.2	2.6	41.5	1.75	4.53	16.09
Metacarpal 2	13.0	4.1	53.0	2.40	4.07	12.83
Metacarpal 3	13.4	4.4	47.8	1.80	3.58	10.84
Metacarpal 4	6.6	3.9	46.4	1.80	7.07	11.90
Metacarpal 5	7.7	2.4	65.5	37.50	8.55	27.52
Patella R	37.0	10.1	173.7	5.60	4.70	17.15
Pisiform	2.0	0.4	21.4	2.00	10.49	53.50
Radius DE	18.6	4.7	83.8	2.60	4.51	18.02
Radius DS	25.9	13.8	113.2	4.00	4.37	8.23
Radius PS	22.4	11.9	105.6	4.80	4.71	8.88
Radius, PE	7.4	2.4	38.8	2.00	5.27	16.01
Rib 1 R	17.9	5.3	77.1	3.50	4.31	14.48
Rib 2 R	13.7	3.4	51.1	2.50	3.74	14.99

Table 10. Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Rib 3 R	22.9	5.1	106.8	4.00	4.66	21.11
Rib 4 R	30.2	7.6	108.0	6.00	3.57	14.17
Rib 5 R	31.0	5.2	78.5	5.00	2.53	15.09
Rib 6 R	29.6	8.6	74.4	3.25	2.51	8.70
Rib 7 R	32.8	9.4	178.2	7.00	5.44	18.88
Rib 8 R	30.5	8.8	106.3	4.00	3.48	12.12
Rib 9 R	19.9	6.4	120.1	4.80	6.04	18.71
Rib 10 R	21.9	5.5	62.3	3.60	2.84	11.32
Rib 11 R	15.1	5.7	87.6	3.60	5.80	15.51
sacrum	165.6	30.0	280.0	12.00	1.69	9.32
Scaphoid	5.8	1.6	38.5	1.75	6.67	23.48
Scapula DE R	38.5	11.9	160.7	6.40	4.17	13.56
Scapula PE R	16.9	5.2	75.7	4.50	4.48	14.66
Scapula Spine R	86.5	29.5	214.3	9.00	2.48	7.27
Skull frontal 1	43.8	25.4	127.0	5.50	2.90	5.00
Skull frontal 2	16.9	10.8	76.7	4.50	4.54	7.09
Skull frontal 3	20.9	11.2	78.4	4.00	3.76	6.98
Skull occipital	23.6	12.2	82.5	4.50	3.49	6.74
Skull parietal 1	44.5	23.6	152.6	5.60	3.43	6.47
Skull parietal 2	70.2	40.5	464.8	14.50	6.62	11.48
Skull temporal 1	32.8	19.4	91.6	4.80	2.79	4.72
Skull temporal 2	36.4	14.6	75.4	4.50	2.07	5.18
Skull temporal 3	50.9	15.7	139.0	5.60	2.73	8.86
Sternum	131.4	17.7	208.8	8.00	1.59	11.80
Tibia DE	71.1	20.1	192.0	6.50	2.70	9.58
Tibia DS	98.8	49.2	376.1	11.20	3.81	7.65
Tibia PE	184.5	42.0	-----	-----	-----	-----
Tibia PS	130.1	68.6	344.7	15.20	2.65	5.03
Trapezium	2.4	0.6	25.8	1.00	10.75	40.95
Triangular	2.6	0.7	20.8	1.40	8.09	31.52
Ulna DS	21.2	10.9	160.0	5.60	7.55	14.64
Ulna PS	24.9	13.7	138.8	4.00	5.57	10.16
Vert-C1 atlas	25.8	6.9	116.5	6.00	4.51	16.84
Vert-C3 arch	9.9	3.4	103.0	4.00	10.38	30.29
Vert-C3 body	4.9	1.7	41.6	2.00	8.46	23.91
Vert-C4 arch	9.1	3.8	43.3	2.00	4.76	11.38
Vert-C4 body	9.6	3.4	47.8	2.00	4.97	14.17

Table 10. Uranium in Tissues of USTUR Case 0213

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Vert-C5 arch	7.9	3.9	51.0	2.00	6.46	13.08
Vert-C5 body	16.3	5.7	63.5	2.50	3.90	11.18
Vert-C7 arch	15.9	4.4	95.0	4.00	5.99	21.69
Vert-C7 body	13.9	3.5	34.8	1.80	2.50	9.94
Vert-L1 arch	24.3	6.2	93.0	4.50	3.83	14.95
Vert-L3 arch	29.5	7.7	109.0	6.50	3.70	14.17
Vert-L3 body	71.7	11.5	164.0	6.00	2.29	14.32
Vert-L5 arch	35.1	10.3	204.5	7.50	5.83	19.78
Vert-L5 body	51.8	9.9	41.8	3.50	0.81	4.22
Vert-T1 arch	20.1	5.9	70.5	2.75	3.51	11.91
Vert-T1 body	14.7	3.4	50.3	2.25	3.41	14.91
Vert-T3 arch	16.8	4.0	57.0	2.50	3.39	14.11
Vert-T5 arch	17.6	4.2	52.5	3.00	2.98	12.65
Vert-T5 body	20.2	4.4	66.8	2.50	3.30	15.31
Vert-T7 arch	15.3	4.0	73.5	4.00	4.79	18.42
Vert-T7 body	23.2	4.0	112.0	4.50	4.83	28.35
Vert-T9 arch	18.3	4.7	102.0	4.00	5.58	21.52
Vert-T9 body	32.3	5.4	57.5	2.50	1.78	10.65
Vert-T11 arch	17.7	4.6	82.0	3.60	4.63	17.67
	48443.2	1438.7	35820.1			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Soft Tissues						
Abdominal fluid	198.3	2.0	40.0	2.00	0.20	19.70
Adrenal R	21.0	0.1	10.0	1.20	0.48	90.91
Adrenal L	18.0	0.1	35.8	1.80	1.99	397.78
Aortic arch	41.6	1.5	22.8	1.60	0.55	14.90
Aorta -descending	51.1	0.3	56.8	2.40	1.11	218.46
Aorta -ascending	22.4	2.3	74.0	2.80	3.30	32.17
Cart - cricoid	45.3	2.1	36.4	2.40	0.80	17.50
Diaphram	60.0	0.8	79.2	3.20	1.32	99.00
Ear R	25.8	0.3	35.8	1.80	1.39	127.86
Ear L	28.8	0.3	14.0	1.50	0.49	41.18
Epidura	18.7	0.3	32.4	1.40	1.73	104.52
Esophagus	48.9	0.04	20.8	2.00	0.43	520.00
Eye R	6.7	0.1	13.0	0.80	1.94	216.67
Eye L	7.3	0.02	29.8	1.20	4.08	1490.00
Hair	12.7	------	37.2	2.00	2.93	------
Heart	541.0	4.8	114.0	5.50	0.21	23.65
Kidney R	150.6	1.4	146.0	5.00	0.97	104.29
Kidney L	161.0	1.5	------	------	------	------
Liver	1620.0	19.1	200.0	32.00	0.12	10.47
Lung R	753.1	6.1	928.0	21.60	1.23	152.63
Lung L	588.6	7.8	848.0	21.60	1.44	109.28
Omentum	1973.9	0.1	349.0	8.50	0.18	3877.78
Pancreas	117.2	0.8	49.5	4.00	0.42	60.37
Peritesticular scraps	225.0	3.2	132.0	4.80	0.59	41.90
Spleen	204.9	2.7	132.8	5.60	0.65	50.11
Stomach	198.8	1.4	122.4	4.00	0.62	86.81
LN thorac	0.6	------	155.6	20.00	259.33	------
LN mediast	5.7	------	169.6	5.40	29.72	------
LN-TB	5.1	------	188.0	5.50	36.86	------
Lacrimal gland	24.6	0.1	31.0	1.20	1.26	221.43
Testicle L	11.7	0.1	27.6	1.40	2.36	212.31
Testicle R	11.8	0.1	16.2	1.20	1.37	124.62
Thyroid	3.3	0.04	19.6	1.20	5.94	490.00
Trachea	21.5	0.8	80.0	3.60	3.72	103.90
Trachea-scrp 1	28.0	0.5	68.0	1.80	2.43	141.67

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Trachea scrp 2	48.1	0.4	33.8	1.50	0.70	82.44
Skin-up arm R	918.6	------	124.0	10.30	0.14	------
Skin-hand R	157.9	------	68.4	8.00	0.43	------
Skin-forearm R	371.0	------	------	------	------	------
Skin-hand L	157.5	------	79.2	5.00	0.50	------
Skin R front 1	337.9	------	88.3	10.00	0.26	------
Skin R front 2	86.2	------	49.4	15.00	0.57	------
Skin R front 3	185.8	------	55.4	10.00	0.30	------
Skin R front 4	201.5	------	51.6	10.00	0.26	------
Skin L front 1	998.4	------	134.0	24.00	0.13	------
Skin L front 2	754.8	------	------	------	------	------
Skin L front 3	1498.0	------	1967.0	80.00	1.31	------
Skin L front 4	1508.9	------	------	------	------	------
Skin R back 1	318.0	------	46.5	5.00	0.15	------
Skin R back 2	218.9	------	------	------	------	------
Skin R back 3	212.0	------	------	------	------	------
Skin R back 4	234.2	------	------	------	------	------
Skin L back 1	513.1	------	------	------	------	------
Skin L back 2	182.7	------	------	------	------	------
Skin L back 3	457.9	------	627.4	48.00	1.37	------
Skin L back 4	717.7	------	------	------	------	------
Skin R thigh 1	1757.0	------	141.6	10.00	0.08	------
Skin R thigh 2	1110.5	------	181.6	10.20	0.16	------
Skin R calf 1	601.2	------	85.4	16.00	0.14	------
Skin R calf 2	258.6	------	165.9	32.00	0.64	------
Skin R foot	232.6	------	92.9	25.00	0.40	------
Skin L thigh 1	1246.8	------	95.0	8.00	0.08	------
Skin L thigh 2	1656.0	------	------	------	------	------
Skin L calf 1	555.8	------	39.2	16.00	0.07	------
Skin L calf 2	339.8	------	119.4	20.00	0.35	------
Skin L foot	236.0	------	168.7	16.00	0.71	------
Skin head	723.0	------	150.7	8.00	0.21	------
Skin R forearm	319.8	------	203.4	9.60	0.64	------
Skin l upper arm	887.5	------	141.0	6.40	0.16	------
Muscle head	432.1	------	178.0	11.00	0.41	------
Muscle R upper arm	1290.7	------	194.3	8.00	0.15	------

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Muscle R forearm	682.5	------	132.2	6.40	0.19	------
Muscle R hand	160.2	------	59.1	2.80	0.37	------
Muscle L upper arm	1283.0	------	131.4	8.00	0.10	------
Muscle L forearm	510.4	------	76.7	2.80	0.15	------
Muscle L hand	145.0	------	84.3	3.50	0.58	------
Muscle R front 1	1325.5	------	109.4	49.00	0.08	------
Muscle R front 2	330.9	------	127.4	5.60	0.39	------
Muscle R front 3	1258.2	------	186.9	15.00	0.15	------
Muscle R front 4	1482.0	------	205.9	10.00	0.14	------
Muscle L front 1	805.0	------	86.7	4.40	0.11	------
Muscle L front 2	437.2	------	111.2	6.40	0.25	------
Muscle L front 3	1033.0	------	172.3	10.00	0.17	------
Muscle L front 4	777.0	------	287.6	11.20	0.37	------
Muscle R back 1	1563.0	------	158.8	6.50	0.10	------
Muscle R back 2	620.5	------	155.1	7.20	0.25	------
Muscle R back 3	1393.1	------	135.4	5.60	0.10	------
Muscle R back 4	1717.0	------	534.1	26.40	0.31	------
Muscle L back 1	925.7	------	178.0	11.00	0.19	------
Muscle L back 2	195.1	------	60.6	3.00	0.31	------
Muscle L back 3	503.6	------	143.1	8.00	0.28	------
Muscle L back 4	468.7	------	75.5	4.00	0.16	------
Muscle R thigh 1	2074.3	------	855.5	26.00	0.41	------
Muscle R thigh 2	2508.4	------	457.3	0.18	------	------
Muscle R calf 1	998.2	------	180.3	0.18	------	------
Muscle R calf 2	700.5	------	164.3	0.23	------	------
Muscle R foot	394.0	------	94.0	0.24	------	------
Muscle L thigh 1	2615.0	------	468.4	0.18	------	------
Muscle L thigh 2	2597.0	------	269.2	0.10	------	------
Muscle L calf 1	1099.7	------	254.6	0.23	------	------
Muscle L calf 2	701.9	------	203.4	0.29	------	------
Muscle L foot	418.4	------	78.9	0.19	------	------
Musc-clav L chest	285.1	------	165.3	0.58	------	------
Musc-clav R chest	248.2	------	176.5	0.71	------	------
Musc-pelvic	637.5	------	517.1	0.81	------	------
Musc-ribs	976.4	------	337.7	0.35	------	------
Musc-vert	576.6	------	366.5	0.64	------	------

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Musc-scrap R	99.0	------	71.0	0.72	------	------
Musc-fluid L	307.8	------	65.7	0.21	------	------
Bones						
Calcaneus	101.9	25.8	386.0	12.00	3.79	14.98
Coccyx	10.0	1.6	21.2	1.20	2.12	13.50
Cuboid	20.5	5.3	99.2	2.80	4.84	18.79
Cuneform Int	6.5	2.0	58.4	2.40	8.98	29.20
Cuneform Lat	9.2	2.6	60.4	2.00	6.57	23.50
Cuneform M	16.2	4.3	79.0	2.30	4.88	18.29
Febula DS	35.4	11.0	270.6	8.00	7.64	24.60
Femur DE	261.2	70.3	944.0	26.40	3.61	13.44
Femur DS	137.2	75.1	733.0	22.00	5.34	9.76
Femur ms	151.3	63.9	1292.0	27.00	8.54	20.22
Femur PE	238.8	73.8	748.0	23.00	3.13	10.14
Femur PS	114.4	52.0	644.0	18.50	5.63	12.38
Fibula DE	15.8	2.9	39.6	2.00	2.51	13.47
Fibula PE	21.8	6.0	89.6	3.60	4.11	15.01
Fibula PS	31.3	14.1	148.4	5.20	4.74	10.52
Footphal d2	0.4	0.1	42.3	1.00	105.75	384.55
Footphal d3	0.1	0.1	25.4	0.90	254.00	423.33
Footphal d4	0.2	0.1	17.5	0.60	87.50	194.44
Footphal d5	0.2	0.1	32.6	1.40	163.00	543.33
Footphal m2	0.8	0.3	16.3	0.60	20.38	58.21
Footphal m3	0.5	0.2	21.7	0.80	43.40	135.63
Footphal m4	0.3	0.1	21.8	0.80	72.67	155.71
Footphal m5	0.2	0.1	62.2	1.60	311.00	777.50
Footphal p2	2.2	0.9	43.0	1.20	19.55	47.78
Footphal p3	1.5	0.6	30.6	1.20	20.82	53.68
Footphal p4	1.3	0.4	36.6	1.20	28.15	83.18
Footphal p5	1.3	0.4	12.6	1.20	9.69	33.16
Hamate	4.7	1.3	34.8	1.40	7.40	26.36
Hand phalynx d1	2.2	0.6	35.6	1.40	16.18	62.46
Hand phalynx d4	1.0	0.3	28.6	1.00	28.60	95.33
Hand phalynx d5	0.8	0.2	21.6	0.60	27.00	102.86
Hand phalynx p1	5.0	1.6	103.6	5.00	20.72	63.56
Hand phalynx p2	5.9	2.1	54.6	2.60	9.25	26.12

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Hand phalynx p4	5.8	1.9	127.4	3.60	21.97	66.01
Hand phalynx p5	3.9	1.2	43.6	2.60	11.18	36.64
Hand- sesamoid	1.8	1.0	31.8	1.40	17.28	32.12
Humerus DE	60.0	20.9	236.4	6.40	3.94	11.31
Humerus DS	77.0	28.3	364.8	10.00	4.74	12.89
Humerus PE	93.5	16.7	146.0	6.00	1.56	8.76
Humerus PS	72.0	32.4	363.0	8.00	5.04	11.20
Hyoid bone	4.2	0.9	18.5	2.50	4.40	19.68
Illium-body	206.2	64.6	618.8	18.10	3.00	9.58
Illium-crest	57.5	14.7	657.6	36.80	11.44	44.83
Ischium	245.0	70.6	650.0	19.00	2.65	9.21
Lunate	3.7	0.9	39.0	1.40	10.54	42.39
Mandible	28.5	15.3	146.4	4.80	5.15	9.57
Metacarpal p1	8.9	2.7	50.2	1.40	5.64	18.46
Metacarpal p2	12.6	4.3	82.0	2.30	6.51	19.11
Metacarpal p3	11.6	4.0	61.2	2.00	5.28	15.45
Metacarpal p4	7.3	2.5	55.2	1.80	7.56	21.73
Metacarpal p5	7.0	2.3	52.2	1.60	7.46	22.40
Metatarsal 1	24.3	7.9	110.8	3.00	4.56	14.10
Metatarsal 2	12.3	4.2	56.8	2.00	4.62	13.40
Metatarsal 3	10.3	3.6	64.8	1.80	6.29	18.25
Metatarsal 4	11.7	4.0	68.3	2.30	5.83	16.91
Metatarsal 5	12.5	4.6	83.8	2.30	6.70	18.38
Navicular	17.3	5.2	108.0	3.00	6.24	20.65
Patella	34.3	7.9	148.8	4.80	4.34	18.96
Radius DE	19.6	4.9	145.8	5.20	7.44	29.82
Radius DS	25.0	8.4	105.4	3.40	4.22	12.55
Radius PE	7.5	2.2	415.0	1.80	53.21	192.13
Radius PS	36.3	11.3	95.6	3.40	2.63	8.46
Rib 1	18.3	4.6	32.8	2.80	1.79	7.13
Rib 2	18.0	5.1	57.6	2.80	3.20	11.29
Rib 3	21.7	5.9	65.0	4.00	3.00	11.07
Rib 4	31.3	8.2	48.0	3.50	1.53	5.85
Rib 5	32.4	9.3	73.5	4.50	2.27	7.88
Rib 6	33.1	10.3	108.0	6.00	3.26	10.45
Rib 7	43.6	12.5	365.0	14.00	8.37	29.20

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Rib 8	30.0	9.2	55.0	3.50	1.83	5.98
Rib 9	27.8	5.6	124.5	6.00	4.48	22.43
Rib 10	23.7	7.8	83.0	4.50	3.50	10.63
Rib 11	15.7	5.6	52.8	2.80	3.36	9.38
Rib 12	12.1	4.1	76.4	4.00	6.31	18.77
Sacrum	346.5	65.0	647.7	21.40	1.87	9.97
Scaphoid	5.5	1.7	54.6	2.40	9.93	32.89
Skull frontal 1	37.9	22.6	198.0	7.00	5.22	8.76
Skull frontal 2	19.4	11.8	89.0	3.00	4.59	7.52
Skull frontal 3	15.5	7.1	134.4	3.60	8.67	19.01
Skull occipital	44.0	19.6	198.4	6.00	4.51	10.11
Skull parietal 1	45.2	26.6	236.8	7.50	5.24	8.91
Skull parietal 2	76.6	43.3	386.0	11.00	5.04	8.91
Skull temporal 1	12.3	6.7	78.0	2.50	6.34	11.61
Skull temporal 2	40.3	17.1	167.6	5.60	4.16	9.81
Skull temporal 3	28.0	8.7	79.0	3.00	2.82	9.12
Talus	56.7	16.8	259.2	8.80	4.57	15.46
Tibia DE	73.5	19.2	262.4	7.20	3.57	13.65
Tibia DS	121.6	61.7	825.0	16.00	6.78	13.37
Tibia PE	218.9	50.7	909.5	28.50	4.15	17.94
Tibia PS	130.3	44.2	529.6	26.40	4.06	11.98
Trapezium	4.0	1.0	35.6	1.60	8.90	36.70
Trapezoid	2.6	0.9	41.6	1.70	16.00	48.94
Ulna DE	6.2	1.2	129.0	3.80	20.81	104.03
Ulna DS	25.7	8.6	109.2	3.80	4.25	12.70
Ulna PE	36.1	14.4	139.0	4.00	3.85	9.68
Ulna PS	36.4	11.3	140.2	4.40	3.85	12.41
Vert-c1 atlas	23.3	8.3	69.5	4.50	2.98	8.38
Vert-c3 arch	11.9	4.1	25.2	1.20	2.12	6.18
Vert-c3 body	8.8	2.0	16.6	2.20	1.89	8.34
Vert-c5 arch	12.2	3.9	47.8	1.80	3.92	12.16
Vert-c7 arch	16.5	5.6	43.8	2.60	2.65	7.81
Vert-c7 body	11.7	2.2	14.8	1.50	1.26	6.70
Vert-l1 arch	31.1	10.4	151.0	7.00	4.86	14.56
Vert-l1 body	58.7	7.3	152.0	7.00	2.59	20.82
Vert-l3 arch	39.8	13.2	92.0	6.00	2.31	6.97

Table 11. Uranium in Tissues of USTUR Case 0242

Sample ID	Wet Wt (g)	Ash wt (g)	Uranium Content (ng)	SD	Conc. Wet (ng/g)	Conc. Ash (ng/g)
Vert-l3 body	67.3	8.4	64.0	5.00	0.95	7.60
Vert-t1 arch	20.3	6.8	52.3	2.50	2.57	7.70
Vert-t1 body	15.6	2.8	22.3	1.80	1.43	7.88
Vert-t3 arch	24.9	7.2	70.0	3.60	2.81	9.67
Vert-t3 body	8.7	1.6	21.3	1.50	2.44	13.74
Vert-t5 arch	24.5	7.3	47.2	3.60	1.93	6.43
Vert-t5 body	28.4	4.6	37.5	2.30	1.32	8.19
Vert-t7 arch	23.0	7.8	67.2	5.20	2.92	8.57
Vert-t7 body	24.5	3.2	------	------	------	------
Vert-t9 arch	24.6	8.0	62.5	2.80	2.54	7.79
Vert-t11 arch	25.9	8.6	40.8	3.00	1.57	4.74
Vert-t11 body	42.4	6.6	94.0	4.00	2.22	14.20
	68386.9	1508.7	36920.0			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

ACUTE ACCIDENTAL INHALATION EXPOSURE TO ^{241}Am: PRELIMINARY EVALUATION

Ronald L. Kathren and Timothy P. Lynch[3]

USTUR Case 0855 is a 38 year old white male of approximately Reference Man (ICRP 1975) size who received an acute accidental inhalation exposure to ^{241}Am. On February 1, 1996, while examining an old 370 MBq (10 mCi) sealed source, Case 0855 discovered loose contamination in the vicinity of the work area. Subsequent measurements revealed contamination in the general work area, with hot spots in excess of 1 kBq/100 cm^2. The ^{241}Am was believed to be chemically in the form of the oxide. A single urine sample was collected from Case 0855 on Day 10 postaccident; this sample indicated an ^{241}Am concentration of about 37 μBq (1 fCi)/L, or a total daily excretion of about 50 μBq (1.4 fCi), assuming the Reference Man urinary excretion level of 1.4 L/day. On the basis of this sample, which had a reasonable liklihood of external contamination and hence would overestimate the intake, intake was initially estimated as approximately 13 kBq (350 nCi) of ^{241}Am. ICRP 30 (1978) biokinetic parameters were assumed to apply as the particle size distribution and solubility were not known.

Case 0855 voluntarily enrolled as a USTUR registrant approximately six weeks postexposure. He was deeply interested in his exposure, and agreed to participate in a long term follow-up of his exposure. This, coupled with the fact that the circumstances of the exposure were well known, provided a unique opportunity for intermediate and long term follow-up of this case with considerable promise of determining new or validating existing biokinetic parameters. The follow-up program called for in-vivo chest, liver, and skeletal counts, at approximately monthly intervals for six months, followed by quarterly or semiannual counts for approximately two to three years postexposure. The plan also called for the in-vivo counts to be supplemented by radiourinalyses for ^{241}Am but on a less frequent interval.

The initial USTUR in-vivo counting and urine collection were carried out on March 20, the 45th postexposure day. The data obtained from these procedures permitted a more reliable estimate of intake to be made, and this was done using the default values in Publications 30 and 56 of the International Commission on

[3] Battelle, Pacific Northwest Division, Richland, Washington.

Radiological Protection (ICRP 1979, 1989) so as to ensure consistency with existing regulations. The resultant estimated inhalation intake was 4.3 kBq (120 nCi), leading to the following 50 year committed effective dose estimates:

CEDE: 0.480 Sv
Liver: 0.660 Sv
Lung: 0.090 Sv
Bone surfaces: 11 Sv

During the period from March through September 1996, seven in-vivo counts were obtained on Case 0855; these data are presented in Table 12 and Figure 4. Clearance from the lung was consistent with and could be fitted to a a single compartment exponential with a half-life of about 240 days. In comparison with the ICRP 30 model, this clearance half-time is greater than would be expected for a Class W material but less than for a Class Y material (ICRP 1994). If the assumption is made that clearance is all or very nearly all via the blood, and hence through dissolution, the calculated dissolution rate, viz. 0.693/240 days = 0.003 day^{-1}, is close to the final dissolution rate given for Type M materials in the most recent ICRP human respiratory model (ICRP 1993). Ingrowth of activity into the liver and skeleton, as indicated by the in-vivo counting data, could also be fitted to a single exponential ingrowth equation of the form $(1-e^{-\lambda t})$ with λ being approximately 0.023 d^{-1}.

The USTUR model (Kathren 1994) postulates an initial uptake fraction from the transfer compartment of 0.45 for skeleton, 0.25 for liver, and 0.3 to the rest of the body. Thus the ratio of uptake by skeleton and liver is 1.8, virtually identical with the ratio of activity in the skeleton and liver of Case 0855 which averaged about 1.7 $\pm$ 0.3. However, the mean value obtained from the empirical data for Case 0855 may be somewhat high because of the influence of the relatively large values noted on postexposure days 95 and especially 114. Thus this value might be slightly lower, perhaps on the order of 1.5-1.6; additional in-vivo counting data obtained through further follow-up will help to provide greater confidence with respect the actual value. Note that a small correction was made to the liver data to account for excretion, since the half-time in the liver, as put forth in the USTUR model, is only 2.5 years. For the skeleton, given the half-time of 50 years posed by the model, the excretion during the first six months postexposure is so small that it can be ignored.

Given that the relative distribution or uptake fractions put forth in the USTUR model apply to skeleton and liver, and assuming that the relative uptake to soft tissue put forth in the model also holds, it is possible to determine the fraction of americium reaching the blood that goes to early excretion. This is accomplished by utilizing the equations empirically derived from the excretion data along with the assumption that such clearance was presumably all or nearly all via the blood, which is consistent with animal studies and indicative of soluble material in ionic/isomeric form (ICRP 1994). Somewhere between 50-60 per cent, or approximately half of the material cleared from the lungs would be deposited in the skelton and liver. Using relative uptake put forth by the USTUR model, an additional 25 per cent would have been taken up by soft tissue. Thus, the fraction going to early excretion, essentially all via the urine, is estimated at 0.2 to 0.25 based on this early and as yet preliminary data. This value is about two fold greater than the value of 0.1 put forth by ICRP Publications 30 and 48.

The above leads to a refinement in the parameters for uptake and excretion of americium from blood, which are summarized in Table 13 below along with the associated clearance half-times; the data in the table represent tentative, rounded values.

Note that a somewhat different dose distribution pattern would be obtained using the recently proposed USTUR model (Kathren and McInroy, 1992; Kathren 1994, 1995); dose to skeleton and bone surfaces would be 10% lower, while the dose to the liver would be significantly reduced. There would be additional incremental doses to the soft tissues, which would be relatively small, and overall the CEDE would be somewhat lower. A similar pattern would be obtained using the new biokinetic parameters presented above, which are consistent with the observations in this case. Thus the calculated dose estimates based on ICRP 30 default values given above are likely to be somewhat higher than the actual dose incurred, and hence conservative.

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Figure 4. In-vivo Measurement of ^{241}Am in USTUR Case 0855

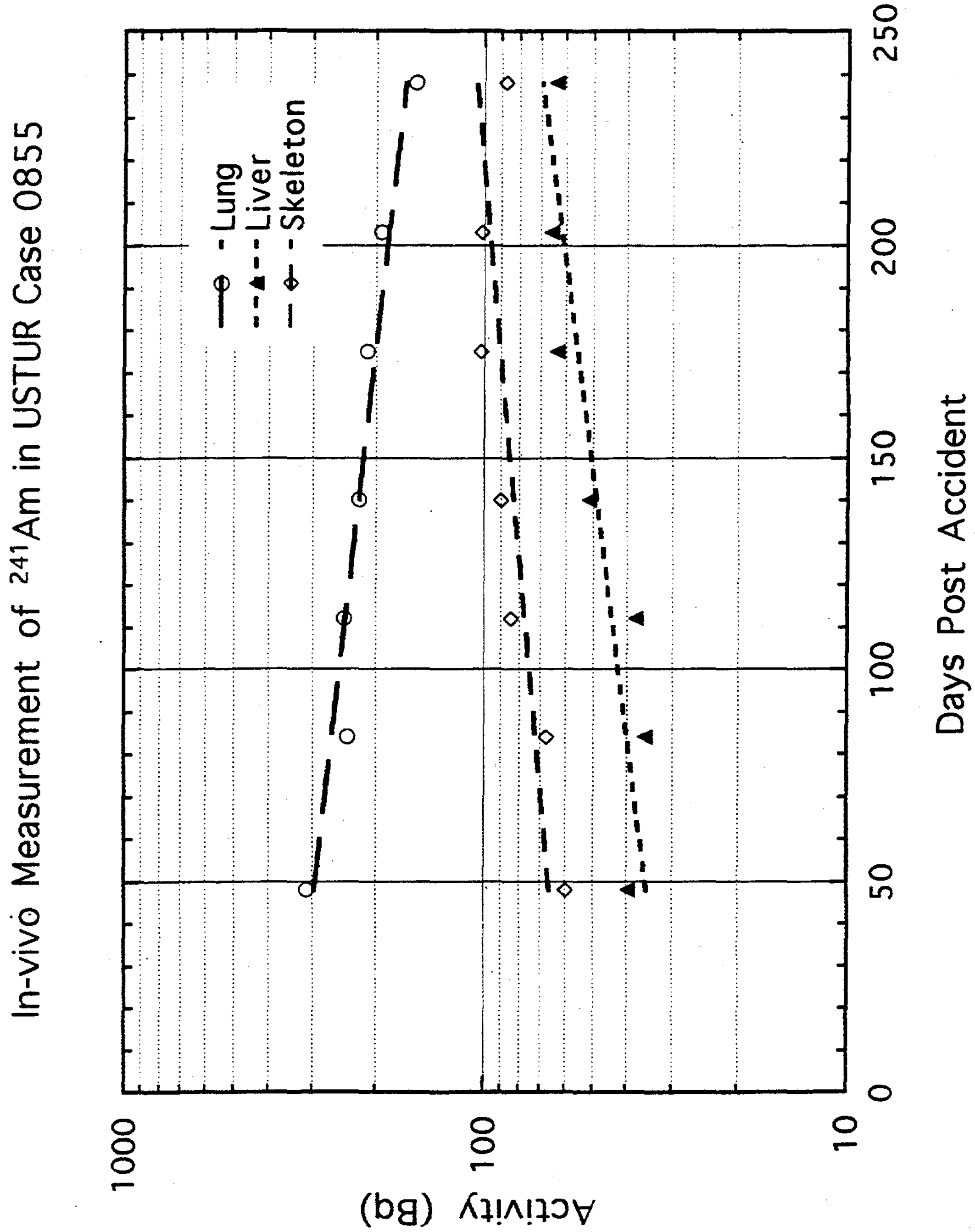

Table 12: ^{241}Am Activity Determined by In-vivo Counting (Bq $\pm$ 1σ countine uncertainty)

Days Postexposure	Lung	Skeleton	Liver
45	315 $\pm$ 5	60 $\pm$ 7	40 $\pm$ 3
85	241 $\pm$ 5	68 $\pm$ 7	36 $\pm$ 3
114	246 $\pm$ 5	85 $\pm$ 7	38 $\pm$ 3
142	226 $\pm$ 5	91 $\pm$ 6	52 $\pm$ 3
177	214 $\pm$ 4	103 $\pm$ 6	64 $\pm$ 3
208	195 $\pm$ 4	103 $\pm$ 6	66 $\pm$ 3
243	156 $\pm$ 4	88 $\pm$ 6	64 $\pm$ 3

Table 13. Tentative Uptake Fractions of ^{241}Am from Blood and Clearance Half-Times

Compartment	Initial Blood Uptake Fraction	Clearance Half-Time
Skeleton	0.35	50 y
Liver	0.20	2.5 y
Rest of Body	0.25	10 y
Early Excretion	0.20	Short (days)

^{238}Pu, ^{239}Pu, and ^{241}Am IN THE TISSUES OF USTUR CASE 0259, A WHOLE BODY DONOR WITH AN ACUTE ACCIDENTAL EXPOSURE TO ^{238}Pu: FINAL RADIOCHEMICAL RESULTS

Ronald L. Kathren, John J. Russell, Royston H. Filby

USTUR Case 0259, a whole body donor who suffered an acute accidental inhalation exposure of ^{238}Pu some 18 years prior to his death from cardiovascular disease at age 54, has been described in detail in previous publications along with summary data of the radiochemical tissue analysis (Kathren 1995; Kathren, Russell and James 1995). Briefly, USTUR Case 0259 was a caucasian male who received an accidental acute inhalation of $^{238}PuO_2$ in the form of a high fired ceramic oxide in July 1971. Postaccident nasal wipes were positive for ^{238}Pu. Case 0259 also had opportunity for low level chronic exposure to ^{238}Pu from June 1957 until the time of death in June 1989. TableS 14-16 presents the final radiochemical results for each individual tissue sample analyzed from this donor, for three radionuclides: ^{238}Pu, ^{239}Pu, and ^{241}Am.

The results of bioassay measurements and the biokinetic analysis of this case were presented in the previous USTUR annual report (Kathren 1995). At the time of death, radiochemical of analysis of the tissues from Case 0259 indicated a body burden of 287 Bq of ^{238}Pu, of which 48 per cent was resident in the liver and 37 per cent in the skeleton and teeth. Although the distribution of ^{238}Pu in the tissues of the whole body was within the range of values that would be expected for ^{239}Pu, and indeed with what has been observed in other whole body donors (Kathren et al. 1988; McInroy, Kathren and Swint 1989), the greater fraction in the liver relative to the skeleton bears mention, and may be indicative of insoluble particle clearance via the lymphatics to the liver.

The greater fraction of ^{238}Pu in the liver however, differs somewhat from that found in an earlier Registries publication (Kathren et al. 1988) and the results from $^{238}PuO_2$ inhalation studies in dogs (Park et al. 1980 ; Muggenburg et al. 1980) which resulted in an enhanced dissolution, translocation, and excretion of ^{238}Pu with a higher burden retained in the skeleton than in the liver. The increased bone burden thus indicated that the ^{238}Pu was translocating in a ionic or monomeric form and not as an insoluble particulate. Under physiological conditions, Pu compounds in the blood are known to undergo hydrolysis and form colloids and complexes with serum proteins i.e. ferritin, depending on pH, concentration, particle size, hydrolysis pH, and organ metabolism. Unfortunately, levels of ^{239}Pu were too low to permit a comparison of the 238 and 239 isotopes of plutonium in Case 0259.

Average concentrations of ^{238}Pu in selected soft tissues are shown in Table 15. The relative concentrations in the tissues is not particularly remarkable. Not unexpectedly, the greatest concentrations of ^{238}Pu were found in the lymph nodes associated with the respiratory tract, which were approximately an order magnitude greater than the concentration in liver, the next highest tissue. Concentrations in the other soft tissues, with the exception of lung, were about two orders of magnitude less than those in liver.

Concentrations of ^{238}Pu in skeleton were 10.8 Bq/kg wet weight and 32.4 Bq/kg ash. The inverse relationship between ash fraction and actinide concentration previously reported by Kathren, McInroy and Swint (1987) was evident in this case. The ash fraction of the skeleton in this case, 0.33, was somewhat greater than observed in other USTUR cases (McInroy, Kathren and Swint 1989) or the 0.28 value given by Reference Man (ICRP 1975) but considered to be within the normal range.

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Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	11.7	0.10	3.32E-02	1.80E-03	2.84E-03	3.32E-01
Adrenal-R	9.2	0.10	2.81E-02	1.70E-03	3.05E-03	2.81E-01
Aorta	45.9	0.30	1.57E-01	5.50E-03	3.42E-03	5.23E-01
Aortic Arch	29.2	0.30	1.29E-01	4.90E-03	4.40E-03	4.28E-01
Bile	10.2	0.10	3.60E-03	6.00E-04	3.53E-04	3.60E-02
Bladder	78.0	0.40	1.40E-02	1.10E-03	1.80E-04	3.51E-02
Blood	44.3	0.40	1.98E-01	7.10E-03	4.47E-03	4.95E-01
Cerebellum	153.2	2.40	4.23E-02	2.10E-03	2.76E-04	1.76E-02
Cerebrum	1206.9	16.80	1.48E-01	5.10E-03	1.22E-04	8.79E-03
Diaphragm	287.9	2.10	7.49E-01	2.15E-02	2.60E-03	3.57E-01
Duodenum	76.3	0.50	8.43E-02	3.50E-03	1.10E-03	1.69E-01
Dura mater #1	30.3	0.40	2.34E-02	1.50E-03	7.71E-04	5.84E-02
Dura mater #2	22.8	0.30	1.39E-02	1.20E-03	6.11E-04	4.64E-02
Ear-L	19.5	0.18	1.05E-02	1.10E-03	5.37E-04	5.81E-02
Ear-R	18.3	0.24	9.27E-03	1.30E-03	5.07E-04	3.86E-02
Esophagus	44.4	0.30	3.19E-02	1.80E-03	7.18E-04	1.06E-01
Eye-R	7.5	0.04	6.70E-03	9.00E-04	8.93E-04	1.68E-01
Gall Bladder	10.3	0.20	5.09E-02	2.40E-03	4.94E-03	2.54E-01
Hair	15.4	0.18	2.20E-03	6.00E-04	1.43E-04	1.22E-02
Heart	338.3	2.40	4.12E-01	1.28E-02	1.22E-03	1.72E-01
Hilar LN - L	3.5	0.10				
Hilar LN - R	3.6	0.10	3.68E+00	1.24E-01	1.02E+00	3.68E+01
Intestine-large	898.1	4.50	2.22E-01	7.30E-03	2.47E-04	4.93E-02
Intestine-small	686.4	2.70	1.75E-01	6.10E-03	2.54E-04	6.47E-02
Kidney-L	159.4	1.50	1.53E-01	5.60E-03	9.57E-04	1.02E-01
Kidney-R	143.7	1.30	1.62E-01	6.10E-03	1.13E-03	1.25E-01
Larynx	105.7	3.70	3.14E-01	1.01E-02	2.97E-03	8.49E-02
Liver	1483.2	15.50	1.37E+02	3.79E+00	9.25E-02	8.85E+00

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Lung-L	599.3	5.50	8.52E+00	3.35E-01	1.42E-02	1.55E+00
Lung-R	696.2	6.20	1.24E+01	4.42E-01	1.77E-02	1.99E+00
Mesentery	246.5	0.90	1.85E-01	6.20E-03	7.51E-04	2.06E-01
Musc Calf-L lower	683.5	7.36	1.08E-01	4.60E-03	1.58E-04	1.47E-02
Musc Calf-L upper	755.9					
Musc Calf-R lower	835.1	8.45	1.40E-01	6.60E-03	1.67E-04	1.65E-02
Musc Calf-R upper	617.0	49.03	8.79E-02	3.90E-03	1.42E-04	1.79E-03
Musc Foot-L	305.8	6.70	8.63E-02	3.50E-03	2.82E-04	1.29E-02
Musc Foot-R	325.3	2.17	7.45E-02	3.10E-03	2.29E-04	3.43E-02
Musc forearm-L	503.4	27.77	9.84E-02	3.80E-03	1.96E-04	3.54E-03
Musc forearm-R	520.7	4.53	9.97E-02	3.90E-03	1.92E-04	2.20E-02
Musc hand-L	112.7	1.65	6.04E-02	3.20E-03	5.36E-04	3.66E-02
Musc hand-R	134.8	4.60	4.27E-03	6.00E-04	3.17E-05	9.28E-04
Musc L back#1	1032.3	9.22	3.10E-01	1.11E-02	3.00E-04	3.36E-02
Musc L back#2	449.8	19.25	1.02E-01	4.30E-03	2.27E-04	5.29E-03
Musc L back#3	469.5	6.09	1.14E-01	4.30E-03	2.44E-04	1.88E-02
Musc L back#4	930.1	36.24	4.28E-01	1.40E-02	4.60E-04	1.18E-02
Musc L front#1	660.6	9.02	1.39E-01	5.00E-03	2.10E-04	1.54E-02
Musc L front#2	97.5	1.05	2.60E-02	1.70E-03	2.67E-04	2.48E-02
Musc L front#3	267.9	3.71	8.59E-02	3.60E-03	3.21E-04	2.32E-02
Musc L front#4	622.0	5.10	1.07E-01	4.30E-03	1.72E-04	2.09E-02
Musc R back#1	945.8	10.65	2.65E-01	7.50E-03	2.81E-04	2.49E-02
Musc R back#2	545.7	4.97	1.26E-01	5.10E-03	2.31E-04	2.54E-02
Musc R back#3	659.2	7.82	2.25E-01	7.80E-03	3.41E-04	2.87E-02
Musc R back#4	910.6	8.84	1.87E-01	7.50E-03	2.06E-04	2.12E-02
Musc R front#1	563.6	13.00	1.72E-01	6.60E-03	3.05E-04	1.32E-02
Musc R front#2	408.6	30.47	4.83E-01	1.45E-02	1.18E-03	1.59E-02
Musc R front#3	647.7	6.01	1.82E-01	6.20E-03	2.82E-04	3.03E-02
Musc R front#4	1035.4	7.85	1.94E-01	7.80E-03	1.87E-04	2.47E-02

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc Thigh-L lower	2412.0	15.40	3.13E-01	1.09E-02	1.30E-04	2.04E-02
Musc Thigh-L upper	2859.0	27.30	3.60E-01	1.33E-02	1.26E-04	1.32E-02
Musc Thigh-R lower	1581.0					
Musc Thigh-R upper	3025.0	25.80	3.57E-01	1.21E-02	1.18E-04	1.39E-02
Musc unidentified	660.6		1.74E-02	1.50E-03	2.64E-05	
Musc up arm-L	1055.2	8.73	2.06E-01	6.70E-03	1.96E-04	2.36E-02
Musc up arm-R	1274.5	34.90	2.45E-01	8.80E-03	1.92E-04	7.02E-03
Muscle head	571.3	5.99	2.64E-01	1.18E-02	4.63E-04	4.42E-02
Pancreas	121.3	1.10	2.53E-01	8.10E-03	2.08E-03	2.30E-01
Penis	205.3	1.47	2.48E-02	1.70E-03	1.21E-04	1.69E-02
Pericardium	34.3	0.20	3.82E-01	1.15E-02	1.11E-02	1.91E+00
Peritracheal scraps	27.3	0.20	1.92E-01	6.50E-03	7.02E-03	9.58E-01
Pituitary	0.4	0.10	7.00E-04	3.00E-04	1.75E-03	7.00E-03
Pons	17.1	0.20	2.17E-03	5.00E-04	1.27E-04	1.08E-02
Prostate	23.1	0.30	6.47E-03	8.00E-04	2.80E-04	2.16E-02
Rectum	230.0	3.99	1.15E-01	4.50E-03	5.00E-04	2.88E-02
Skin Calf-L lower	237.0	1.10	5.95E-02	2.90E-03	2.51E-04	5.41E-02
Skin Calf-L upper	322.4	1.64	4.85E-02	2.40E-03	1.51E-04	2.96E-02
Skin Calf-R lower	199.8	1.07	4.22E-02	2.40E-03	2.11E-04	3.94E-02
Skin Calf-R upper	487.9	2.03	9.84E-02	4.00E-03	2.02E-04	4.85E-02
Skin Foot-L	280.6	1.71	7.61E-02	3.40E-03	2.71E-04	4.45E-02
Skin Foot-R	268.9	1.73	7.35E-02	3.40E-03	2.73E-04	4.25E-02
Skin forearm-L	233.5	2.98	7.13E-02	3.00E-03	3.05E-04	2.39E-02
Skin forearm-R	204.1	1.20	5.22E-02	2.50E-03	2.56E-04	4.35E-02
Skin hand-L	146.2	1.03	6.30E-02	3.40E-03	4.31E-04	6.12E-02
Skin hand-R	162.8	1.11	6.51E-02	3.60E-03	4.00E-04	5.87E-02
Skin head	479.5	5.25				
Skin L back#1	595.3	2.30	1.08E-01	4.30E-03	1.82E-04	4.70E-02
Skin L back#2	425.7	1.90	7.05E-02	3.20E-03	1.66E-04	3.71E-02

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin L back#3	467.9					
Skin L back#4	635.4					
Skin L front#1	282.8	5.60	8.30E-02	3.30E-03	2.93E-04	1.48E-02
Skin L front#2	540.8	6.80	7.73E-02	6.50E-03	1.43E-04	1.14E-02
Skin L front#3	396.4	3.40	4.25E-02	2.30E-03	1.07E-04	1.25E-02
Skin L front#4	529.2	2.40	5.13E-02	2.80E-03	9.69E-05	2.14E-02
Skin R back#1	457.2	2.70	1.11E-01	4.30E-03	2.43E-04	4.12E-02
Skin R back#2	412.0	2.03	6.45E-02	4.50E-03	1.57E-04	3.18E-02
Skin R back#3	544.6	2.00	6.34E-02	3.00E-03	1.16E-04	3.17E-02
Skin R back#4	808.8	2.80	8.58E-02	4.00E-03	1.06E-04	3.07E-02
Skin R front#1	408.5	8.42				
Skin R front#2	337.3	6.10	5.02E-02	2.60E-03	1.49E-04	8.23E-03
Skin R front#3	402.1	2.41	3.51E-02	2.10E-03	8.73E-05	1.46E-02
Skin R front#4	432.3	1.70	2.67E-02	1.60E-03	6.17E-05	1.57E-02
Skin Thigh-L lower	680.2	2.80	6.69E-02	3.70E-03	9.83E-05	2.39E-02
Skin Thigh-L upper	1336.9	5.60	1.03E-01	4.40E-03	7.72E-05	1.84E-02
Skin Thigh-R lower	863.1	3.16	7.90E-02	4.30E-03	9.16E-05	2.50E-02
Skin Thigh-R upper	1287.3	4.20	8.96E-02	4.60E-03	6.96E-05	2.13E-02
Skin up arm-L	552.0	2.20	8.48E-02	3.50E-03	1.54E-04	3.86E-02
Skin up arm-R	605.8	3.84	1.05E-01	4.00E-03	1.73E-04	2.72E-02
Spinal Cord	35.7	0.50	1.70E-02	1.30E-03	4.77E-04	3.41E-02
Spleen	212.6	2.20	1.05E+00	2.93E-02	4.93E-03	4.77E-01
Stomach	186.7	1.20	3.24E-01	1.01E-02	1.74E-03	2.70E-01
TBLN #1	0.6	0.05	1.99E+00	9.68E-02	3.32E+00	3.98E+01
TBLN #2	0.6	0.05	1.92E-01	1.83E-02	3.20E-01	3.84E+00
TBLN #3	1.3	0.05	4.76E-01	3.27E-02	3.66E-01	9.52E+00
TBLN #4	1.3	0.05	1.18E-01	1.75E-02	9.10E-02	2.37E+00
Testis-L	22.6	0.20	3.73E-02	2.00E-03	1.65E-03	1.87E-01
Testis-R	30.3	0.30	4.67E-02	2.30E-03	1.54E-03	1.56E-01

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Thyroid	23.9	0.40	2.11E-02	1.50E-03	8.83E-04	5.28E-02
Tongue	85.2	0.80	4.14E-02	2.30E-03	4.86E-04	5.18E-02
Trachea	15.2	0.10	3.59E-02	2.00E-03	2.36E-03	3.59E-01
Bones						
Calcaneus	107.0	28.91				
Canine RL3	1.3	0.97	2.67E-04	2.00E-04	2.05E-04	2.75E-04
Canine RU3	1.8	1.31	4.90E-03	1.20E-03	2.72E-03	3.74E-03
Capitate	5.9	1.91	1.67E-02	1.40E-03	2.84E-03	8.76E-03
Clavicle Acrom	19.4	4.86	2.39E-01	7.80E-03	1.23E-02	4.91E-02
Clavicle SE	15.5	5.17	2.05E-01	7.50E-03	1.32E-02	3.96E-02
Clavicle Shaft	16.8	8.09	2.27E-01	1.33E-02	1.35E-02	2.81E-02
Coccyx	5.2	0.73	3.43E-02	2.00E-03	6.60E-03	4.70E-02
Costal cart-R	103.7	3.84	8.37E-02	3.60E-03	8.07E-04	2.18E-02
Cuboid	19.4	4.85	6.05E-02	2.70E-03	3.12E-03	1.25E-02
Femur DE	239.0	56.70	1.46E+00	5.59E-02	6.11E-03	2.58E-02
Femur DS	126.6	47.32	1.05E+00	5.66E-02	8.26E-03	2.21E-02
Femur MS	136.3	66.88	1.64E+00	8.01E-02	1.20E-02	2.45E-02
Femur PE	228.3	56.62	2.78E+00	9.30E-02	1.22E-02	4.91E-02
Femur PS	130.8	59.52	1.40E+00	5.11E-02	1.07E-02	2.36E-02
Fibula DE	17.4	5.31	1.25E-01	6.20E-03	7.18E-03	2.35E-02
Fibula DS	30.4	16.36	1.74E-01	1.33E-02	5.71E-03	1.06E-02
Fibula PE	19.3	3.61				
Fibula PS	31.1	16.12	2.51E-01	1.61E-02	8.08E-03	1.56E-02
Fingernails	1.9	0.01	1.30E-03	4.00E-04	6.84E-04	1.30E-01
Frontal #1	43.8	25.04	4.82E-01	2.02E-02	1.10E-02	1.93E-02
Frontal #2	20.6	11.67	1.80E-01	7.30E-03	8.74E-03	1.54E-02
Frontal #3	16.3	7.26	1.54E-01	6.60E-03	9.45E-03	2.12E-02
Ft Phal D1	3.5	0.91	2.30E-02	1.60E-03	6.56E-03	2.52E-02
Ft Phal D2	0.7	0.14	7.10E-03	9.00E-04	1.01E-02	5.07E-02

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal D3	0.7	0.13	6.87E-03	9.00E-04	9.81E-03	5.28E-02
Ft Phal D4	0.6	0.12	5.43E-03	7.00E-04	9.06E-03	4.53E-02
Ft Phal D5	0.5	0.08	4.27E-03	7.00E-04	8.53E-03	5.33E-02
Ft Phal M2	1.1	0.28				
Ft Phal M3	0.7	0.16	5.30E-03	7.00E-04	7.57E-03	3.31E-02
Ft Phal M4	0.5	0.13	5.20E-03	7.00E-04	1.02E-02	4.00E-02
Ft Phal M5	0.4	0.09	2.93E-03	5.00E-04	7.33E-03	3.26E-02
Ft Phal P1	7.5	2.53	4.92E-02	2.60E-03	6.56E-03	1.94E-02
Ft Phal P2	2.7	0.85				
Ft Phal P3	2.0	0.58	1.44E-02	1.40E-03	7.20E-03	2.48E-02
Ft Phal P4	1.7	0.52	1.18E-02	1.10E-03	6.96E-03	2.28E-02
Ft Phal P5	1.8	0.46	7.83E-03	1.40E-03	4.35E-03	1.70E-02
Hamate	4.5	1.39	3.56E-02	2.10E-03	7.91E-03	2.56E-02
Hand-phal D1	1.9	0.56	1.60E-02	1.20E-03	8.42E-03	2.86E-02
Hand-phal D2	1.0	0.27	7.63E-03	9.00E-04	7.63E-03	2.83E-02
Hand-phal D3	1.3	0.35	7.07E-03	9.00E-04	5.44E-03	2.02E-02
Hand-phal D4	1.0	0.29	5.17E-03	7.00E-04	5.17E-03	1.78E-02
Hand-phal D5	0.8	0.21	6.37E-03	8.00E-04	7.96E-03	3.03E-02
Hand-phal M2	2.0	0.77	1.46E-02	2.40E-03	7.32E-03	1.90E-02
Hand-phal M3	2.8	1.13	2.95E-02	1.70E-03	1.05E-02	2.61E-02
Hand-phal M4	2.2	0.84	1.65E-02	1.20E-03	7.50E-03	1.96E-02
Hand-phal M5	1.3	0.49	1.60E-02	3.10E-03	1.23E-02	3.27E-02
Hand-phal P1	4.2	1.41	3.17E-02	1.90E-03	7.56E-03	2.25E-02
Hand-phal P2	6.0	2.17				
Hand-phal P3	7.0	2.71	5.08E-02	2.70E-03	7.25E-03	1.87E-02
Hand-phal P4	5.1	1.85	3.35E-02	1.90E-03	6.58E-03	1.81E-02
Hand-phal P5	3.3	1.14	2.49E-02	1.60E-03	7.54E-03	2.18E-02
Humerus DE	68.7	23.82	4.26E-01	1.80E-02	6.19E-03	1.79E-02
Humerus DS	72.4	34.71	1.69E-02	3.20E-03	2.33E-04	4.87E-04

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Humerus PE	93.2	18.53	1.03E+00	3.29E-02	1.11E-02	5.59E-02
Humerus PS	86.0	33.80	8.47E-01	3.14E-02	9.85E-03	2.51E-02
R cuneiform	6.8	2.07	3.14E-02	1.80E-03	4.62E-03	1.52E-02
Ilium-body	235.5	63.06	2.96E+00	9.54E-02	1.26E-02	4.69E-02
Ilium-crest	49.7	15.02	7.62E-01	2.47E-02	1.53E-02	5.07E-02
Incisor RL1	0.6	0.38	2.13E-03	5.00E-04	3.56E-03	5.61E-03
Incisor RL2	0.7	0.52	3.70E-03	7.00E-04	5.29E-03	7.12E-03
Incisor RU1	1.3	0.94	4.73E-03	8.00E-04	3.73E-03	5.04E-03
Incisor RU2	1.1	0.76	3.83E-03	6.00E-04	3.62E-03	5.04E-03
Ischium-R	246.9	73.16	3.62E+00	1.12E-01	1.47E-02	4.95E-02
I cuneiform	9.9	2.63	4.81E-02	2.40E-03	4.86E-03	1.83E-02
Lunate	4.1	1.24	2.77E-02	1.70E-03	6.76E-03	2.24E-02
M cuneiform	16.4	4.76	5.17E-02	2.60E-03	3.15E-03	1.09E-02
Mandible	43.9	22.84	3.89E-01	1.76E-02	8.85E-03	1.70E-02
Maxilla	45.5	15.56	4.26E-01	1.50E-02	9.36E-03	2.74E-02
Metacarpal #1	8.5	2.77	5.68E-02	4.70E-03	6.69E-03	2.05E-02
Metacarpal #2	13.1	4.89				
Metacarpal #3	12.6	4.76	9.91E-02	6.00E-03	7.87E-03	2.08E-02
Metacarpal #4	7.8	2.68	4.57E-02	2.40E-03	5.85E-03	1.70E-02
Metacarpal #5	6.2	2.14	2.21E-02	1.50E-03	3.56E-03	1.03E-02
Metatarsal 1	25.5	8.72	1.44E-01	5.30E-03	5.65E-03	1.65E-02
Metatarsal 2	13.2	4.72				
Metatarsal 3	11.8	3.90	6.35E-02	3.00E-03	5.38E-03	1.63E-02
Metatarsal 4	13.0	4.53				
Metatarsal 5	13.9	4.91				
Molar RL6	1.9	1.36	7.03E-03	2.60E-03	3.70E-03	5.17E-03
Molar RL7	2.0	1.57	5.93E-03	1.10E-03	2.97E-03	3.78E-03
Molar RL8	1.4	1.09	6.17E-03	9.00E-04	4.40E-03	5.66E-03
Molar RU6	2.3	1.70	8.47E-03	1.00E-03	3.68E-03	4.98E-03

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Molar RU7	2.4	1.64	1.89E-02	1.50E-03	7.94E-03	1.15E-02
Molar RU8	0.8	0.53	1.10E-03	1.30E-03	1.47E-03	2.08E-03
Nasal Cartilage	20.8	0.60	7.36E-02	3.40E-03	3.54E-03	1.23E-01
Navicular	19.8	5.92	1.17E-01	4.30E-03	5.89E-03	1.97E-02
Occipital	31.9	17.14	4.73E-01	1.89E-02	1.48E-02	2.76E-02
Parietal #1	63.0	35.25	1.10E+00	4.64E-02	1.74E-02	3.11E-02
Parietal #2	84.2	46.51	1.40E+00	4.83E-02	1.67E-02	3.02E-02
Patella-R	35.3	11.33	2.24E-01	1.28E-02	6.34E-03	1.97E-02
Premolar RL4	1.1	0.83	2.67E-04	3.00E-04	2.42E-04	3.21E-04
Premolar RL5	1.2	0.93	3.13E-03	2.00E-03	2.61E-03	3.37E-03
Premolar RU4	1.2	0.93	3.93E-03	8.00E-04	3.17E-03	4.23E-03
Premolar RU5	1.0	0.73	1.78E-03	6.00E-04	1.87E-03	2.43E-03
R-Rib #1	29.4	7.87	4.35E-01	1.34E-02	1.48E-02	5.53E-02
R-Rib #10	25.5	8.82	4.04E-01	1.40E-02	1.58E-02	4.58E-02
R-Rib #11	18.8	6.80	3.51E-01	1.41E-02	1.87E-02	5.17E-02
R-Rib #12	9.9	3.31	1.97E-01	8.00E-03	1.99E-02	5.94E-02
R-Rib #2	22.7	6.81	4.28E-01	1.78E-02	1.88E-02	6.28E-02
R-Rib #3	25.1	7.93	3.63E-01	1.32E-02	1.45E-02	4.58E-02
R-Rib #4 bone	24.6	9.61	4.26E-01	1.45E-02	1.73E-02	4.43E-02
R-Rib #4 marrow	6.5		4.96E-02	3.70E-03	7.64E-03	
R-Rib #5	33.2	10.09	6.34E-01	2.60E-02	1.91E-02	6.28E-02
R-Rib #6	38.6	12.82	7.26E-01	2.94E-02	1.88E-02	5.66E-02
R-Rib #7 bone	21.6	9.51	4.01E-01	1.38E-02	1.85E-02	4.21E-02
R-Rib #7 marrow	5.4		2.49E-02	1.30E-03	4.61E-03	
R-Rib #8	36.0	12.33	5.65E-01	1.88E-02	1.57E-02	4.58E-02
R-Rib #9 bone	21.9	9.20	3.21E-01	1.15E-02	1.47E-02	3.49E-02
R-Rib #9 marrow	6.1		1.89E-02	1.90E-03	3.10E-03	
Radius DE	17.3	4.96	8.78E-02	1.05E-02	5.08E-03	1.77E-02
Radius DS	23.1	12.02	6.59E-02	4.50E-03	2.85E-03	5.48E-03

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius PE	10.3	3.13	7.91E-02	3.70E-03	7.68E-03	2.53E-02
Radius PS	30.9	15.23	1.94E-01	7.80E-03	6.28E-03	1.27E-02
Sacrum	301.5	64.46	4.36E+00	1.41E-01	1.45E-02	6.77E-02
Scap spine	40.5	14.12	6.16E-01	2.51E-02	1.52E-02	4.36E-02
Scaphoid	5.4	1.69	2.32E-02	1.60E-03	4.29E-03	1.37E-02
Scapula DE	42.1	17.70	6.18E-01	3.20E-02	1.47E-02	3.49E-02
Scapula PE	45.4	14.69	7.11E-01	2.48E-02	1.57E-02	4.84E-02
Sesamoid-Ft	3.1	0.90	1.42E-02	3.60E-03	4.58E-03	1.58E-02
Sternum	117.1	22.84	1.89E+00	5.89E-02	1.61E-02	8.27E-02
Talus	65.5	19.21	4.17E-01	1.80E-02	6.37E-03	2.17E-02
Temporal #1	22.6	12.97	2.72E-01	1.11E-02	1.20E-02	2.10E-02
Temporal #2	74.6	27.44	7.36E-01	2.98E-02	9.86E-03	2.68E-02
Temporal #3	33.6	19.55	3.47E-01	1.28E-02	1.03E-02	1.77E-02
Tibia DE	66.1	18.37	2.93E-01	1.22E-02	4.43E-03	1.59E-02
Tibia DS	126.7	60.33	5.99E-01	3.10E-02	4.73E-03	9.93E-03
Tibia PE	187.8	40.44	1.17E+00	4.48E-02	6.21E-03	2.88E-02
Tibia PS	167.3	73.69	9.56E-01	4.21E-02	5.72E-03	1.30E-02
Toenails-Ft	1.3	0.01	1.40E-03	4.00E-04	1.08E-03	1.40E-01
Trapezium	3.6	1.05	2.59E-02	1.70E-03	7.20E-03	2.47E-02
Trapezoid	2.5	0.75	2.16E-02	1.50E-03	8.65E-03	2.88E-02
Triangular	1.9	0.60	1.63E-02	3.50E-03	8.58E-03	2.72E-02
Ulna DE	7.9	2.45	1.71E-02	1.50E-03	2.16E-03	6.97E-03
Ulna DS	22.0	11.52	1.24E-01	2.29E-02	5.64E-03	1.08E-02
Ulna PE	41.4	15.61	3.38E-01	1.26E-02	8.16E-03	2.16E-02
Ulna PS	30.4	16.41	1.04E-01	1.81E-02	3.42E-03	6.34E-03
Vert arch C-3	11.9	4.10	1.34E-01	5.20E-03	1.12E-02	3.26E-02
Vert arch C-5	9.8	3.52	3.24E-01	1.03E-02	3.31E-02	9.22E-02
Vert arch C-7	13.8	4.82	1.48E-02	1.20E-03	1.07E-03	
Vert arch L-1	33.5	8.79	4.94E-01	1.64E-02	1.48E-02	5.62E-02

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert arch L-3	37.8	12.48	6.60E-01	2.20E-02	1.75E-02	5.29E-02
Vert arch L-5	41.3	11.08	5.58E-01	1.95E-02	1.35E-02	5.03E-02
Vert arch T-1	22.4	7.43	3.83E-01	1.22E-02	1.71E-02	5.15E-02
Vert arch T-11	25.1	7.02	3.22E-01	1.17E-02	1.28E-02	4.58E-02
Vert arch T-3	19.8	5.88	3.69E-01	1.29E-02	1.87E-02	6.28E-02
Vert arch T-5	18.4	5.41	3.22E-01	1.04E-02	1.75E-02	5.95E-02
Vert arch T-7	21.5					
Vert arch T-9	24.9	7.23	4.59E-01	1.51E-02	1.84E-02	6.35E-02
Vert atlas C-1	22.6	8.25	4.70E-01	1.57E-02	2.08E-02	5.70E-02
Vert body bone C-5	6.7	2.12	1.61E-01	5.70E-03	2.41E-02	7.61E-02
Vert body bone L-3	27.7	8.07	6.73E-01	1.97E-02	2.43E-02	8.34E-02
Vert body bone T-5	10.9	2.85	2.59E-01	8.60E-03	2.37E-02	9.08E-02
Vert body C-3	7.7	2.19	2.16E-01	7.40E-03	2.81E-02	9.88E-02
Vert body C-7	8.9	2.42	1.92E-01	6.60E-03	2.16E-02	7.93E-02
Vert body L-1	42.3	7.76	7.13E-01	2.18E-02	1.68E-02	9.18E-02
Vert body L-5	69.9	14.63	9.56E-01	3.00E-02	1.37E-02	6.54E-02
Vert body marrow C-5	0.7		1.04E-02	1.00E-03	1.48E-02	
Vert body marrow L-3	14.8		5.30E-02	2.10E-03	3.58E-03	
Vert body marrow T-5	3.7		1.11E-02	1.00E-03	2.99E-03	
Vert body T-1	12.5	2.89	2.57E-01	8.70E-03	2.06E-02	8.90E-02
Vert body T-11	32.3	6.37	5.71E-01	1.84E-02	1.77E-02	8.96E-02
Vert body T-3	12.8	2.60	2.70E-01	8.50E-03	2.11E-02	1.04E-01
Vert body T-7	23.9					
Vert body T-9	27.2	5.28	4.77E-01	1.39E-02	1.75E-02	9.04E-02
Vert whole T-10	62.3	13.93	1.14E+00	3.51E-02	1.84E-02	8.21E-02
Vert whole T-12	62.1	13.37	1.00E+00	2.95E-02	1.61E-02	7.48E-02

Table 14. ^{238}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert whole T-2	35.3	9.39	4.22E-01	1.48E-02	1.20E-02	4.50E-02
Vert whole T-6	40.3	9.13	3.83E-01	1.58E-02	9.51E-03	4.20E-02
Vert whole T-8	52.3	11.33	7.67E-01	2.48E-02	1.47E-02	6.77E-02
	58722.7	2325.16	236.20			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
RL	Right Lower			t	thoracic
RU	Right Upper			l	lumbar

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	11.7	0.10	4.67E-04	2.00E-04	3.99E-05	4.67E-03
Adrenal-R	9.2	0.10	2.81E-02	3.00E-04	3.05E-03	2.81E-01
Aorta	45.9	0.30	2.80E-03	5.00E-04	6.10E-05	9.33E-03
Aortic Arch	29.2	0.30	4.30E-02	2.30E-03	1.47E-03	1.43E-01
Bile	10.2	0.10	4.67E-04	2.00E-04	4.58E-05	4.67E-03
Bladder	78.0	0.40	1.67E-04	2.00E-04	2.14E-06	4.17E-04
Blood	44.3	0.40	4.00E-03	7.00E-04	9.03E-05	1.00E-02
Cerebellum	153.2	2.40	2.97E-03	5.00E-04	1.94E-05	1.24E-03
Cerebrum	1206.9	16.80	2.40E-03	4.00E-04	1.99E-06	1.43E-04
Diaphragm	287.9	2.10	9.37E-02	3.80E-03	3.25E-04	4.46E-02
Duodenum	76.3	0.50	9.00E-04	3.00E-04	1.18E-05	1.80E-03
Dura mater #1	30.3	0.40	5.67E-04	2.00E-04	1.87E-05	1.42E-03
Dura mater #2	22.8	0.30	6.67E-04	3.00E-04	2.92E-05	2.22E-03
Ear-L	19.5	0.18	3.67E-04	3.00E-04	1.88E-05	2.04E-03
Ear-R	18.3	0.24	2.30E-03	6.00E-04	1.26E-04	9.59E-03
Esophagus	44.4	0.30	1.30E-03	3.00E-04	2.93E-05	4.33E-03
Eye-R	7.5	0.04	4.67E-04	3.00E-04	6.22E-05	1.17E-02
Gall Bladder	10.3	0.20	1.03E-03	3.00E-04	1.00E-04	5.17E-03
Hair	15.4	0.18	9.01E-04	4.00E-04	5.85E-05	5.00E-03
Heart	338.3	2.40	7.40E-03	9.00E-04	2.19E-05	3.08E-03
Hilar LN - L	3.5	0.10	9.12E-01	4.63E-02	2.61E-01	9.12E+00
Hilar LN - R	3.6	0.10	1.03E+00	4.91E-02	2.85E-01	1.03E+01
Intestine-large	898.1	4.50	4.07E-03	6.00E-04	4.53E-06	9.04E-04
Intestine-small	686.4	2.70	3.50E-03	6.00E-04	5.10E-06	1.30E-03
Kidney-L	159.4	1.50	2.77E-03	5.00E-04	1.74E-05	1.84E-03
Kidney-R	143.7	1.30	5.33E-03	8.00E-04	3.71E-05	4.10E-03
Larynx	105.7	3.70	4.63E-03	7.00E-04	4.38E-05	1.25E-03
Liver	1483.2	15.50	2.11E+00	1.36E-01	1.43E-03	1.36E-01

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Lung-L	599.3	5.50	1.22E+00	9.89E-02	2.04E-03	2.23E-01
Lung-R	696.2	6.20	1.93E+00	1.28E-01	2.78E-03	3.12E-01
Mesentery	246.5	0.90	2.97E-03	5.00E-04	1.20E-05	3.30E-03
Musc Calf-L lower	683.5	7.36	2.54E-03	6.00E-04	3.71E-06	3.45E-04
Musc Calf-L upper	755.9					
Musc Calf-R lower	835.1	8.45	4.49E-03	1.00E-03	5.37E-06	5.31E-04
Musc Calf-R upper	617.0	49.03	2.87E-03	6.00E-04	4.65E-06	5.85E-05
Musc Foot-L	305.8	6.70	1.83E-03	4.00E-04	6.00E-06	2.74E-04
Musc Foot-R	325.3	2.17	1.80E-03	4.00E-04	5.53E-06	8.29E-04
Musc forearm-L	503.4	27.77	1.87E-03	4.00E-04	3.71E-06	6.72E-05
Musc forearm-R	520.7	4.53	1.97E-03	4.00E-04	3.78E-06	4.34E-04
Musc hand-L	112.7	1.65	4.03E-03	7.00E-04	3.58E-05	2.44E-03
Musc hand-R	134.8	4.60	1.16E-02	1.00E-03	8.63E-05	2.53E-03
Musc L back#1	1032.3	9.22	1.25E-02	1.50E-03	1.21E-05	1.35E-03
Musc L back#2	449.8	19.25	4.00E-03	7.00E-04	8.89E-06	2.08E-04
Musc L back#3	469.5	6.09	2.40E-03	5.00E-04	5.11E-06	3.94E-04
Musc L back#4	930.1	36.24	7.60E-03	1.20E-03	8.17E-06	2.10E-04
Musc L front#1	660.6	9.02	1.42E-02	1.20E-03	2.15E-05	1.57E-03
Musc L front#2	97.5	1.05	1.60E-03	4.00E-04	1.64E-05	1.52E-03
Musc L front#3	267.9	3.71	1.53E-03	4.00E-04	5.72E-06	4.13E-04
Musc L front#4	622.0	5.10	1.93E-03	5.00E-04	3.11E-06	3.79E-04
Musc R back#1	945.8	10.65	1.29E+00	3.22E-02	1.36E-03	1.21E-01
Musc R back#2	545.7	4.97	7.00E-01	2.12E-02	1.28E-03	1.41E-01
Musc R back#3	659.2	7.82	8.44E-03	1.00E-03	1.28E-05	1.08E-03
Musc R back#4	910.6	8.84	3.37E-03	8.00E-04	3.70E-06	3.81E-04
Musc R front#1	563.6	13.00	5.40E-01	1.71E-02	9.58E-04	4.15E-02
Musc R front#2	408.6	30.47	1.18E-02	1.10E-03	2.90E-05	3.88E-04
Musc R front#3	647.7	6.01	5.27E-03	7.00E-04	8.13E-06	8.76E-04
Musc R front#4	1035.4	7.85	4.34E-03	9.00E-04	4.19E-06	5.53E-04

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc Thigh-L lower	2412.0	15.40	7.34E-03	1.10E-03	3.04E-06	4.76E-04
Musc Thigh-L upper	2859.0	27.30	8.93E-03	1.40E-03	3.12E-06	3.27E-04
Musc Thigh-R lower	1581.0					
Musc Thigh-R upper	3025.0	25.80	8.33E-03	1.20E-03	2.75E-06	3.23E-04
Musc unidentified	660.6		7.31E-01	2.22E-02	1.11E-03	
Musc up arm-L	1055.2	8.73	4.00E-03	6.00E-04	3.79E-06	4.58E-04
Musc up arm-R	1274.5	34.90	5.24E-03	8.00E-04	4.11E-06	1.50E-04
Muscle head	571.3	5.99	3.04E-02	2.80E-03	5.31E-05	5.07E-03
Pancreas	121.3	1.10	5.07E-03	7.00E-04	4.18E-05	4.61E-03
Penis	205.3	1.47	3.21E-03	6.00E-04	1.56E-05	2.18E-03
Pericardium	34.3	0.20	8.11E-02	3.30E-03	2.37E-03	4.06E-01
Peritracheal scraps	27.3	0.20	1.90E-02	6.40E-03	6.95E-04	9.48E-02
Pituitary	0.4	0.10	1.67E-04	1.00E-04	4.17E-04	1.67E-03
Pons	17.1	0.20	6.33E-04	2.00E-04	3.70E-05	3.17E-03
Prostate	23.1	0.30	1.67E-04	2.00E-04	7.22E-06	5.56E-04
Rectum	230.0	3.99	2.40E-03	5.00E-04	1.04E-05	6.02E-04
Skin Calf-L lower	237.0	1.10	1.24E-03	4.00E-04	5.23E-06	1.13E-03
Skin Calf-L upper	322.4	1.64	1.83E-03	4.00E-04	5.69E-06	1.12E-03
Skin Calf-R lower	199.8	1.07	1.43E-03	4.00E-04	7.17E-06	1.34E-03
Skin Calf-R upper	487.9	2.03	2.24E-03	5.00E-04	4.59E-06	1.10E-03
Skin Foot-L	280.6	1.71	1.83E-03	4.00E-04	6.53E-06	1.07E-03
Skin Foot-R	268.9	1.73	2.21E-03	5.00E-04	8.20E-06	1.27E-03
Skin forearm-L	233.5	2.98	1.73E-03	4.00E-04	7.42E-06	5.82E-04
Skin forearm-R	204.1	1.20	1.13E-03	3.00E-04	5.55E-06	9.44E-04
Skin hand-L	146.2	1.03	9.07E-04	4.00E-04	6.21E-06	8.81E-04
Skin hand-R	162.8	1.11	1.18E+00	3.75E-02	7.24E-03	1.06E+00
Skin head	479.5	5.25				
Skin L back#1	595.3	2.30	1.63E-03	4.00E-04	2.74E-06	7.10E-04
Skin L back#2	425.7	1.90	1.53E-03	4.00E-04	3.60E-06	8.07E-04

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin L back#3	467.9					
Skin L back#4	635.4					
Skin L front#1	282.8	5.60	1.33E-03	3.00E-04	4.71E-06	2.38E-04
Skin L front#2	540.8	6.80	2.07E-02	3.10E-03	3.82E-05	3.04E-03
Skin L front#3	396.4	3.40	4.67E-04	3.00E-04	1.18E-06	1.37E-04
Skin L front#4	529.2	2.40	1.71E-03	5.00E-04	3.24E-06	7.14E-04
Skin R back#1	457.2	2.70	3.17E-03	6.00E-04	6.93E-06	1.17E-03
Skin R back#2	412.0	2.03	2.73E-03	9.00E-04	6.63E-06	1.35E-03
Skin R back#3	544.6	2.00	1.44E-03	4.00E-04	2.64E-06	7.18E-04
Skin R back#4	808.8	2.80	2.57E-03	6.00E-04	3.17E-06	9.17E-04
Skin R front#1	408.5	8.42				
Skin R front#2	337.3	6.10	9.67E-04	4.00E-04	2.87E-06	1.59E-04
Skin R front#3	402.1	2.41	4.34E-04	3.00E-04	1.08E-06	1.80E-04
Skin R front#4	432.3	1.70	7.67E-04	3.00E-04	1.77E-06	4.51E-04
Skin Thigh-L lower	680.2	2.80	1.71E-02	1.60E-03	2.51E-05	6.10E-03
Skin Thigh-L upper	1336.9	5.60	2.87E-03	6.00E-04	2.14E-06	5.12E-04
Skin Thigh-R lower	863.1	3.16	1.43E-03	5.00E-04	1.66E-06	4.54E-04
Skin Thigh-R upper	1287.3	4.20	2.07E-03	7.00E-04	1.61E-06	4.93E-04
Skin up arm-L	552.0	2.20	1.17E-03	3.00E-04	2.11E-06	5.31E-04
Skin up arm-R	605.8	3.84	1.97E-03	4.00E-04	3.25E-06	5.12E-04
Spinal Cord	35.7	0.50	3.00E-04	2.00E-04	8.40E-06	6.00E-04
Spleen	212.6	2.20	2.89E-02	1.80E-03	1.36E-04	1.31E-02
Stomach	186.7	1.20	1.73E-02	1.30E-03	9.28E-05	1.44E-02
TBLN #1	0.6	0.05	2.68E-01	3.12E-02	4.47E-01	5.36E+00
TBLN #2	0.6	0.05	1.19E-01	1.41E-02	1.99E-01	2.39E+00
TBLN #3	1.3	0.05	6.31E-01	3.84E-02	4.85E-01	1.26E+01
TBLN #4	1.3	0.05	2.61E-01	2.53E-02	2.01E-01	5.22E+00
Testis-L	22.6	0.20	1.00E-03	3.00E-04	4.42E-05	5.00E-03
Testis-R	30.3	0.30	1.03E-03	3.00E-04	3.41E-05	3.44E-03

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Thyroid	23.9	0.40	7.00E-04	3.00E-04	2.93E-05	1.75E-03
Tongue	85.2	0.80	1.27E-03	4.00E-04	1.49E-05	1.58E-03
Trachea	15.2	0.10	1.05E-02	1.00E-03	6.89E-04	1.05E-01
Bones						
Calcaneus	107.0	28.91				
Canine RL3	1.3	0.97	3.33E-05	1.00E-04	2.56E-05	3.44E-05
Canine RU3	1.8	1.31	-1.67E-04	2.00E-04	-9.26E-05	-1.27E-04
Capitate	5.9	1.91	1.67E-04	2.00E-04	2.82E-05	8.73E-05
Clavicle Acrom	19.4	4.86	5.07E-03	7.00E-04	2.62E-04	1.04E-03
Clavicle SE	15.5	5.17	3.37E-03	6.00E-04	2.17E-04	6.52E-04
Clavicle Shaft	16.8	8.09	6.95E-03	2.10E-03	4.14E-04	8.59E-04
Coccyx	5.2	0.73	6.11E-04	3.00E-04	1.18E-04	8.37E-04
Costal cart-R	103.7	3.84	1.47E-03	4.00E-04	1.41E-05	3.82E-04
Cuboid	19.4	4.85	1.17E-03	3.00E-04	6.01E-05	2.41E-04
Femur DE	239.0	56.70	3.50E-02	6.50E-03	1.46E-04	6.17E-04
Femur DS	126.6	47.32	1.75E-02	6.70E-03	1.38E-04	3.70E-04
Femur MS	136.3	66.88	2.50E-02	9.10E-03	1.84E-04	3.74E-04
Femur PE	228.3	56.62	4.88E-02	6.90E-03	2.14E-04	8.62E-04
Femur PS	130.8	59.52	3.37E-02	5.60E-03	2.57E-04	5.66E-04
Fibula DE	17.4	5.31	2.67E-03	9.00E-04	1.53E-04	5.03E-04
Fibula DS	30.4	16.36	7.47E-03	2.90E-03	2.46E-04	4.56E-04
Fibula PE	19.3	3.61				
Fibula PS	31.1	16.12	5.34E-03	2.30E-03	1.72E-04	3.31E-04
Fingernails	1.9	0.01	1.67E-04	2.00E-04	8.77E-05	1.67E-02
Frontal #1	43.8	25.04	1.03E-02	2.40E-03	2.36E-04	4.13E-04
Frontal #2	20.6	11.67	3.87E-03	9.00E-04	1.88E-04	3.31E-04
Frontal #3	16.3	7.26	2.93E-03	8.00E-04	1.80E-04	4.04E-04
Ft Phal D1	3.5	0.91	5.00E-04	3.00E-04	1.43E-04	5.49E-04

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal D2	0.7	0.14	1.00E-04	2.00E-04	1.43E-04	7.14E-04
Ft Phal D3	0.7	0.13	2.33E-04	3.00E-04	3.33E-04	1.79E-03
Ft Phal D4	0.6	0.12	1.00E-04	1.00E-04	1.67E-04	8.33E-04
Ft Phal D5	0.5	0.08	2.67E-04	2.00E-04	5.33E-04	3.33E-03
Ft Phal M2	1.1	0.28				
Ft Phal M3	0.7	0.16	3.33E-04	2.00E-04	4.76E-04	2.08E-03
Ft Phal M4	0.5	0.13	6.67E-05	1.00E-04	1.31E-04	5.13E-04
Ft Phal M5	0.4	0.09	1.67E-04	2.00E-04	4.17E-04	1.85E-03
Ft Phal P1	7.5	2.53	1.63E-03	4.00E-04	2.18E-04	6.46E-04
Ft Phal P2	2.7	0.85				
Ft Phal P3	2.0	0.58	5.33E-04	3.00E-04	2.67E-04	9.20E-04
Ft Phal P4	1.7	0.52	5.00E-04	3.00E-04	2.94E-04	9.62E-04
Ft Phal P5	1.8	0.46	1.57E-03	6.00E-04	8.70E-04	3.41E-03
Hamate	4.5	1.39	1.07E-03	3.00E-04	2.37E-04	7.67E-04
Hand-phal D1	1.9	0.56	2.00E-04	2.00E-04	1.05E-04	3.57E-04
Hand-phal D2	1.0	0.27	7.07E-03	8.00E-04	7.07E-03	2.62E-02
Hand-phal D3	1.3	0.35	6.00E-04	3.00E-04	4.62E-04	1.71E-03
Hand-phal D4	1.0	0.29	6.33E-04	3.00E-04	6.33E-04	2.18E-03
Hand-phal D5	0.8	0.21	1.67E-04	2.00E-04	2.08E-04	7.94E-04
Hand-phal M2	2.0	0.77	2.67E-04	6.00E-04	1.33E-04	3.46E-04
Hand-phal M3	2.8	1.13	9.00E-04	3.00E-04	3.21E-04	7.96E-04
Hand-phal M4	2.2	0.84	6.67E-04	3.00E-04	3.03E-04	7.94E-04
Hand-phal M5	1.3	0.49	4.00E-04	6.00E-04	3.08E-04	8.16E-04
Hand-phal P1	4.2	1.41	5.33E-04	2.00E-04	1.27E-04	3.78E-04
Hand-phal P2	6.0	2.17				
Hand-phal P3	7.0	2.71	1.03E-03	3.00E-04	1.48E-04	3.81E-04
Hand-phal P4	5.1	1.85	8.00E-04	3.00E-04	1.57E-04	4.32E-04
Hand-phal P5	3.3	1.14	6.00E-04	3.00E-04	1.82E-04	5.26E-04
Humerus DE	68.7	23.82	1.37E-02	2.60E-03	1.99E-04	5.74E-04

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Humerus DS	72.4	34.71	-2.22E-04	8.00E-04	-3.07E-06	-6.40E-06
Humerus PE	93.2	18.53	1.70E-02	2.40E-03	1.82E-04	9.18E-04
Humerus PS	86.0	33.80	1.67E-02	3.20E-03	1.94E-04	4.93E-04
R cuneiform	6.8	2.07	8.67E-04	3.00E-04	1.27E-04	4.19E-04
Ilium-body	235.5	63.06	5.30E-02	7.40E-03	2.25E-04	8.40E-04
Ilium-crest	49.7	15.02	1.40E-02	1.90E-03	2.82E-04	9.32E-04
Incisor RL1	0.6	0.38	3.33E-04	2.00E-04	5.56E-04	8.77E-04
Incisor RL2	0.7	0.52	-6.67E-05	2.00E-04	-9.52E-05	-1.28E-04
Incisor RU1	1.3	0.94	3.33E-04	2.00E-04	2.62E-04	3.55E-04
Incisor RU2	1.1	0.76	-1.33E-04	1.00E-04	-1.26E-04	-1.75E-04
Ischium-R	246.9	73.16	7.59E-02	9.00E-03	3.07E-04	1.04E-03
I cuneiform	9.9	2.63	1.57E-03	4.00E-04	1.58E-04	5.96E-04
Lunate	4.1	1.24	9.00E-04	3.00E-04	2.20E-04	7.26E-04
M cuneiform	16.4	4.76	1.43E-03	4.00E-04	8.74E-05	3.01E-04
Mandible	43.9	22.84	9.67E-03	2.30E-03	2.20E-04	4.23E-04
Maxilla	45.5	15.56	1.01E-02	1.60E-03	2.22E-04	6.49E-04
Metacarpal #1	8.5	2.77	6.67E-05	6.00E-04	7.84E-06	2.41E-05
Metacarpal #2	13.1	4.89				
Metacarpal #3	12.6	4.76	2.40E-03	9.00E-04	1.90E-04	5.04E-04
Metacarpal #4	7.8	2.68	1.10E-03	4.00E-04	1.41E-04	4.10E-04
Metacarpal #5	6.2	2.14	1.23E-03	4.00E-04	1.99E-04	5.76E-04
Metatarsal 1	25.5	8.72	4.50E-03	7.00E-04	1.76E-04	5.16E-04
Metatarsal 2	13.2	4.72				
Metatarsal 3	11.8	3.90	1.40E-03	4.00E-04	1.19E-04	3.59E-04
Metatarsal 4	13.0	4.53				
Metatarsal 5	13.9	4.91				
Molar RL6	1.9	1.36	1.63E-03	1.40E-03	8.60E-04	1.20E-03
Molar RL7	2.0	1.57		2.00E-04		
Molar RL8	1.4	1.09	1.00E-04	2.00E-04	7.14E-05	9.17E-05

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Molar RU6	2.3	1.70	3.67E-04	2.00E-04	1.59E-04	2.16E-04
Molar RU7	2.4	1.64	7.67E-04	3.00E-04	3.22E-04	4.67E-04
Molar RU8	0.8	0.53	-5.33E-04	5.00E-04	-7.11E-04	-1.01E-03
Nasal Cartilage	20.8	0.60	8.01E-04	3.00E-04	3.85E-05	1.33E-03
Navicular	19.8	5.92	2.73E-03	5.00E-04	1.38E-04	4.62E-04
Occipital	31.9	17.14	1.53E-02	2.60E-03	4.78E-04	8.90E-04
Parietal #1	63.0	35.25	2.00E-02	4.70E-03	3.17E-04	5.67E-04
Parietal #2	84.2	46.51	2.72E-02	4.50E-03	3.23E-04	5.85E-04
Patella-R	35.3	11.33	5.00E-03	1.80E-03	1.42E-04	4.41E-04
Premolar RL4	1.1	0.83	1.33E-04	2.00E-04	1.21E-04	1.61E-04
Premolar RL5	1.2	0.93	3.67E-04	8.00E-04	3.06E-04	3.94E-04
Premolar RU4	1.2	0.93	1.67E-04	3.00E-04	1.34E-04	1.79E-04
Premolar RU5	1.0	0.73	5.70E-04	3.00E-04	5.99E-04	7.80E-04
R-Rib #1	29.4	7.87	7.94E-03	1.00E-03	2.70E-04	1.01E-03
R-Rib #10	25.5	8.82	8.17E-03	1.20E-03	3.20E-04	9.26E-04
R-Rib #11	18.8	6.80	7.09E-03	1.60E-03	3.77E-04	1.04E-03
R-Rib #12	9.9	3.31	3.33E-03	8.00E-04	3.37E-04	1.01E-03
R-Rib #2	22.7	6.81	8.96E-03	2.00E-03	3.95E-04	1.32E-03
R-Rib #3	25.1	7.93	6.20E-03	1.20E-03	2.47E-04	7.82E-04
R-Rib #4 bone	24.6	9.61	1.10E-02	1.50E-03	4.47E-04	1.14E-03
R-Rib #4 marrow	6.5		1.03E-03	6.00E-04	1.59E-04	
R-Rib #5	33.2	10.09	1.32E-02	2.90E-03	3.97E-04	1.31E-03
R-Rib #6	38.6	12.82	1.21E-02	3.00E-03	3.13E-04	9.43E-04
R-Rib #7 bone	21.6	9.51	6.47E-03	1.10E-03	2.99E-04	6.80E-04
R-Rib #7 marrow	5.4		5.67E-04	2.00E-04	1.05E-04	
R-Rib #8	36.0	12.33	1.35E-02	1.70E-03	3.76E-04	1.10E-03
R-Rib #9 bone	21.9	9.20	4.47E-03	9.00E-04	2.04E-04	4.86E-04
R-Rib #9 marrow	6.1		2.67E-04	4.00E-04	4.37E-05	
Radius DE	17.3	4.96	4.33E-04	1.10E-03	2.50E-05	8.74E-05

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius DS	23.1	12.02	2.50E-03	9.00E-04	1.08E-04	2.08E-04
Radius PE	10.3	3.13	1.63E-03	5.00E-04	1.59E-04	5.22E-04
Radius PS	30.9	15.23	3.70E-03	9.00E-04	1.20E-04	2.43E-04
Sacrum	301.5	64.46	1.21E-01	1.30E-02	4.02E-04	1.88E-03
Scap spine	40.5	14.12	1.16E-02	2.80E-03	2.85E-04	8.18E-04
Scaphoid	5.4	1.69	1.07E-03	3.00E-04	1.98E-04	6.31E-04
Scapula DE	42.1	17.70	1.70E-02	4.80E-03	4.04E-04	9.62E-04
Scapula PE	45.4	14.69	1.54E-02	2.20E-03	3.39E-04	1.05E-03
Sesamoid-Ft	3.1	0.90	3.00E-04	1.00E-03	9.68E-05	3.33E-04
Sternum	117.1	22.84	3.62E-02	4.00E-03	3.09E-04	1.58E-03
Talus	65.5	19.21	1.06E-02	2.40E-03	1.61E-04	5.49E-04
Temporal #1	22.6	12.97	6.53E-03	1.40E-03	2.89E-04	5.04E-04
Temporal #2	74.6	27.44	1.77E-02	3.50E-03	2.38E-04	6.46E-04
Temporal #3	33.6	19.55	1.19E-02	1.70E-03	3.54E-04	6.09E-04
Tibia DE	66.1	18.37	7.71E-03	1.60E-03	1.17E-04	4.20E-04
Tibia DS	126.7	60.33	1.50E-02	4.50E-03	1.18E-04	2.49E-04
Tibia PE	187.8	40.44	2.13E-02	4.50E-03	1.14E-04	5.28E-04
Tibia PS	167.3	73.69	2.38E-02	5.90E-03	1.42E-04	3.23E-04
Toenails-Ft	1.3	0.01	-6.67E-05	1.00E-04	-5.13E-05	-6.67E-03
Trapezium	3.6	1.05	7.00E-04	3.00E-04	1.94E-04	6.67E-04
Trapezoid	2.5	0.75	4.67E-04	2.00E-04	1.87E-04	6.22E-04
Triangular	1.9	0.60	8.00E-04	1.00E-03	4.21E-04	1.33E-03
Ulna DE	7.9	2.45	4.80E-04	3.00E-04	6.08E-05	1.96E-04
Ulna DS	22.0	11.52	3.80E-02	1.23E-02	1.73E-03	3.30E-03
Ulna PE	41.4	15.61	7.67E-03	1.40E-03	1.85E-04	4.91E-04
Ulna PS	30.4	16.41	2.28E-02	8.60E-03	7.51E-04	1.39E-03
Vert arch C-3	11.9	4.10	2.80E-03	6.00E-04	2.36E-04	6.84E-04
Vert arch C-5	9.8	3.52	5.40E-03	7.00E-04	5.51E-04	1.54E-03
Vert arch C-7	13.8	4.82	3.67E-04	2.00E-04	2.66E-05	7.61E-05

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert arch L-1	33.5	8.79	9.45E-03	1.50E-03	2.82E-04	1.08E-03
Vert arch L-3	37.8	12.48	1.19E-02	1.80E-03	3.15E-04	9.55E-04
Vert arch L-5	41.3	11.08	1.18E-02	1.80E-03	2.87E-04	1.07E-03
Vert arch T-1	22.4	7.43	5.70E-03	9.00E-04	2.54E-04	7.67E-04
Vert arch T-11	25.1	7.02	7.34E-03	1.20E-03	2.93E-04	1.05E-03
Vert arch T-3	19.8	5.88	8.98E-03	1.20E-03	4.53E-04	1.53E-03
Vert arch T-5	18.4	5.41	6.17E-03	9.00E-04	3.35E-04	1.14E-03
Vert arch T-7	21.5					
Vert arch T-9	24.9	7.23	9.00E-03	1.30E-03	3.61E-04	1.24E-03
Vert atlas C-1	22.6	8.25	8.15E-03	1.30E-03	3.60E-04	9.87E-04
Vert body bone C-5	6.7	2.12	4.40E-03	6.00E-04	6.57E-04	2.08E-03
Vert body bone L-3	27.7	8.07	1.20E-02	1.10E-03	4.32E-04	1.48E-03
Vert body bone T-5	10.9	2.85	4.33E-03	7.00E-04	3.98E-04	1.52E-03
Vert body C-3	7.7	2.19	3.34E-03	6.00E-04	4.33E-04	1.52E-03
Vert body C-7	8.9	2.42	3.60E-03	6.00E-04	4.04E-04	1.49E-03
Vert body L-1	42.3	7.76	1.29E-02	1.50E-03	3.04E-04	1.66E-03
Vert body L-5	69.9	14.63	1.73E-02	2.20E-03	2.48E-04	1.18E-03
Vert body marrow C-5	0.7		4.00E-04	2.00E-04	5.71E-04	
Vert body marrow L-3	14.8		1.43E-03	3.00E-04	9.68E-05	
Vert body marrow T-5	3.7		2.33E-04	2.00E-04	6.31E-05	
Vert body T-1	12.5	2.89	4.57E-03	7.00E-04	3.65E-04	1.58E-03
Vert body T-11	32.3	6.37	9.47E-03	1.40E-03	2.93E-04	1.49E-03
Vert body T-3	12.8	2.60	5.95E-03	7.00E-04	4.64E-04	2.29E-03
Vert body T-7	23.9					
Vert body T-9	27.2	5.28	8.17E-03	8.00E-04	3.00E-04	1.55E-03
Vert whole T-10	62.3	13.93	2.05E-02	2.40E-03	3.29E-04	1.47E-03
Vert whole T-12	62.1	13.37	1.71E-02	1.90E-03	2.75E-04	1.28E-03
Vert whole T-2	35.3	9.39	7.93E-03	1.30E-03	2.25E-04	8.45E-04
Vert whole T-6	40.3	9.13	6.09E-03	1.50E-03	1.51E-04	6.67E-04

Table 15. ^{239}Pu in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert whole T-8	52.3	11.33	1.52E-02	2.00E-03	2.91E-04	1.34E-03
	58722.7	2325.16	14.85			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
RL	Right Lower	I	Intermediate	t	thoracic
RU	Right Upper			l	lumbar

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	11.7	0.10	6.00E-04	2.00E-04	5.13E-05	6.00E-03
Adrenal-R	9.2	0.10	2.81E-02	2.00E-04	3.05E-03	2.81E-01
Aorta	45.9	0.30	1.57E-03	4.00E-04	3.41E-05	5.22E-03
Aortic Arch	29.2	0.30	5.40E-03	7.00E-04	1.85E-04	1.80E-02
Bile	10.2	0.10	1.00E-03	4.00E-04	9.80E-05	1.00E-02
Bladder	78.0	0.40	1.57E-03	4.00E-04	2.01E-05	3.92E-03
Blood	44.3	0.40	7.33E-04	3.00E-04	1.66E-05	1.83E-03
Cerebellum	153.2	2.40	4.67E-04	2.00E-04	3.05E-06	1.94E-04
Cerebrum	1206.9	16.80	7.33E-04	3.00E-04	6.08E-07	4.37E-05
Diaphragm	287.9	2.10	1.34E-02	1.30E-03	4.67E-05	6.40E-03
Duodenum	76.3	0.50	8.67E-04	3.00E-04	1.14E-05	1.73E-03
Dura mater #1	30.3	0.40	5.00E-04	3.00E-04	1.65E-05	1.25E-03
Dura mater #2	22.8	0.30	1.07E-03	3.00E-04	4.68E-05	3.56E-03
Ear-L	19.5	0.18	2.33E-04	2.00E-04	1.20E-05	1.30E-03
Ear-R	18.3	0.24	8.34E-04	4.00E-04	4.56E-05	3.47E-03
Esophagus	44.4	0.30	1.33E-03	4.00E-04	3.00E-05	4.44E-03
Eye-R	7.5	0.04	1.07E-03	4.00E-04	1.42E-04	2.67E-02
Gall Bladder	10.3	0.20	7.33E-04	3.00E-04	7.12E-05	3.67E-03
Hair	15.4	0.18	1.43E-03	4.00E-04	9.31E-05	7.97E-03
Heart	338.3	2.40	2.70E-03	6.00E-04	7.98E-06	1.13E-03
Hilar LN - L	3.5	0.10	1.37E-01	1.79E-02	3.90E-02	1.37E+00
Hilar LN - R	3.6	0.10	1.31E-01	1.56E-02	3.63E-02	1.31E+00
Intestine-large	898.1	4.50	2.02E-03	4.00E-04	2.25E-06	4.49E-04
Intestine-small	686.4	2.70	2.40E-03	5.00E-04	3.50E-06	8.89E-04
Kidney-L	159.4	1.50	2.13E-03	5.00E-04	1.34E-05	1.42E-03
Kidney-R	143.7	1.30	1.70E-03	1.40E-03	1.18E-05	1.31E-03
Larynx	105.7	3.70	2.00E-03	5.00E-04	1.89E-05	5.41E-04
Liver	1483.2	15.50	2.67E-01	4.48E-02	1.80E-04	1.72E-02

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Lung-L	599.3	5.50	1.95E-01	3.76E-02	3.25E-04	3.54E-02
Lung-R	696.2	6.20	2.64E-01	4.37E-02	3.79E-04	4.26E-02
Mesentery	246.5	0.90	1.87E-03	4.00E-04	7.57E-06	2.07E-03
Musc Calf-L lower	683.5	7.36	3.00E-03	6.00E-04	4.39E-06	4.08E-04
Musc Calf-L upper	755.9					
Musc Calf-R lower	835.1	8.45	4.28E-03	1.00E-03	5.13E-06	5.07E-04
Musc Calf-R upper	617.0	49.03	1.17E-03	4.00E-04	1.89E-06	2.38E-05
Musc Foot-L	305.8	6.70	2.94E-03	6.00E-04	9.61E-06	4.38E-04
Musc Foot-R	325.3	2.17	2.17E-03	5.00E-04	6.66E-06	9.98E-04
Musc forearm-L	503.4	27.77	1.33E-03	4.00E-04	2.65E-06	4.80E-05
Musc forearm-R	520.7	4.53	1.53E-03	5.00E-04	2.95E-06	3.39E-04
Musc hand-L	112.7	1.65	1.30E-03	4.00E-04	1.15E-05	7.88E-04
Musc hand-R	134.8	4.60	2.39E-02	1.70E-03	1.77E-04	5.20E-03
Musc L back#1	1032.3	9.22	2.20E-03	1.10E-03	2.13E-06	2.39E-04
Musc L back#2	449.8	19.25	2.60E-03	6.00E-04	5.78E-06	1.35E-04
Musc L back#3	469.5	6.09	1.67E-03	5.00E-04	3.55E-06	2.74E-04
Musc L back#4	930.1	36.24	4.13E-03	1.60E-03	4.44E-06	1.14E-04
Musc L front#1	660.6	9.02	4.57E-03	1.50E-03	6.91E-06	5.06E-04
Musc L front#2	97.5	1.05	9.67E-04	4.00E-04	9.91E-06	9.21E-04
Musc L front#3	267.9	3.71	1.50E-03	6.00E-04	5.59E-06	4.04E-04
Musc L front#4	622.0	5.10	3.08E-03	1.00E-03	4.94E-06	6.03E-04
Musc R back#1	945.8	10.65	2.38E-01	1.35E-02	2.52E-04	2.24E-02
Musc R back#2	545.7	4.97	1.07E-01	4.50E-03	1.95E-04	2.15E-02
Musc R back#3	659.2	7.82	2.36E-03	9.00E-04	3.58E-06	3.02E-04
Musc R back#4	910.6	8.84	3.44E-03	1.30E-03	3.77E-06	3.89E-04
Musc R front#1	563.6	13.00	8.63E-02	8.10E-03	1.53E-04	6.64E-03
Musc R front#2	408.6	30.47	5.73E-03	1.50E-03	1.40E-05	1.88E-04
Musc R front#3	647.7	6.01	2.44E-03	6.00E-04	3.77E-06	4.06E-04
Musc R front#4	1035.4	7.85	1.60E-03	1.20E-03	1.55E-06	2.04E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc Thigh-L lower	2412.0	15.40	4.34E-03	1.20E-03	1.80E-06	2.82E-04
Musc Thigh-L upper	2859.0	27.30	5.60E-03	2.70E-03	1.96E-06	2.05E-04
Musc Thigh-R lower	1581.0					
Musc Thigh-R upper	3025.0	25.80	5.73E-03	1.20E-03	1.90E-06	2.22E-04
Musc unidentified	660.6		1.59E-01	6.30E-03	2.41E-04	
Musc up arm-L	1055.2	8.73	2.77E-03	6.00E-04	2.62E-06	3.17E-04
Musc up arm-R	1274.5	34.90	2.97E-03	1.00E-03	2.33E-06	8.51E-05
Muscle head	571.3	5.99	2.34E-04	2.00E-04	4.09E-07	3.90E-05
Pancreas	121.3	1.10	1.40E-03	4.00E-04	1.15E-05	1.27E-03
Penis	205.3	1.47	6.74E-03	9.00E-04	3.29E-05	4.59E-03
Pericardium	34.3	0.20	1.15E-02	1.10E-03	3.36E-04	5.77E-02
Peritracheal scraps	27.3	0.20	2.26E-02	1.60E-03	8.29E-04	1.13E-01
Pituitary	0.4	0.10	8.33E-04	3.00E-04	2.08E-03	8.33E-03
Pons	17.1	0.20	6.67E-04	3.00E-04	3.90E-05	3.33E-03
Prostate	23.1	0.30	5.00E-04	2.00E-04	2.16E-05	1.67E-03
Rectum	230.0	3.99	2.23E-03	8.00E-04	9.71E-06	5.60E-04
Skin Calf-L lower	237.0	1.10	3.45E-03	6.00E-04	1.46E-05	3.14E-03
Skin Calf-L upper	322.4	1.64	2.33E-03	5.00E-04	7.24E-06	1.42E-03
Skin Calf-R lower	199.8	1.07	3.63E-03	7.00E-04	1.82E-05	3.40E-03
Skin Calf-R upper	487.9	2.03	9.53E-03	1.00E-03	1.95E-05	4.69E-03
Skin Foot-L	280.6	1.71	4.20E-03	8.00E-04	1.50E-05	2.46E-03
Skin Foot-R	268.9	1.73	2.47E-03	6.00E-04	9.20E-06	1.43E-03
Skin forearm-L	233.5	2.98	1.77E-03	5.00E-04	7.57E-06	5.93E-04
Skin forearm-R	204.1	1.20	2.23E-03	5.00E-04	1.09E-05	1.86E-03
Skin hand-L	146.2	1.03	1.41E-03	1.10E-03	9.65E-06	1.37E-03
Skin hand-R	162.8	1.11	1.71E-01	1.39E-02	1.05E-03	1.54E-01
Skin head	479.5	5.25				
Skin L back#1	595.3	2.30	2.57E-03	6.00E-04	4.31E-06	1.12E-03
Skin L back#2	425.7	1.90	3.00E-03	6.00E-04	7.05E-06	1.58E-03

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin L back#3	467.9					
Skin L back#4	635.4					
Skin L front#1	282.8	5.60	1.17E-03	8.00E-04	4.13E-06	2.08E-04
Skin L front#2	540.8	6.80	3.50E-03	2.20E-03	6.47E-06	5.15E-04
Skin L front#3	396.4	3.40	1.54E-03	6.00E-04	3.87E-06	4.52E-04
Skin L front#4	529.2	2.40	2.32E-03	6.00E-04	4.38E-06	9.67E-04
Skin R back#1	457.2	2.70	2.20E-03	5.00E-04	4.81E-06	8.15E-04
Skin R back#2	412.0	2.03	2.37E-03	6.00E-04	5.74E-06	1.17E-03
Skin R back#3	544.6	2.00	2.81E-03	6.00E-04	5.15E-06	1.40E-03
Skin R back#4	808.8	2.80	2.80E-03	6.00E-04	3.46E-06	1.00E-03
Skin R front#1	408.5	8.42				
Skin R front#2	337.3	6.10	6.20E-04	1.00E-03	1.84E-06	1.02E-04
Skin R front#3	402.1	2.41	2.33E-04	4.00E-04	5.81E-07	9.69E-05
Skin R front#4	432.3	1.70	1.07E-03	4.00E-04	2.47E-06	6.27E-04
Skin Thigh-L lower	680.2	2.80	1.83E-03	5.00E-04	2.70E-06	6.55E-04
Skin Thigh-L upper	1336.9	5.60	4.70E-03	8.00E-04	3.52E-06	8.39E-04
Skin Thigh-R lower	863.1	3.16	1.77E-03	5.00E-04	2.05E-06	5.59E-04
Skin Thigh-R upper	1287.3	4.20	2.47E-03	8.00E-04	1.92E-06	5.88E-04
Skin up arm-L	552.0	2.20	2.43E-03	5.00E-04	4.41E-06	1.11E-03
Skin up arm-R	605.8	3.84	1.10E-03	4.00E-04	1.82E-06	2.86E-04
Spinal Cord	35.7	0.50	7.33E-04	3.00E-04	2.05E-05	1.47E-03
Spleen	212.6	2.20	4.33E-03	7.00E-04	2.04E-05	1.97E-03
Stomach	186.7	1.20	4.47E-03	7.00E-04	2.39E-05	3.72E-03
TBLN #1	0.6	0.05	6.13E-02	2.35E-02	1.02E-01	1.23E+00
TBLN #2	0.6	0.05	2.47E-02	6.70E-03	4.11E-02	4.93E-01
TBLN #3	1.3	0.05	6.93E-02	1.09E-02	5.33E-02	1.39E+00
TBLN #4	1.3	0.05	4.17E-02	1.09E-02	3.21E-02	8.33E-01
Testis-L	22.6	0.20	7.00E-04	3.00E-04	3.10E-05	3.50E-03
Testis-R	30.3	0.30	8.67E-04	3.00E-04	2.86E-05	2.89E-03

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Thyroid	23.9	0.40	4.33E-04	3.00E-04	1.81E-05	1.08E-03
Tongue	85.2	0.80	5.00E-04	3.00E-04	5.87E-06	6.25E-04
Trachea	15.2	0.10	7.00E-04	3.00E-04	4.61E-05	7.00E-03
Bones						
Calcaneus	107.0	28.91				
Canine RL3	1.3	0.97	6.67E-05	2.00E-04	5.13E-05	6.87E-05
Canine RU3	1.8	1.31	7.67E-04	4.00E-04	4.26E-04	5.85E-04
Capitate	5.9	1.91	1.50E-03	5.00E-04	2.54E-04	7.85E-04
Clavicle Acrom	19.4	4.86	1.05E-02	1.10E-03	5.42E-04	2.16E-03
Clavicle Shaft	16.8	8.09	3.62E-03	1.60E-03	2.15E-04	4.47E-04
Clavicle SE	15.5	5.17	2.33E-03	5.00E-04	1.51E-04	4.52E-04
Coccyx	5.2	0.73	6.39E-04	3.00E-04	1.23E-04	8.75E-04
Costal cart-R	103.7	3.84	3.33E-04	5.00E-04	3.21E-06	8.68E-05
Cuboid	19.4	4.85	2.23E-03	5.00E-04	1.15E-04	4.60E-04
Femur DE	239.0	56.70	1.83E-02	6.00E-03	7.67E-05	3.23E-04
Femur DS	126.6	47.32	4.92E-02	1.18E-02	3.88E-04	1.04E-03
Femur MS	136.3	66.88	3.63E-01	3.48E-02	2.66E-03	5.42E-03
Femur PE	228.3	56.62	3.47E-02	8.90E-03	1.52E-04	6.12E-04
Femur PS	130.8	59.52	3.03E-02	6.20E-03	2.32E-04	5.10E-04
Fibula DE	17.4	5.31	3.92E-03	1.10E-03	2.25E-04	7.38E-04
Fibula DS	30.4	16.36	7.39E-02	8.70E-03	2.43E-03	4.52E-03
Fibula PE	19.3	3.61	1.94E-03	9.00E-04	1.01E-04	5.39E-04
Fibula PS	31.1	16.12	1.15E-02	4.30E-03	3.69E-04	7.12E-04
Fingernails	1.9	0.01	3.00E-04	2.00E-04	1.58E-04	3.00E-02
Frontal #1	43.8	25.04	1.63E-02	3.50E-03	3.73E-04	6.52E-04
Frontal #2	20.6	11.67	1.93E-03	7.00E-04	9.39E-05	1.66E-04
Frontal #3	16.3	7.26	1.07E-03	3.00E-04	6.54E-05	1.47E-04
Ft Phal D1	3.5	0.91	7.67E-04	3.00E-04	2.19E-04	8.42E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal D2	0.7	0.14	1.00E-03	3.00E-04	1.43E-03	7.14E-03
Ft Phal D3	0.7	0.13	3.67E-04	3.00E-04	5.24E-04	2.82E-03
Ft Phal D4	0.6	0.12	5.33E-04	3.00E-04	8.89E-04	4.44E-03
Ft Phal D5	0.5	0.08	1.07E-03	4.00E-04	2.13E-03	1.33E-02
Ft Phal M2	1.1	0.28	8.00E-04	4.00E-04	7.27E-04	2.86E-03
Ft Phal M3	0.7	0.16	5.00E-04	3.00E-04	7.14E-04	3.13E-03
Ft Phal M4	0.5	0.13	6.00E-04	2.00E-04	1.18E-03	4.62E-03
Ft Phal M5	0.4	0.09	4.00E-04	3.00E-04	1.00E-03	4.44E-03
Ft Phal P1	7.5	2.53	8.67E-04	3.00E-04	1.16E-04	3.43E-04
Ft Phal P2	2.7	0.85	1.27E-03	3.00E-04	4.69E-04	1.49E-03
Ft Phal P3	2.0	0.58	3.00E-04	2.00E-04	1.50E-04	5.17E-04
Ft Phal P4	1.7	0.52	8.67E-04	3.00E-04	5.10E-04	1.67E-03
Ft Phal P5	1.8	0.46	3.67E-04	3.00E-04	2.04E-04	7.97E-04
Hamate	4.5	1.39	6.67E-04	3.00E-04	1.48E-04	4.80E-04
Hand-phal D1	1.9	0.56	2.00E-04	1.00E-04	1.05E-04	3.57E-04
Hand-phal D2	1.0	0.27	1.40E-03	4.00E-04	1.40E-03	5.19E-03
Hand-phal D3	1.3	0.35	8.33E-04	3.00E-04	6.41E-04	2.38E-03
Hand-phal D4	1.0	0.29	9.00E-04	3.00E-04	9.00E-04	3.10E-03
Hand-phal D5	0.8	0.21	4.00E-04	3.00E-04	5.00E-04	1.90E-03
Hand-phal M2	2.0	0.77	1.00E-03	4.00E-04	5.00E-04	1.30E-03
Hand-phal M3	2.8	1.13	6.33E-04	3.00E-04	2.26E-04	5.60E-04
Hand-phal M4	2.2	0.84	3.33E-04	3.00E-04	1.52E-04	3.97E-04
Hand-phal M5	1.3	0.49	1.40E-03	3.00E-04	1.08E-03	2.86E-03
Hand-phal P1	4.2	1.41	9.33E-04	4.00E-04	2.22E-04	6.62E-04
Hand-phal P2	6.0	2.17	1.13E-03	3.00E-04	1.89E-04	5.22E-04
Hand-phal P3	7.0	2.71	6.00E-04	2.00E-04	8.57E-05	2.21E-04
Hand-phal P4	5.1	1.85	2.33E-04	3.00E-04	4.58E-05	1.26E-04
Hand-phal P5	3.3	1.14	7.67E-04	3.00E-04	2.32E-04	6.73E-04
Humerus DE	68.7	23.82	1.20E-02	2.80E-03	1.75E-04	5.04E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Humerus DS	72.4	34.71	1.78E-02	4.40E-03	2.46E-04	5.12E-04
Humerus PE	93.2	18.53	8.45E-03	2.00E-03	9.07E-05	4.56E-04
Humerus PS	86.0	33.80	7.29E-03	3.40E-03	8.48E-05	2.16E-04
R cuneiform	6.8	2.07	1.07E-03	3.00E-04	1.57E-04	5.15E-04
Ilium-body	235.5	63.06	3.10E-02	6.90E-03	1.32E-04	4.92E-04
Ilium-crest	49.7	15.02	5.42E-03	1.40E-03	1.09E-04	3.61E-04
Incisor RL1	0.6	0.38	3.17E-03	7.00E-04	5.28E-03	8.33E-03
Incisor RL2	0.7	0.52	2.33E-04	2.00E-04	3.33E-04	4.49E-04
Incisor RU1	1.3	0.94	5.33E-04	3.00E-04	4.20E-04	5.67E-04
Incisor RU2	1.1	0.76	6.67E-04	2.00E-04	6.29E-04	8.77E-04
Ischium-R	246.9	73.16	2.75E-02	6.20E-03	1.11E-04	3.76E-04
I cuneiform	9.9	2.63	5.33E-04	3.00E-04	5.39E-05	2.03E-04
Lunate	4.1	1.24	6.67E-04	3.00E-04	1.63E-04	5.38E-04
M cuneiform	16.4	4.76	1.03E-03	4.00E-04	6.30E-05	2.17E-04
Mandible	43.9	22.84	7.67E-03	2.30E-03	1.75E-04	3.36E-04
Maxilla	45.5	15.56	5.25E-03	1.30E-03	1.16E-04	3.38E-04
Metacarpal #1	8.5	2.77	1.53E-03	5.00E-04	1.80E-04	5.54E-04
Metacarpal #2	13.1	4.89				
Metacarpal #3	12.6	4.76	1.67E-03	5.00E-04	1.32E-04	3.50E-04
Metacarpal #4	7.8	2.68	1.07E-03	4.00E-04	1.37E-04	3.98E-04
Metacarpal #5	6.2	2.14	9.33E-04	4.00E-04	1.51E-04	4.36E-04
Metatarsal 1	25.5	8.72	2.27E-03	6.00E-04	8.89E-05	2.60E-04
Metatarsal 2	13.2	4.72				
Metatarsal 3	11.8	3.90	1.57E-03	4.00E-04	1.33E-04	4.02E-04
Metatarsal 4	13.0	4.53				
Metatarsal 5	13.9	4.91				
Molar RL6	1.9	1.36	3.00E-04	4.00E-04	1.58E-04	2.21E-04
Molar RL7	2.0	1.57	2.63E-03	5.00E-04	1.32E-03	1.68E-03
Molar RL8	1.4	1.09	4.67E-04	3.00E-04	3.33E-04	4.28E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Molar RU6	2.3	1.70	1.57E-03	7.00E-04	6.81E-04	9.22E-04
Molar RU7	2.4	1.64	6.00E-04	3.00E-04	2.52E-04	3.66E-04
Molar RU8	0.8	0.53	9.33E-04	3.00E-04	1.24E-03	1.76E-03
Nasal Cartilage	20.8	0.60	1.47E-03	4.00E-04	7.06E-05	2.45E-03
Navicular	19.8	5.92	2.13E-03	5.00E-04	1.08E-04	3.60E-04
Occipital	31.9	17.14	4.63E-03	1.90E-03	1.45E-04	2.70E-04
Parietal #1	63.0	35.25	1.41E-02	3.90E-03	2.24E-04	4.01E-04
Parietal #2	84.2	46.51	1.33E-02	4.90E-03	1.58E-04	2.87E-04
Patella-R	35.3	11.33	1.10E-02	6.50E-03	3.12E-04	9.71E-04
Premolar RL4	1.1	0.83	1.00E-03	4.00E-04	9.09E-04	1.20E-03
Premolar RL5	1.2	0.93	5.33E-04	4.00E-04	4.44E-04	5.73E-04
Premolar RU4	1.2	0.93	1.67E-04	3.00E-04	1.34E-04	1.79E-04
Premolar RU5	1.0	0.73	9.38E-04	5.00E-04	9.87E-04	1.28E-03
R-Rib #1	29.4	7.87	5.10E-03	9.00E-04	1.73E-04	6.48E-04
R-Rib #10	25.5	8.82	3.95E-03	1.22E-02	1.55E-04	4.48E-04
R-Rib #11	18.8	6.80	6.05E-03	1.70E-03	3.22E-04	8.90E-04
R-Rib #12	9.9	3.31	7.20E-03	1.30E-03	7.27E-04	2.18E-03
R-Rib #2	22.7	6.81	6.77E-03	1.80E-03	2.98E-04	9.94E-04
R-Rib #3	25.1	7.93	5.40E-03	1.20E-03	2.15E-04	6.81E-04
R-Rib #4 bone	24.6	9.61	5.53E-03	1.10E-03	2.25E-04	5.76E-04
R-Rib #4 marrow	6.5		1.77E-02	1.40E-03	2.73E-03	
R-Rib #5	33.2	10.09	1.00E-02	2.70E-03	3.02E-04	9.93E-04
R-Rib #6	38.6	12.82	1.04E-02	2.70E-03	2.70E-04	8.13E-04
R-Rib #7 bone	21.6	9.51	5.47E-03	1.00E-03	2.53E-04	5.75E-04
R-Rib #7 marrow	5.4		6.17E-03	6.00E-04	1.14E-03	
R-Rib #8	36.0	12.33	7.47E-03	1.40E-03	2.07E-04	6.06E-04
R-Rib #9 bone	21.9	9.20				
R-Rib #9 marrow	6.1		4.37E-03	2.40E-03	7.16E-04	
Radius DE	17.3	4.96	2.40E-03	7.00E-04	1.39E-04	4.84E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius DS	23.1	12.02	2.00E-03	9.00E-04	8.66E-05	1.66E-04
Radius PE	10.3	3.13	9.67E-04	4.00E-04	9.39E-05	3.09E-04
Radius PS	30.9	15.23	3.40E-03	1.00E-03	1.10E-04	2.23E-04
Sacrum	301.5	64.46	4.67E-02	9.00E-03	1.55E-04	7.24E-04
Scap spine	40.5	14.12	1.69E-02	3.70E-03	4.17E-04	1.20E-03
Scaphoid	5.4	1.69	4.33E-04	2.00E-04	8.02E-05	2.56E-04
Scapula DE	42.1	17.70	1.16E-01	1.25E-02	2.76E-03	6.56E-03
Scapula PE	45.4	14.69	5.60E-03	1.60E-03	1.23E-04	3.81E-04
Sesamoid-Ft	3.1	0.90	9.33E-04	3.00E-04	3.01E-04	1.04E-03
Sternum	117.1	22.84	1.97E-02	3.70E-03	1.69E-04	8.65E-04
Talus	65.5	19.21	7.64E-03	2.00E-03	1.17E-04	3.98E-04
Temporal #1	22.6	12.97	3.38E-03	1.30E-03	1.50E-04	2.61E-04
Temporal #2	74.6	27.44	9.96E-03	2.60E-03	1.34E-04	3.63E-04
Temporal #3	33.6	19.55	7.20E-03	1.50E-03	2.14E-04	3.68E-04
Tibia DE	66.1	18.37	1.08E-02	2.00E-03	1.64E-04	5.90E-04
Tibia DS	126.7	60.33	2.04E-02	5.80E-03	1.61E-04	3.38E-04
Tibia PE	187.8	40.44	9.87E-03	3.70E-03	5.26E-05	2.44E-04
Tibia PS	167.3	73.69	1.17E-02	4.80E-03	6.99E-05	1.59E-04
Toenails-Ft	1.3	0.01	4.33E-04	2.00E-04	3.33E-04	4.33E-02
Trapezium	3.6	1.05	1.10E-03	4.00E-04	3.06E-04	1.05E-03
Trapezoid	2.5	0.75	8.33E-04	3.00E-04	3.33E-04	1.11E-03
Triangular	1.9	0.60	7.67E-04	3.00E-04	4.04E-04	1.28E-03
Ulna DE	7.9	2.45	1.36E-03	6.00E-04	1.72E-04	5.55E-04
Ulna DS	22.0	11.52	2.50E-03	1.80E-03	1.14E-04	2.17E-04
Ulna PE	41.4	15.61	4.17E-03	1.50E-03	1.01E-04	2.67E-04
Ulna PS	30.4	16.41	6.67E-03	2.30E-03	2.19E-04	4.06E-04
Vert arch C-3	11.9	4.10	2.54E-03	6.00E-04	2.13E-04	6.19E-04
Vert arch C-5	9.8	3.52	4.30E-03	7.00E-04	4.39E-04	1.22E-03
Vert arch C-7	13.8	4.82	2.73E-03	6.00E-04	1.98E-04	5.67E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert arch L-1	33.5	8.79	5.74E-03	1.50E-03	1.71E-04	6.53E-04
Vert arch L-3	37.8	12.48	8.00E-03	1.90E-03	2.12E-04	6.41E-04
Vert arch L-5	41.3	11.08	3.75E-03	1.30E-03	9.08E-05	3.38E-04
Vert arch T-1	22.4	7.43	4.25E-03	9.00E-04	1.90E-04	5.72E-04
Vert arch T-11	25.1	7.02	1.54E-03	7.00E-04	6.12E-05	2.19E-04
Vert arch T-3	19.8	5.88	1.91E-03	5.00E-04	9.65E-05	3.25E-04
Vert arch T-5	18.4	5.41	2.85E-03	8.00E-04	1.55E-04	5.26E-04
Vert arch T-7	21.5					
Vert arch T-9	24.9	7.23	3.47E-03	1.00E-03	1.39E-04	4.79E-04
Vert atlas C-1	22.6	8.25	4.07E-03	1.10E-03	1.80E-04	4.94E-04
Vert body bone C-5	6.7	2.12	1.33E-03	4.00E-04	1.99E-04	6.29E-04
Vert body bone L-3	27.7	8.07	5.33E-03	8.00E-04	1.93E-04	6.61E-04
Vert body bone T-5	10.9	2.85	1.50E-03	4.00E-04	1.38E-04	5.26E-04
Vert body C-3	7.7	2.19	1.73E-03	5.00E-04	2.25E-04	7.92E-04
Vert body C-7	8.9	2.42	8.33E-04	3.00E-04	9.36E-05	3.44E-04
Vert body L-1	42.3	7.76	5.13E-03	1.10E-03	1.21E-04	6.62E-04
Vert body L-5	69.9	14.63	5.60E-03	1.70E-03	8.01E-05	3.83E-04
Vert body marrow C-	0.7		1.20E-03	3.00E-04	1.71E-03	
Vert body marrow L-3	14.8		2.80E-03	9.00E-04	1.89E-04	
Vert body marrow T-	3.7		1.37E-03	4.00E-04	3.69E-04	
Vert body T-1	12.5	2.89	7.70E-03	2.60E-03	6.16E-04	2.66E-03
Vert body T-11	32.3	6.37	4.54E-03	1.20E-03	1.40E-04	7.12E-04
Vert body T-3	12.8	2.60	4.74E-03	8.00E-04	3.71E-04	1.82E-03
Vert body T-7	23.9					
Vert body T-9	27.2	5.28	5.20E-03	9.00E-04	1.91E-04	9.85E-04
Vert whole T-10	62.3	13.93	6.33E-03	1.69E-02	1.02E-04	4.55E-04
Vert whole T-12	62.1	13.37	5.75E-03	1.40E-03	9.26E-05	4.30E-04
Vert whole T-2	35.3	9.39	3.93E-03	1.00E-03	1.11E-04	4.19E-04
Vert whole T-6	40.3	9.13	3.83E-03	1.20E-03	9.52E-05	4.20E-04

Table 16. ^{241}Am in the Tissues of USTUR Case 0259

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert whole T-8	52.3	11.33	6.18E-03	1.60E-03	1.18E-04	5.45E-04
	58722.7	2325.16	3.64			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
RL	Right Lower	I	Intermediate	t	thoracic
RU	Right Upper			l	lumbar

Table 17. Average ^{238}Pu Concentrations in Selected Soft Tissues of USTUR Case 0259

Tissue	Average ^{238}Pu Concentration (Bq/kg wet wt)
Hilar lymph nodes	803
Tracheobronchial lymph nodes	711
Liver	92.8
Lung	16.1
Spleen	5.16
Testes	1.74
Kidney	1.02
Muscle	0.26
Skin	0.15
Other soft tissue	0.81

PLUTONIUM AND AMERICIUM IN THE TISSUES OF TWO WHOLE BODY DONORS, USTUR CASES 0262 AND 0769: FINAL RADIOCHEMICAL RESULTS

Ronald L. Kathren, Royston H. Filby and Gerald R. Dagle

Tabulated herein are the final radiochemical analysis results in the tissues of two whole body donors, USTUR Cases 0262 and 0769 (Tables 18-23). These two plutonium exposure cases are of particular interest because of the cause of death -- liver cancer in one and osteosarcoma in the other. Therefore, in keeping with the Registries objective of making data available to the scientific community at an early stage, the radiochemical data are presented here along with brief case descriptions and the caveat that although the data are considered final at this point, minor changes may be made when they are subjected to more complete examination. Full evaluation of these two cases is currently in progress.

USTUR Case 0262

USTUR Case 0262 was a 72 year old caucasian male 183 cm tall and, during normal health weighed about 125 kg, who died of hepatocellular carcinoma with extensive metastases. He was employed as a scientist at the DOE Hanford site in various capacities from 1951 until his retirement in 1983. On several occasions he was involved in situations or incidents in which the potential for plutonium intake existed. These included possible acute inhalation intakes in June 1954, July and December 1955, and January 1956. However, urinalyses following these possible exposures indicate that intake was minimal. In June 1957, he suffered a plutonium contaminated wound of the right thumb. There is no evidence of chelation or surgical removal of tissue. Estimates of deposition made in 1957 and subsequently by the health physics staff based on urinalysis data indicated a systemic deposition from these incidents of approximately 84 Bq (2.3 nCi) of ^{239}Pu and 660 Bq (18 nCi) of ^{241}Pu, the latter based on an assumed isotopic ratio and not obtained by direct measurement.

In February 1971, a routine urine sample indicated an unusually high level of ^{239}Pu, equivalent to a 24 hour excretion of about 1.6 mBq (5fCi). Three subseqent urinalyses taken 4-5 weeks later were all at or below the minimum detection limit of 0.8 mBq (2 fCi) and the employer's health physics staff concluded that there had been no additional intake. It is likely that the February 1971 urine sample was an anomaly. The health physics estimates were consistent with periodic in-vivo counts which failed to detect levels of ^{239}Pu and ^{241}Am in excess of detection limits which typically were several fold greater than the long term estimated deposition.

During his 32 year employment at the Hanford site, Case 0262 incurred an external radiation dose to the whole body of 110 mSv (11 rem), of which about 42 mSv (4.2 rem) was received during the three year period 1956-58.

USTUR Case 0769

USTUR Case 0769 was a 66 year old caucasian male, 180 cm tall and weighing 60 kg at the time of death. Normal healthy weight was 76 kg. Cause of death was metastatic osteoblastic osteosarcoma which originated in the lumbar-sacral spine area. The osteosarcoma was diagnosed 17 months prior to death. Upon histologic examination by the USTUR staff and consultant pathologist, a distinct chondroid component to the tumor was noted, but the diagnosis of osteosarcoma was verified and chonrosarcoma ruled out. Other significant medical problems included blindness from glacoma which occured at age 43. USTUR 0769 was one of the participants in the long term follow-up study of 26 Manhattan Project plutonium workers at Los Alamos. Participants in that study were workers at Los Alamos who were judged to have the greatest depositions of plutonium as a result of their work in 1944 and 1945 (Hempelmann et al. 1973). USTUR Case 0769 is identified as Subject 20 in this study. Additional details regarding the long term follow-up study and this case and the circumstances of exposure can be obtained from the several publications of this study (Hempelmann et al. 1973; Voelz et al. 1979, 1985; Voelz and Lawrence 1991).

Case 0769 was employed at Los Alamos as a chemical operator and was involved with plutonium purification and recovery work in 1945 and 1946. As reported by Voelz and Lawrence (1991), he had "consistantly positive" counts of nasal swabs from July to September 1945 and from March to August 1946." Thus he's likely to have incurred a significant inhalation intake four or more decades prior to his death. Intake was not restricted to inhalation, for in August 1945, he suffered a contaminated wound of the left thumb from which 70 Bq (2 nCi) were excised (Voelz and Lawrence 1991).

Based on the postmortem radiochemistry results, the total estimated ^{239}Pu deposition in USTUR Case 0769 at the time of death in 1990 is 252 Bq (6.8 nCi). Despite the high liklihood of a significant inhalation intake, only about 10 Bq (270 pCi) was present in the lungs, suggesting that clearance was fairly rapid, not an unlikely scenario as the plutonium may have been in fairly soluble form. The USTUR estimate of deposition is slightly less than half the estimate of 550 Bq (15 nCi) made from urinalysis data using the PUQFUA code by Los Alamos National Laboratory at the time of his death, as well as significantly lower than earlier estimates of 480 Bq (13 nCi) made in 1987, three years prior to his death, and 1.4 kBq (39 nCi) made in 1982 (Voelz and Lawrence 1991).

The distribution of ^{239}Pu in both Cases 0262 and 0769 was entirely consistent with observations in previous cases and with the USTUR model for plutonium (McInroy, Kathren and Swint, 1989; Kathren (1994); as indicated by the USTUR model, both cases expected showed significant soft tissue burdens.

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Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal	4.77	0.01	-4.76E-04	4.00E-04	-9.99E-05	-5.29E-02
Aorta	75.23	0.93	3.49E-04	5.87E-04	4.64E-06	3.75E-04
Bladder	41.83	0.12	6.67E-05	3.30E-04	1.59E-06	5.38E-04
Brain	1269.40	17.82	1.33E-03	3.97E-04	1.05E-06	7.48E-05
Colon-piece	22.60	0.07	-1.06E-04	3.44E-04	-4.68E-06	-1.58E-03
Diaphragm	221.59					
Duramater	60.94	0.67	5.20E-04	3.44E-04	8.53E-06	7.74E-04
Ear-L	25.32					
Ear-R	22.32	0.18	-2.00E-04	2.03E-04	-8.97E-06	-1.10E-03
Epididymus	19.03	0.13	-3.34E-05	2.40E-04	-1.75E-06	-2.53E-04
Esophagus	53.90	0.38	1.00E-03	3.57E-04	1.86E-05	2.64E-03
Eye-L	8.16	0.07	-3.33E-05	2.73E-04	-4.08E-06	-4.57E-04
Eye-R	3.43	0.06	-1.11E-04	1.98E-04	-3.24E-05	-1.85E-03
Fat abdominal #1	1353.40					
Fat abdominal #2	238.15	0.24	2.26E-04	3.04E-04	9.47E-07	9.28E-04
Fat abdominal #3	246.50	0.24	5.00E-04	3.27E-04	2.03E-06	2.06E-03
Fat thoracic cavity	182.77					
Gonads	28.73	0.25	8.52E-04	4.54E-04	2.97E-05	3.41E-03
Hair	6.90	0.08	-1.00E-04	2.73E-04	-1.45E-05	-1.21E-03
Heart	387.39	2.81	5.67E-04	3.07E-04	1.46E-06	2.02E-04
Intestine-large	268.64	0.77	3.33E-04	3.03E-04	1.24E-06	4.33E-04
Intestine-small	557.44	1.82	1.47E-03	4.60E-04	2.63E-06	8.06E-04
Kidney-L	191.80	1.30	7.33E-04	3.23E-04	3.82E-06	5.65E-04
Kidney-R	179.21	1.45	-1.84E-05	2.76E-04	-1.03E-07	-1.27E-05
Larynx	72.66	3.56	6.66E-04	4.27E-04	9.17E-06	1.87E-04
Liver	2628.25	54.72	4.17E-01	1.60E-02	1.59E-04	7.62E-03
LN Axilla-L	171.70	0.63	1.09E+00	6.52E-02	6.37E-03	1.75E+00
LN Axilla-R	26.29	0.10	-1.94E-03	2.34E-03	-7.37E-05	-2.04E-02

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
LN-peribronchial	18.11	0.19	1.86E-02	1.50E-03	1.03E-03	9.95E-02
Lung-L	433.50	3.80	2.67E-02	1.93E-03	6.15E-05	7.02E-03
Lung-R	757.10	7.18	1.97E-02	1.58E-03	2.60E-05	2.74E-03
Mesentery	463.90					
Musc Calf-L lower	642.41	4.55	4.00E-04	3.03E-04	6.23E-07	8.80E-05
Musc Calf-L upper	1189.37	7.48	1.50E-03	4.40E-04	1.26E-06	2.01E-04
Musc Calf-R lower	620.78	7.27	2.67E-04	9.47E-04	4.30E-07	3.67E-05
Musc Calf-R upper	1153.20	20.09	1.43E-03	4.07E-04	1.24E-06	7.14E-05
Musc Foot-L	396.66					
Musc Foot-L#2	45.52	0.66	3.00E-04	3.47E-04	6.59E-06	4.52E-04
Musc Foot-R	297.88					
Musc forearm-L#1	420.57	3.97	6.33E-04	2.97E-04	1.51E-06	1.59E-04
Musc forearm-L#2	276.77	2.40	3.67E-04	3.27E-04	1.32E-06	1.53E-04
Musc forearm-R#1	490.16	5.00	7.00E-04	3.57E-04	1.43E-06	1.40E-04
Musc forearm-R#2	252.09	2.06	6.00E-04	6.00E-04	2.38E-06	2.91E-04
Musc hand-L	149.76					
Musc hand-R	160.94	1.37	4.68E-05	1.93E-04	2.91E-07	3.43E-05
Musc L back#1	538.40	3.96	-3.19E-04	3.85E-04	-5.93E-07	-8.05E-05
Musc L back#2	532.20	5.48	4.94E-04	6.29E-04	9.29E-07	9.03E-05
Musc R front#3	561.00	3.70	6.33E-04	4.10E-04	1.13E-06	1.71E-04
Musc R front#4	853.70	4.69	5.00E-04	4.07E-04	5.86E-07	1.07E-04
Musc Thigh-L lower	2226.74					
Musc Thigh-L upper	3086.23					
Musc Thigh-R lower	2496.80					
Musc Thigh-R upper	2851.75	22.03	2.45E-03	1.53E-03	8.59E-07	1.11E-04
Musc up arm-L#1	699.04	6.21	4.67E-04	5.53E-04	6.68E-07	7.52E-05
Musc up arm-L#2	564.13	5.49	3.33E-04	5.13E-04	5.91E-07	6.07E-05
Musc up arm-R#1	609.48	5.34	1.17E-03	6.03E-04	1.93E-06	2.20E-04
Musc up arm-R#2	595.02	5.77	9.33E-04	7.13E-04	1.57E-06	1.62E-04

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc vert column	323.90	6.01	9.33E-04	5.67E-04	2.88E-06	1.55E-04
Muscle head	763.72					
Muscle-R Ribs	471.20	4.63	1.73E-03	5.00E-04	3.68E-06	3.74E-04
Pancreas	248.10	1.11	2.06E-02	2.24E-03	8.32E-05	1.86E-02
Pancreas #2	41.60	0.07	5.00E-04	3.90E-04	1.20E-05	7.58E-03
Penis	111.96	0.79	1.00E-04	4.07E-04	8.93E-07	1.26E-04
Prostate	27.18	0.29	9.47E-05	3.69E-04	3.48E-06	3.29E-04
Salvary gland	64.39	0.33	4.00E-04	2.60E-04	6.21E-06	1.21E-03
Skin Calf-L lower	316.60	1.67	6.67E-05	2.73E-04	2.11E-07	3.99E-05
Skin Calf-L upper	671.36	3.53	4.67E-04	3.40E-04	6.95E-07	1.32E-04
Skin Calf-R lower	328.47	1.83	2.00E-04	2.17E-04	6.09E-07	1.09E-04
Skin Calf-R upper	680.09					
Skin Foot-L	394.62	1.95	4.00E-04	4.33E-04	1.01E-06	2.05E-04
Skin Foot-R	410.54	2.04	6.33E-04	3.17E-04	1.54E-06	3.11E-04
Skin forearm-L	446.85	1.70	3.67E-04	2.83E-04	8.21E-07	2.16E-04
Skin forearm-R	408.54					
Skin Hand wound	36.87					
Skin hand-L	175.06					
Skin hand-R	107.49					
Skin head	1341.86	5.18	7.33E-04	5.80E-04	5.47E-07	1.42E-04
Skin L back#1	1431.81					
Skin L back#2	1573.93	3.12	4.01E-04	3.74E-04	2.55E-07	1.29E-04
Skin L back#3	1545.94	2.51	-3.33E-05	2.10E-04	-2.16E-08	-1.33E-05
Skin L back#4	1839.40	2.74				
Skin L front#1	2189.40	7.31	8.67E-04	6.73E-04	3.96E-07	1.19E-04
Skin L front#2	2689.09	5.92	6.93E-03	1.31E-03	2.58E-06	1.17E-03
Skin L front#3	1204.93	1.69	5.33E-04	2.87E-04	4.43E-07	3.16E-04
Skin L front#4	1537.96	2.67	1.00E-04	3.57E-04	6.50E-08	3.75E-05
Skin R back#1	2536.80					

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin R back#2	2535.93	6.96	1.11E-04	5.21E-04	4.39E-08	1.60E-05
Skin R back#3	837.93	1.62	5.33E-04	4.80E-04	6.36E-07	3.29E-04
Skin R back#4a	1114.13	2.08				
Skin R back#4b	737.08					
Skin R front#1	2224.87					
Skin R front#2	2706.83					
Skin R front#4	732.21	1.56	3.67E-04	3.17E-04	5.01E-07	2.35E-04
Skin Thigh-L lower	1444.70	5.03	2.67E-04	4.13E-04	1.85E-07	5.30E-05
Skin Thigh-L upper	2208.81	6.94	1.07E-03	7.20E-04	4.83E-07	1.54E-04
Skin Thigh-R lower	2459.20	25.31	1.27E-03	6.63E-04	5.15E-07	5.01E-05
Skin Thigh-R lower#2	1131.26	3.72	6.67E-05	3.60E-04	5.89E-08	1.79E-05
Skin Thigh-R upper	2233.28	6.79	9.67E-04	3.70E-04	4.33E-07	1.42E-04
Skin up arm-L#1	706.96	1.93	4.00E-04	3.03E-04	5.66E-07	2.07E-04
Skin up arm-L#2	539.59	1.61	4.00E-04	3.70E-04	7.42E-07	2.49E-04
Skin up arm-R#1	512.55	1.14	2.67E-04	3.10E-04	5.20E-07	2.35E-04
Skin up arm-R#2	606.42	1.40	3.53E-03	9.00E-04	5.83E-06	2.52E-03
Skin upper R#1	2157.53	4.24	8.00E-04	7.87E-04	3.71E-07	1.89E-04
Skin with fat	66.49	0.13	3.67E-04	3.30E-04	5.52E-06	2.82E-03
Spinal cord	47.43	0.42	1.67E-04	2.40E-04	3.51E-06	3.97E-04
Spleen	203.90	1.89	6.43E-02	2.94E-03	3.15E-04	3.39E-02
Stomach	203.30	1.16	8.49E-03	1.28E-03	4.17E-05	7.32E-03
Thyroid	11.80	0.11	6.67E-05	2.27E-04	5.65E-06	6.23E-04
Tongue	113.15	0.97	4.00E-04	2.53E-04	3.54E-06	4.14E-04
Trachea	31.94	0.78	1.87E-03	6.39E-04	5.84E-05	2.38E-03
Bones						
Calcaneus	71.99	20.19	2.19E-03	8.13E-04	3.04E-05	1.08E-04
Capitate	7.56	1.83	5.67E-04	3.49E-04	7.49E-05	3.09E-04
Clavicle Acrom	19.96	4.68	8.33E-04	4.03E-04	4.18E-05	1.78E-04
Clavicle Shaft	23.03	8.53	6.48E-04	8.04E-04	2.81E-05	7.59E-05

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Clavicle SE	20.36	3.90	1.20E-03	4.43E-04	5.89E-05	3.08E-04
Coccyx	6.31					
Costal cart-L	130.71					
Costal cart-R	144.04	11.87	2.73E-03	8.20E-04	1.90E-05	2.30E-04
Costal Cart-Rib	10.58	0.19				
Cuboid	24.33	5.34	5.00E-04	3.97E-04	2.06E-05	9.36E-05
Femur DE	260.28	54.86	1.10E-02	2.77E-03	4.23E-05	2.01E-04
Femur DS	146.96	51.45	5.07E-03	1.21E-03	3.45E-05	9.85E-05
Femur MS	155.76	77.96	8.60E-03	1.89E-03	5.52E-05	1.10E-04
Femur PE	269.36	63.99	1.33E-02	1.91E-03	4.95E-05	2.08E-04
Femur PS	142.44	70.11	8.15E-03	1.45E-03	5.72E-05	1.16E-04
Fibula DE	21.42	5.79	1.00E-03	3.73E-04	4.67E-05	1.73E-04
Fibula DS	41.94	20.61	1.30E-03	5.37E-04	3.10E-05	6.31E-05
Fibula PE	17.48	3.16				
Fibula PS	38.98	18.50				
Fingernails-R	1.13					
Frontal #1	40.36	21.70	1.77E-03	9.88E-04	4.39E-05	8.16E-05
Frontal #2	16.37	8.87	1.63E-03	5.40E-04	9.98E-05	1.84E-04
Frontal #3	21.99	9.20	1.69E-03	5.89E-04	7.69E-05	1.84E-04
Ft Phal D1	3.45	0.84	-2.84E-05	1.63E-04	-8.23E-06	-3.38E-05
Ft Phal D2	0.52	0.12	2.00E-04	3.63E-04	3.85E-04	1.68E-03
Ft Phal D3	0.74	0.13				
Ft Phal D4	0.57	0.10	9.33E-04	4.23E-04	1.64E-03	9.62E-03
Ft Phal D5	0.57	0.14	-1.59E-04	4.53E-04	-2.78E-04	-1.13E-03
Ft Phal M2	1.03	0.25	1.33E-04	4.77E-04	1.29E-04	5.25E-04
Ft Phal M3	0.73	0.17	3.07E-03	5.67E-04	4.20E-03	1.86E-02
Ft Phal M4	0.47	0.09	8.67E-04	4.00E-04	1.84E-03	9.32E-03
Ft Phal P1	8.84	2.83	1.42E-04	6.15E-04	1.60E-05	5.01E-05
Ft Phal P2	2.58	0.84				

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal P3	2.22	0.63	-6.67E-05	2.84E-04	-3.01E-05	-1.06E-04
Ft Phal P4	1.90	0.46	-1.96E-04	3.56E-04	-1.03E-04	-4.22E-04
Ft Phal P5	1.88	0.54	3.00E-04	3.67E-04	1.60E-04	5.57E-04
Hamate	6.22	1.44	2.21E-04	2.91E-04	3.56E-05	1.54E-04
Humerus DE	69.34	22.16	-3.25E-04	6.18E-04	-4.69E-06	-1.47E-05
Humerus DS	67.89	35.09	2.75E-03	1.47E-03	4.05E-05	7.84E-05
Humerus PE	101.17	18.00	3.75E-03	1.31E-03	3.71E-05	2.08E-04
Humerus PS	90.13	38.32	4.40E-03	2.13E-03	4.88E-05	1.15E-04
R+B137+B101 cuneiform	7.39	2.04	1.30E-03	4.57E-04	1.76E-04	6.38E-04
Ilium-R	281.45	65.03	1.76E-02	3.02E-03	6.24E-05	2.70E-04
Ischium-R	287.64	66.42	2.38E-02	2.92E-03	8.27E-05	3.58E-04
I cuneiform	11.36	2.70	9.67E-04	3.73E-04	8.51E-05	3.58E-04
Lunate	4.62	1.12	3.50E-04	3.01E-04	7.58E-05	3.14E-04
M cuneiform	20.13	5.02	1.06E-03	4.22E-04	5.25E-05	2.11E-04
Metacarpal #1	9.90	2.62	9.33E-04	4.20E-04	9.43E-05	3.57E-04
Metacarpal #2	14.50	4.60	-2.01E-04	2.07E-04	-1.38E-05	-4.37E-05
Metacarpal #3	13.14	4.18	1.47E-03	4.97E-04	1.12E-04	3.52E-04
Metacarpal #4	8.60	2.53	1.10E-05	3.48E-04	1.28E-06	4.35E-06
Metacarpal #5	8.18	2.25	7.33E-04	3.90E-04	8.96E-05	3.26E-04
Metatars 1	29.14	8.96	1.75E-03	5.17E-04	6.01E-05	1.95E-04
Metatars 2	12.98	4.53	6.92E-04	3.85E-04	5.33E-05	1.53E-04
Metatars 3	11.25	3.73	5.00E-04	2.76E-04	4.44E-05	1.34E-04
Metatars 4	12.20	4.40	2.41E-04	3.70E-04	1.97E-05	5.47E-05
Metatars 5	11.88	4.31	1.10E-03	6.10E-04	9.26E-05	2.55E-04
Nasal Cartilage	3.83					
Navicular	20.57	5.63	1.69E-03	6.58E-04	8.20E-05	2.99E-04
Occipital	51.39	25.56	4.92E-03	1.48E-03	9.57E-05	1.92E-04
Parietal #1	66.47	33.98	1.03E-02	2.50E-03	1.54E-04	3.02E-04
Parietal #2	43.80	22.93	3.42E-03	1.11E-03	7.80E-05	1.49E-04

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Patella-R	49.07	13.82	2.75E-03	6.45E-04	5.61E-05	1.99E-04
Phalanges D1	2.32	0.58				
Phalanges D2	1.48	0.37	1.72E-05	1.12E-04	1.16E-05	4.68E-05
Phalanges D3	1.29	0.31	3.00E-04	3.17E-04	2.33E-04	9.75E-04
Phalanges D4	1.02	0.25	2.80E-03	1.19E-03	2.75E-03	1.13E-02
Phalanges D5	0.78	0.18	-1.92E-04	6.73E-05	-2.46E-04	-1.09E-03
Phalanges M2	2.47	0.76	-1.05E-04	1.48E-04	-4.26E-05	-1.39E-04
Phalanges M3	3.23	1.03	8.01E-04	3.50E-04	2.48E-04	7.77E-04
Phalanges M4	2.38	0.76	-2.08E-04	6.85E-05	-8.74E-05	-2.75E-04
Phalanges M5	1.54	0.43				
Phalanges P1	4.61	1.32				
Phalanges P2	6.34	1.91	5.12E-04	4.56E-04	8.07E-05	2.68E-04
Phalanges P3	7.48	2.45	5.00E-04	3.03E-04	6.68E-05	2.04E-04
Phalanges P4	5.56	1.81	4.67E-04	3.43E-04	8.39E-05	2.58E-04
Phalanges P5	4.04	1.14	-3.53E-06	1.93E-04	-8.73E-07	-3.11E-06
Pisiform	2.26	0.46	-1.87E-05	1.83E-04	-8.28E-06	-4.10E-05
R-Rib #1	19.00	4.77	-2.43E-04	3.26E-04	-1.28E-05	-5.10E-05
R-Rib #10	30.56	8.86	1.66E-03	5.67E-04	5.43E-05	1.87E-04
R-Rib #11	23.29	6.96	1.47E-03	4.63E-04	6.30E-05	2.11E-04
R-Rib #12	11.15	3.04	3.67E-04	2.90E-04	3.29E-05	1.21E-04
R-Rib #2	23.96	5.64	8.67E-04	3.63E-04	3.62E-05	1.54E-04
R-Rib #3	27.71	5.95	8.88E-04	5.52E-04	3.20E-05	1.49E-04
R-Rib #4	36.50	7.97	4.47E-04	3.92E-04	1.22E-05	5.60E-05
R-Rib #5	37.81	9.05	3.93E-03	9.20E-04	1.04E-04	4.34E-04
R-Rib #6	38.72	9.49	1.47E-03	6.30E-04	3.79E-05	1.55E-04
R-Rib #7	40.80	10.59	1.26E-03	7.53E-04	3.08E-05	1.18E-04
R-Rib #8	32.43	9.00	7.28E-04	5.72E-04	2.24E-05	8.09E-05
R-Rib #9	39.73	10.55	4.17E-03	6.67E-04	1.05E-04	3.95E-04
Radius DE	18.35	4.97	2.00E-04	4.83E-04	1.09E-05	4.03E-05

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius DS	23.43	12.30	1.03E-03	4.23E-04	4.41E-05	8.40E-05
Radius PE	8.32	2.02	2.40E-04	1.63E-04	2.88E-05	1.19E-04
Radius PS	30.86	15.09	1.23E-03	6.68E-04	3.97E-05	8.12E-05
Sacrum	413.25					
Scap spine	82.57	23.52	9.56E-03	3.40E-03	1.16E-04	4.07E-04
Scaphoid	5.86	1.45	4.58E-04	3.35E-04	7.81E-05	3.15E-04
Scapula DE	49.43	17.16	3.42E-03	1.18E-03	6.92E-05	1.99E-04
Scapula PE	22.16	6.66	1.60E-03	5.03E-04	7.22E-05	2.40E-04
Sesamoid-Ft	8.23	0.93	2.37E-03	5.23E-04	2.88E-04	2.54E-03
Sesamoids-R	0.95	0.15	-3.57E-04	8.88E-05	-3.76E-04	-2.43E-03
Sternum	144.89	22.00	7.07E-03	1.29E-03	4.88E-05	3.21E-04
Talus	129.29	30.03	5.67E-03	2.17E-03	4.38E-05	1.89E-04
Temporal #1	17.82	9.58	1.63E-03	4.17E-04	9.17E-05	1.70E-04
Temporal #2	73.39	29.89	3.54E-03	8.70E-04	4.82E-05	1.18E-04
Temporal #3	35.55	9.40	1.47E-03	6.59E-04	4.13E-05	1.56E-04
Tibia DE	84.47	22.11	2.63E-03	6.07E-04	3.12E-05	1.19E-04
Tibia DS	124.81	58.24	3.93E-03	1.24E-03	3.15E-05	6.75E-05
Tibia PE	182.50	33.26	3.78E-03	1.18E-03	2.07E-05	1.14E-04
Tibia PS	179.25	71.95	5.32E-03	1.31E-03	2.97E-05	7.40E-05
Toenails-Ft	1.72					
Trapezium	5.50	1.20	2.32E-05	2.53E-04	4.23E-06	1.94E-05
Trapezoid	3.19	0.78	-3.09E-05	9.89E-05	-9.67E-06	-3.96E-05
Triangular	3.39	0.83	2.83E-05	2.88E-04	8.35E-06	3.41E-05
Ulna DE	5.70	1.30	3.17E-04	3.01E-04	5.56E-05	2.44E-04
Ulna DS	19.23	9.76				
Ulna PE	44.51	15.85	2.27E-03	7.13E-04	5.09E-05	1.43E-04
Ulna PS	35.61	19.00	6.24E-04	3.93E-04	1.75E-05	3.28E-05
Vert C-1 Atlas	30.32	8.29	1.40E-03	4.80E-04	4.62E-05	1.69E-04
Vert C-2 arch	12.77	3.57	5.72E-04	4.79E-04	4.48E-05	1.60E-04

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert C-2 body	16.42	4.76	1.07E-03	4.80E-04	6.50E-05	2.24E-04
Vert C-3 arch	11.48	3.26	6.33E-04	4.23E-04	5.52E-05	1.94E-04
Vert C-3 body	7.34	1.64	3.00E-04	3.03E-04	4.09E-05	1.83E-04
Vert C-4 arch	11.90	3.82	7.67E-04	3.77E-04	6.44E-05	2.01E-04
Vert C-4 body	9.19	2.49	9.68E-04	4.84E-04	1.05E-04	3.88E-04
Vert C-5 arch	11.17	3.41	1.34E-03	4.01E-04	1.20E-04	3.92E-04
Vert C-5 body	9.03	2.31	1.53E-03	4.67E-04	1.70E-04	6.63E-04
Vert C-6 arch	11.09	3.05	1.93E-04	3.71E-04	1.74E-05	6.34E-05
Vert C-6 body	12.00	2.94	1.23E-03	4.90E-04	1.03E-04	4.20E-04
Vert C-7 arch	14.98	3.98	9.68E-04	4.34E-04	6.46E-05	2.43E-04
Vert C-7 body	13.52	2.79	1.17E-03	4.60E-04	8.63E-05	4.19E-04
Vert from ribs	10.96	1.70	4.33E-04	9.77E-04	3.96E-05	2.55E-04
Vert L-1 arch	33.88	7.54	2.24E-03	7.80E-04	6.62E-05	2.97E-04
Vert L-1 body	56.98	8.41	4.11E-03	1.19E-03	7.21E-05	4.89E-04
Vert L-3 arch	42.27	10.61	2.90E-03	9.34E-04	6.85E-05	2.73E-04
Vert L-3 body	63.21	9.13	4.72E-03	1.28E-03	7.46E-05	5.16E-04
Vert L-5 arch	52.78	11.80	3.40E-03	6.77E-04	6.44E-05	2.88E-04
Vert L-5 body	71.47	11.73	6.53E-03	8.83E-04	9.14E-05	5.57E-04
Vert T-1 arch	27.89	6.92	2.03E-03	5.33E-04	7.29E-05	2.94E-04
Vert T-1 body	15.66	2.99	5.67E-04	2.83E-04	3.62E-05	1.89E-04
Vert T-3 arch	16.33	4.01	1.17E-03	4.67E-04	7.14E-05	2.91E-04
Vert T-3 body	17.11	3.14	1.07E-03	3.63E-04	6.23E-05	3.40E-04
Vert T-5 arch	19.66	4.48	2.40E-03	6.13E-04	1.22E-04	5.36E-04
Vert T-5 body	22.09	4.29	1.47E-03	4.44E-04	6.64E-05	3.42E-04
Vert T-7 arch	18.60	4.58	1.68E-03	5.34E-04	9.03E-05	3.67E-04
Vert T-7 body	27.79	5.21	2.07E-03	5.10E-04	7.44E-05	3.97E-04
Vert T-8 arch	19.77	4.88	1.43E-03	4.10E-04	7.26E-05	2.94E-04
Vert T-8 body	33.13	6.14	3.60E-03	6.40E-04	1.09E-04	5.87E-04
Vert T-9 arch	20.42	5.08	8.51E-04	5.45E-04	4.17E-05	1.68E-04

Table 18. ^{238}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-9 body	41.49	7.37	3.27E-03	8.84E-04	7.89E-05	4.44E-04
Vert T-10 arch	40.49	5.73	1.60E-03	4.53E-04	3.95E-05	2.79E-04
Vert T-10 body	22.34	8.01	1.90E-03	5.00E-04	8.50E-05	2.37E-04
Vert T-11 arch	24.59	5.60	9.11E-04	4.94E-04	3.71E-05	1.63E-04
Vert T-11 body	48.75	8.67	4.60E-03	7.33E-04	9.44E-05	5.31E-04
Vert T-12 arch	49.67	5.41	1.07E-03	7.49E-04	2.15E-05	1.97E-04
Vert T-12 body	22.09	8.82	4.33E-03	7.90E-04	1.96E-04	4.92E-04
	87364.89	1954.70	2.02			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal	4.77	0.01	1.79E-03	5.95E-04	3.75E-04	1.98E-01
Aorta	75.23	0.93	6.43E-02	3.22E-03	8.55E-04	6.91E-02
Bladder	41.83	0.12	1.73E-03	4.47E-04	4.14E-05	1.40E-02
Brain	1269.40	17.82	6.74E-02	3.36E-03	5.31E-05	3.78E-03
Colon-piece	22.60	0.07	1.30E-03	6.52E-04	5.76E-05	1.94E-02
Diaphragm	221.59					
Duramater	60.94	0.67	1.18E-02	1.14E-03	1.93E-04	1.75E-02
Ear-L	25.32					
Ear-R	22.32	0.18	2.77E-03	5.04E-04	1.24E-04	1.52E-02
Epididymus	19.03	0.13	2.13E-03	4.90E-04	1.12E-04	1.62E-02
Esophagus	53.90	0.38	6.51E-02	3.34E-03	1.21E-03	1.72E-01
Eye-L	8.16	0.07	8.33E-04	3.17E-04	1.02E-04	1.14E-02
Eye-R	3.43	0.06	5.56E-04	2.16E-04	1.62E-04	9.26E-03
Fat abdominal #1	1353.40					
Fat abdominal #2	238.15	0.24	2.73E-03	7.24E-04	1.15E-05	1.12E-02
Fat thoracic cavity	182.77					
Gonads	28.73	0.25	1.77E-02	1.85E-03	6.17E-04	7.09E-02
Hair	6.90	0.08	5.34E-04	2.90E-04	7.73E-05	6.43E-03
Heart	387.39	2.81	5.31E-02	2.75E-03	1.37E-04	1.89E-02
Intestine-large	268.64	0.77	7.94E-03	9.14E-04	2.95E-05	1.03E-02
Intestine-small	557.44	1.82	5.60E-02	2.83E-03	1.01E-04	3.08E-02
Kidney-L	191.80	1.30	2.66E-02	1.84E-03	1.39E-04	2.05E-02
Kidney-R	179.21	1.45	2.61E-02	2.68E-03	1.46E-04	1.80E-02
Larynx	72.66	3.56	6.14E-02	3.60E-03	8.45E-04	1.73E-02
Liver	2628.25	54.72	2.07E+01	6.61E-01	7.86E-03	3.77E-01
LN Axilla-L	171.70	0.63	5.60E+01	1.19E+00	3.26E-01	8.95E+01
LN Axilla-R	26.29	0.10	4.47E-03	4.78E-03	1.70E-04	4.70E-02
LN-peribronchial	18.11	0.19	1.05E+00	3.51E-02	5.80E-02	5.62E+00

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Lung-L	433.50	3.80	1.36E+00	4.65E-02	3.14E-03	3.58E-01
Lung-R	757.10	7.18	1.04E+00	3.52E-02	1.37E-03	1.45E-01
Mesentery	463.90					
Musc Calf-L lower	642.41	4.55	2.65E-02	1.76E-03	4.13E-05	5.84E-03
Musc Calf-L upper	1189.37	7.48	5.10E-02	2.85E-03	4.29E-05	6.82E-03
Musc Calf-R lower	620.78	7.27	3.09E-02	3.06E-03	4.97E-05	4.24E-03
Musc Calf-R upper	1153.20	20.09	5.73E-02	2.79E-03	4.97E-05	2.85E-03
Musc Foot-L	396.66					
Musc Foot-L#2	45.52	0.66	8.57E-03	9.63E-04	1.88E-04	1.29E-02
Musc Foot-R	297.88					
Musc forearm-L#1	420.57	3.97	2.08E-02	1.52E-03	4.95E-05	5.24E-03
Musc forearm-L#2	276.77	2.40	1.45E-02	1.19E-03	5.24E-05	6.03E-03
Musc forearm-R#1	490.16	5.00	2.88E-02	1.93E-03	5.88E-05	5.76E-03
Musc forearm-R#2	252.09	2.06	1.31E-02	1.69E-03	5.21E-05	6.36E-03
Musc hand-L	149.76					
Musc hand-R	160.94	1.37	1.15E-02	2.04E-03	7.17E-05	8.44E-03
Musc L back#1	538.40	3.96	2.52E-02	3.03E-03	4.68E-05	6.36E-03
Musc L back#2	532.20	5.48	4.01E-02	3.87E-03	7.53E-05	7.31E-03
Musc R front#3	561.00	3.70	1.92E-02	1.52E-03	3.42E-05	5.19E-03
Musc R front#4	853.70	4.69	3.42E-02	2.27E-03	4.01E-05	7.30E-03
Musc Thigh-L lower	2226.74					
Musc Thigh-L upper	3086.23					
Musc Thigh-R lower	2496.80					
Musc Thigh-R upper	2851.75	22.03	1.55E-01	1.03E-02	5.44E-05	7.04E-03
Musc up arm-L#1	699.04	6.21	2.99E-02	2.53E-03	4.28E-05	4.82E-03
Musc up arm-L#2	564.13	5.49	2.47E-02	2.27E-03	4.37E-05	4.49E-03
Musc up arm-R#1	609.48	5.34	4.45E-02	2.79E-03	7.31E-05	8.34E-03
Musc up arm-R#2	595.02	5.77	2.31E-02	2.36E-03	3.89E-05	4.01E-03
Musc vert column	323.90	6.01	9.65E-02	5.27E-03	2.98E-04	1.60E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Muscle head	763.72					
Muscle-R Ribs	471.20	4.63	1.72E-03	3.45E-03	3.66E-06	3.72E-04
Pancreas	248.10	1.11	1.23E+00	2.94E-02	4.96E-03	1.11E+00
Pancreas #2	41.60	0.07	4.07E-03	7.20E-04	9.78E-05	6.16E-02
Penis	111.96	0.79	5.90E-03	9.97E-04	5.27E-05	7.46E-03
Prostate	27.18	0.29	4.07E-03	9.55E-04	1.50E-04	1.41E-02
Salvary gland	64.39	0.33	3.97E-03	6.10E-04	6.16E-05	1.20E-02
Skin Calf-L lower	316.60	1.67	1.20E-02	1.03E-03	3.78E-05	7.17E-03
Skin Calf-L upper	671.36	3.53	1.41E-02	1.25E-03	2.11E-05	4.00E-03
Skin Calf-R lower	328.47	1.83	1.17E-02	1.03E-03	3.57E-05	6.41E-03
Skin Calf-R upper	680.09					
Skin Foot-L	394.62	1.95	1.57E-02	1.26E-03	3.97E-05	8.04E-03
Skin Foot-R	410.54	2.04	1.84E-02	1.34E-03	4.49E-05	9.06E-03
Skin forearm-L	446.85	1.70	2.78E-02	1.82E-03	6.22E-05	1.64E-02
Skin forearm-R	408.54					
Skin Hand wound	36.87					
Skin hand-L	175.06					
Skin hand-R	107.49					
Skin head	1341.86	5.18	7.75E-02	4.35E-03	5.77E-05	1.50E-02
Skin L back#1	1431.81					
Skin L back#2	1573.93	3.12	1.54E-02	1.62E-03	9.77E-06	4.93E-03
Skin L back#3	1545.94	2.51	1.40E-02	1.19E-03	9.08E-06	5.59E-03
Skin L back#4	1839.40	2.74	2.02E-02	2.11E-03	1.10E-05	7.37E-03
Skin L front#1	2189.40	7.31	8.29E-02	4.61E-03	3.78E-05	1.13E-02
Skin L front#2	2689.09	5.92	4.34E-01	1.72E-02	1.61E-04	7.34E-02
Skin L front#3	1204.93	1.69	1.11E-02	1.04E-03	9.21E-06	6.58E-03
Skin L front#4	1537.96	2.67	1.70E-02	1.37E-03	1.10E-05	6.35E-03
Skin R back#1	2536.80					
Skin R back#2	2535.93	6.96	4.18E-02	3.60E-03	1.65E-05	6.00E-03

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin R back#3	837.93	1.62	1.16E-02	1.45E-03	1.38E-05	7.16E-03
Skin R back#4a	1114.13	2.08	1.13E-02	1.54E-03	1.01E-05	5.42E-03
Skin R back#4b	737.08					
Skin R front#1	2224.87					
Skin R front#2	2706.83					
Skin R front#4	732.21	1.56	1.02E-02	1.02E-03	1.39E-05	6.53E-03
Skin Thigh-L lower	1444.70	5.03	2.47E-02	2.33E-03	1.71E-05	4.90E-03
Skin Thigh-L upper	2208.81	6.94	2.79E-02	2.43E-03	1.26E-05	4.02E-03
Skin Thigh-R lower	2459.20	25.31	1.02E-01	5.60E-03	4.14E-05	4.03E-03
Skin Thigh-R lower#2	1131.26	3.72	1.73E-03	5.73E-04	1.53E-06	4.66E-04
Skin Thigh-R upper	2233.28	6.79	3.38E-02	2.08E-03	1.51E-05	4.98E-03
Skin up arm-L#1	706.96	1.93	1.40E-02	1.20E-03	1.99E-05	7.26E-03
Skin up arm-L#2	539.59	1.61	2.15E-02	1.54E-03	3.99E-05	1.34E-02
Skin up arm-R#1	512.55	1.14	1.07E-02	1.08E-03	2.08E-05	9.40E-03
Skin up arm-R#2	606.42	1.40	1.20E-01	5.89E-03	1.98E-04	8.58E-02
Skin upper R#1	2157.53	4.24	3.25E-02	3.03E-03	1.51E-05	7.67E-03
Skin with fat	66.49	0.13	3.07E-03	5.64E-04	4.61E-05	2.36E-02
Spinal cord	47.43	0.42	3.37E-03	5.70E-04	7.10E-05	8.02E-03
Spleen	203.90	1.89	3.06E+00	9.31E-02	1.50E-02	1.62E+00
Stomach	203.30	1.16	4.36E-01	1.23E-02	2.15E-03	3.76E-01
Thyroid	11.80	0.11	2.40E-03	5.23E-04	2.03E-04	2.24E-02
Tongue	113.15	0.97	1.10E-02	1.03E-03	9.76E-05	1.14E-02
Trachea	31.94	0.78	1.28E-01	5.35E-03	4.00E-03	1.63E-01
Bones						
Calcaneus	71.99	20.19	1.77E-01	7.25E-03	2.46E-03	8.76E-03
Capitate	7.56	1.83	2.07E-02	1.84E-03	2.74E-03	1.13E-02
Clavicle Acrom	19.96	4.68	4.51E-02	2.46E-03	2.26E-03	9.65E-03
Clavicle Shaft	23.03	8.53	5.59E-02	4.37E-03	2.43E-03	6.55E-03
Clavicle SE	20.36	3.90	4.92E-02	2.57E-03	2.41E-03	1.26E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Coccyx	6.31					
Costal cart-L	130.71					
Costal cart-R	144.04	11.87	1.09E-01	5.69E-03	7.59E-04	9.20E-03
Costal Cart-Rib	10.58	0.19				
Cuboid	24.33	5.34	5.43E-02	3.38E-03	2.23E-03	1.02E-02
Femur DE	260.28	54.86	4.71E-01	1.97E-02	1.81E-03	8.59E-03
Femur DS	146.96	51.45	2.55E-01	1.14E-02	1.74E-03	4.96E-03
Femur MS	155.76	77.96	3.58E-01	1.76E-02	2.30E-03	4.59E-03
Femur PE	269.36	63.99	7.68E-01	2.91E-02	2.85E-03	1.20E-02
Femur PS	142.44	70.11	3.56E-01	1.22E-02	2.50E-03	5.08E-03
Fibula DE	21.42	5.79	4.53E-02	2.59E-03	2.11E-03	7.82E-03
Fibula DS	41.94	20.61	5.78E-02	3.63E-03	1.38E-03	2.81E-03
Fibula PE	17.48	3.16				
Fibula PS	38.98	18.50				
Fingernails-R	1.13					
Frontal #1	40.36	21.70	1.24E-01	8.07E-03	3.07E-03	5.71E-03
Frontal #2	16.37	8.87	5.00E-02	2.98E-03	3.05E-03	5.63E-03
Frontal #3	21.99	9.20	7.81E-02	4.02E-03	3.55E-03	8.49E-03
Ft Phal D1	3.45	0.84	7.54E-03	1.09E-03	2.18E-03	8.97E-03
Ft Phal D2	0.52	0.12	1.17E-03	4.53E-04	2.24E-03	9.80E-03
Ft Phal D3	0.74	0.13	2.13E-03	5.27E-04	2.88E-03	1.69E-02
Ft Phal D4	0.57	0.10	3.27E-03	6.00E-04	5.73E-03	3.37E-02
Ft Phal D5	0.57	0.14	7.46E-03	1.55E-03	1.31E-02	5.33E-02
Ft Phal M2	1.03	0.25	4.13E-03	8.70E-04	4.01E-03	1.63E-02
Ft Phal M3	0.73	0.17	2.97E-03	5.33E-04	4.06E-03	1.80E-02
Ft Phal M4	0.47	0.09	1.60E-03	4.23E-04	3.40E-03	1.72E-02
Ft Phal P1	8.84	2.83	1.26E-01	5.73E-03	1.42E-02	4.44E-02
Ft Phal P2	2.58	0.84				
Ft Phal P3	2.22	0.63	7.24E-03	8.44E-04	3.26E-03	1.15E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal P4	1.90	0.46	5.70E-03	1.08E-03	3.00E-03	1.23E-02
Ft Phal P5	1.88	0.54	5.74E-03	7.74E-04	3.05E-03	1.06E-02
Hamate	6.22	1.44	2.08E-02	1.90E-03	3.35E-03	1.45E-02
Humerus DE	69.34	22.16	2.38E-03	4.88E-04	3.44E-05	1.08E-04
Humerus DS	67.89	35.09	1.59E-01	9.84E-03	2.34E-03	4.53E-03
Humerus PE	101.17	18.00	2.27E-01	1.03E-02	2.24E-03	1.26E-02
Humerus PS	90.13	38.32	2.57E-01	1.38E-02	2.85E-03	6.71E-03
I cuneiform	7.39	2.04	2.54E-02	1.83E-03	3.43E-03	1.24E-02
Ilium-R	281.45	65.03	8.68E-01	2.68E-02	3.09E-03	1.34E-02
Ischium-R	287.64	66.42	1.04E+00	3.01E-02	3.60E-03	1.56E-02
L cuneiform	11.36	2.70	3.36E-02	1.93E-03	2.96E-03	1.25E-02
Lunate	4.62	1.12	1.28E-02	1.42E-03	2.78E-03	1.15E-02
M cuneiform	20.13	5.02	5.69E-02	3.03E-03	2.82E-03	1.13E-02
Metacarpal #1	9.90	2.62	3.02E-02	2.10E-03	3.05E-03	1.15E-02
Metacarpal #2	14.50	4.60	1.64E-02	1.78E-03	1.13E-03	3.57E-03
Metacarpal #3	13.14	4.18	3.86E-02	2.39E-03	2.94E-03	9.25E-03
Metacarpal #4	8.60	2.53	2.24E-02	2.12E-03	2.60E-03	8.84E-03
Metacarpal #5	8.18	2.25	2.28E-02	1.79E-03	2.78E-03	1.01E-02
Metatars 1	29.14	8.96	8.52E-02	4.11E-03	2.92E-03	9.51E-03
Metatars 2	12.98	4.53	3.71E-02	2.52E-03	2.86E-03	8.17E-03
Metatars 3	11.25	3.73	3.04E-02	1.94E-03	2.70E-03	8.17E-03
Metatars 4	12.20	4.40	3.48E-02	2.60E-03	2.85E-03	7.91E-03
Metatars 5	11.88	4.31	5.22E-02	3.28E-03	4.39E-03	1.21E-02
Nasal Cartilage	3.83					
Navicular	20.57	5.63	5.53E-02	3.51E-03	2.69E-03	9.81E-03
Occipital	51.39	25.56	1.98E-01	9.67E-03	3.86E-03	7.75E-03
Parietal #1	66.47	33.98	2.65E-01	1.38E-02	3.98E-03	7.78E-03
Parietal #2	43.80	22.93	2.07E-01	9.18E-03	4.73E-03	9.04E-03
Patella-R	49.07	13.82	1.49E-01	6.16E-03	3.03E-03	1.08E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Phalanges D1	2.32	0.58				
Phalanges D2	1.48	0.37	4.10E-03	4.29E-04	2.77E-03	1.11E-02
Phalanges D3	1.29	0.31	3.67E-03	6.97E-04	2.85E-03	1.19E-02
Phalanges D4	1.02	0.25	3.49E-03	1.32E-03	3.42E-03	1.41E-02
Phalanges D5	0.78	0.18	1.34E-03	5.43E-04	1.72E-03	7.62E-03
Phalanges M2	2.47	0.76	6.97E-03	5.91E-04	2.82E-03	9.18E-03
Phalanges M3	3.23	1.03	1.01E-02	9.71E-04	3.14E-03	9.85E-03
Phalanges M4	2.38	0.76	7.28E-03	1.08E-03	3.06E-03	9.64E-03
Phalanges M5	1.54	0.43				
Phalanges P1	4.61	1.32				
Phalanges P2	6.34	1.91	1.76E-02	1.92E-03	2.78E-03	9.24E-03
Phalanges P3	7.48	2.45	2.11E-02	1.56E-03	2.82E-03	8.61E-03
Phalanges P4	5.56	1.81	1.40E-02	1.29E-03	2.52E-03	7.73E-03
Phalanges P5	4.04	1.14	9.11E-03	1.11E-03	2.25E-03	8.02E-03
Pisiform	2.26	0.46	4.54E-03	5.38E-04	2.01E-03	9.96E-03
R-Rib #1	19.00	4.77	6.08E-02	3.78E-03	3.20E-03	1.27E-02
R-Rib #2	23.96	5.64	6.75E-02	3.39E-03	2.82E-03	1.20E-02
R-Rib #3	27.71	5.95	8.58E-02	4.52E-03	3.10E-03	1.44E-02
R-Rib #4	36.50	7.97	1.01E-01	3.89E-03	2.76E-03	1.26E-02
R-Rib #5	37.81	9.05	1.22E-01	6.57E-03	3.22E-03	1.35E-02
R-Rib #6	38.72	9.49	1.08E-01	5.66E-03	2.80E-03	1.14E-02
R-Rib #7	40.80	10.59	1.07E-01	5.75E-03	2.63E-03	1.01E-02
R-Rib #8	32.43	9.00	1.04E-01	5.16E-03	3.20E-03	1.15E-02
R-Rib #9	39.73	10.55	1.28E-01	5.21E-03	3.23E-03	1.22E-02
R-Rib #10	30.56	8.86	8.96E-02	3.60E-03	2.93E-03	1.01E-02
R-Rib #11	23.29	6.96	7.09E-02	3.43E-03	3.05E-03	1.02E-02
R-Rib #12	11.15	3.04	3.27E-02	2.11E-03	2.93E-03	1.08E-02
Radius DE	18.35	4.97	2.26E-02	1.84E-03	1.23E-03	4.56E-03
Radius DS	23.43	12.30	3.91E-02	2.24E-03	1.67E-03	3.18E-03

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius PE	8.32	2.02	2.32E-02	1.07E-03	2.79E-03	1.15E-02
Radius PS	30.86	15.09	6.43E-02	4.55E-03	2.08E-03	4.26E-03
Sacrum	413.25					
Scap spine	82.57	23.52	2.73E-01	1.81E-02	3.30E-03	1.16E-02
Scaphoid	5.86	1.45	1.53E-02	1.63E-03	2.61E-03	1.05E-02
Scapula DE	49.43	17.16	1.80E-01	8.76E-03	3.63E-03	1.05E-02
Scapula PE	22.16	6.66	7.81E-02	3.64E-03	3.53E-03	1.17E-02
Sesamoid-Ft	8.23	0.93	5.73E-03	7.47E-04	6.97E-04	6.16E-03
Sesamoids-R	0.95	0.15	1.49E-03	5.55E-04	1.57E-03	1.01E-02
Sternum	144.89	22.00	4.16E-01	1.62E-02	2.87E-03	1.89E-02
Talus	129.29	30.03	2.74E-01	1.62E-02	2.12E-03	9.11E-03
Temporal #1	17.82	9.58	6.07E-02	2.97E-03	3.40E-03	6.33E-03
Temporal #2	73.39	29.89	2.62E-01	7.69E-03	3.56E-03	8.75E-03
Temporal #3	35.55	9.40	8.07E-02	5.12E-03	2.27E-03	8.58E-03
Tibia DE	84.47	22.11	1.60E-01	6.79E-03	1.89E-03	7.23E-03
Tibia DS	124.81	58.24	1.93E-01	8.96E-03	1.55E-03	3.32E-03
Tibia PE	182.50	33.26	3.20E-01	1.21E-02	1.76E-03	9.63E-03
Tibia PS	179.25	71.95	2.86E-01	1.08E-02	1.60E-03	3.98E-03
Toenails-Ft	1.72					
Trapezium	5.50	1.20	1.54E-02	1.50E-03	2.80E-03	1.29E-02
Trapezoid	3.19	0.78	1.04E-02	9.61E-04	3.25E-03	1.33E-02
Triangular	3.39	0.83	1.62E-02	1.39E-03	4.78E-03	1.95E-02
Ulna DE	5.70	1.30	1.25E-02	1.50E-03	2.19E-03	9.59E-03
Ulna DS	19.23	9.76				
Ulna PE	44.51	15.85	1.11E-01	5.65E-03	2.48E-03	6.98E-03
Ulna PS	35.61	19.00	5.78E-02	3.37E-03	1.62E-03	3.04E-03
Vert C-1 Atlas	30.32	8.29	1.10E-01	4.97E-03	3.62E-03	1.32E-02
Vert C-2 arch	12.77	3.57	4.94E-02	3.56E-03	3.87E-03	1.38E-02
Vert C-2 body	16.42	4.76	6.76E-02	3.72E-03	4.11E-03	1.42E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert C-3 arch	11.48	3.26	4.73E-02	2.80E-03	4.12E-03	1.45E-02
Vert C-3 body	7.34	1.64	3.09E-02	2.03E-03	4.21E-03	1.89E-02
Vert C-4 arch	11.90	3.82	4.69E-02	2.59E-03	3.94E-03	1.23E-02
Vert C-4 body	9.19	2.49	3.28E-02	2.35E-03	3.57E-03	1.31E-02
Vert C-5 arch	11.17	3.41	4.93E-02	2.67E-03	4.41E-03	1.45E-02
Vert C-5 body	9.03	2.31	4.05E-02	2.39E-03	4.49E-03	1.75E-02
Vert C-6 arch	11.09	3.05	4.93E-02	3.12E-03	4.44E-03	1.62E-02
Vert C-6 body	12.00	2.94	4.18E-02	2.69E-03	3.48E-03	1.42E-02
Vert C-7 arch	14.98	3.98	4.98E-02	2.60E-03	3.32E-03	1.25E-02
Vert C-7 body	13.52	2.79	5.24E-02	2.78E-03	3.88E-03	1.88E-02
Vert from ribs	10.96	1.70	2.54E-02	3.46E-03	2.32E-03	1.49E-02
Vert L-1 arch	33.88	7.54	1.17E-01	5.52E-03	3.45E-03	1.55E-02
Vert L-1 body	56.98	8.41	2.09E-01	8.73E-03	3.66E-03	2.48E-02
Vert L-3 arch	42.27	10.61	1.66E-01	7.21E-03	3.93E-03	1.57E-02
Vert L-3 body	63.21	9.13	2.35E-01	9.48E-03	3.71E-03	2.57E-02
Vert L-5 arch	52.78	11.80	1.83E-01	7.40E-03	3.47E-03	1.55E-02
Vert L-5 body	71.47	11.73	2.45E-01	9.61E-03	3.42E-03	2.08E-02
Vert T-1 arch	27.89	6.92	9.44E-02	4.19E-03	3.38E-03	1.36E-02
Vert T-1 body	15.66	2.99	7.09E-02	3.50E-03	4.53E-03	2.37E-02
Vert T-3 arch	16.33	4.01	6.82E-02	3.46E-03	4.17E-03	1.70E-02
Vert T-3 body	17.11	3.14	7.07E-02	3.50E-03	4.13E-03	2.25E-02
Vert T-5 arch	19.66	4.48	8.08E-02	4.13E-03	4.11E-03	1.80E-02
Vert T-5 body	22.09	4.29	7.67E-02	3.58E-03	3.47E-03	1.79E-02
Vert T-7 arch	18.60	4.58	8.90E-02	4.40E-03	4.79E-03	1.95E-02
Vert T-7 body	27.79	5.21	8.82E-02	4.18E-03	3.17E-03	1.69E-02
Vert T-8 arch	19.77	4.88	8.02E-02	3.71E-03	4.06E-03	1.64E-02
Vert T-8 body	33.13	6.14	1.17E-01	4.79E-03	3.52E-03	1.90E-02
Vert T-9 arch	20.42	5.08	8.87E-02	4.58E-03	4.35E-03	1.75E-02
Vert T-9 body	41.49	7.37	1.27E-01	5.79E-03	3.05E-03	1.72E-02

Table 19. ^{239}Pu in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-10 arch	40.49	5.73	9.73E-02	4.24E-03	2.40E-03	1.70E-02
Vert T-10 body	22.34	8.01	1.51E-01	5.96E-03	6.77E-03	1.89E-02
Vert T-11 arch	24.59	5.60	3.75E-02	2.73E-03	1.52E-03	6.68E-03
Vert T-11 body	48.75	8.67	2.12E-01	7.96E-03	4.35E-03	2.45E-02
Vert T-12 arch	49.67	5.41	9.30E-02	4.45E-03	1.87E-03	1.72E-02
Vert T-12 body	22.09	8.82	1.90E-01	7.93E-03	8.62E-03	2.16E-02
	87118.39	1954.46	102.45			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	*Right*	PE	*Proximal end*	d	*distal*
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
		I	Intermediate	t	thoracic
				l	lumbar

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal	4.77	0.01	-1.73E-03	4.59E-04	-3.64E-04	-1.93E-01
Aorta	75.23	0.93	1.97E-02	2.61E-03	2.62E-04	2.12E-02
Axilla-L	171.70	0.63	8.04E+00	2.41E-01	4.68E-02	1.29E+01
Axilla-R	26.29	0.10	4.56E-03	7.73E-03	1.73E-04	4.80E-02
Bladder	41.83	0.12	1.93E-03	6.43E-04	4.62E-05	1.56E-02
Brain	1269.40	17.82	9.90E-03	1.02E-03	7.80E-06	5.56E-04
Colon-piece	22.60	0.07	9.67E-04	4.40E-04	4.28E-05	1.44E-02
Diaphragm	221.59					
Duramater	60.94	0.67	1.92E-02	1.63E-03	3.16E-04	2.86E-02
Ear-L	25.32					
Ear-R	22.32	0.18	1.83E-03	5.34E-04	8.22E-05	1.01E-02
Epididymus	19.03	0.13	1.80E-03	6.34E-04	9.46E-05	1.36E-02
Esophagus	53.90	0.38	1.33E-02	1.27E-03	2.47E-04	3.51E-02
Eye-L	8.16	0.07	6.33E-04	4.07E-04	7.76E-05	8.68E-03
Eye-R	3.43	0.06	4.89E-04	2.60E-04	1.43E-04	8.15E-03
Fat abdominal #1	1353.40					
Fat abdominal #2	238.15	0.24	9.88E-04	6.51E-04	4.15E-06	4.07E-03
Fat thoracic cavity	182.77					
Gonads	28.73	0.25	3.48E-03	1.48E-03	1.21E-04	1.39E-02
Hair	6.90	0.08	1.24E-02	1.21E-03	1.80E-03	1.49E-01
Heart	387.39	2.81	1.06E-02	1.77E-03	2.73E-05	3.76E-03
Intestine-large	268.64	0.77	3.83E-03	1.43E-03	1.42E-05	4.97E-03
Intestine-small	557.44	1.82	1.45E-02	1.88E-03	2.61E-05	7.98E-03
Kidney-L	191.80	1.30	1.15E-02	1.32E-03	5.98E-05	8.83E-03
Kidney-R	179.21	1.45	9.39E-03	1.96E-03	5.24E-05	6.48E-03
Larynx	72.66	3.56	1.75E-02	2.63E-03	2.41E-04	4.92E-03
Liver	2628.25	54.72	2.14E+00	6.57E-02	8.16E-04	3.92E-02
LN-peribronchial	18.11	0.19	2.00E-01	3.00E-02	1.10E-02	1.07E+00

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Lung-L	433.50	3.80	2.91E-01	4.36E-02	6.72E-04	7.67E-02
Lung-R	757.10	7.18	1.94E-01	7.66E-03	2.56E-04	2.70E-02
Mesentery	463.90					
Musc Calf-L lower	642.41	4.55	1.64E-02	1.50E-03	2.55E-05	3.61E-03
Musc Calf-L upper	1189.37	7.48	2.54E-02	1.72E-03	2.13E-05	3.39E-03
Musc Calf-R lower	620.78	7.27	1.29E-02	2.61E-03	2.08E-05	1.78E-03
Musc Calf-R upper	1153.20	20.09	1.53E-02	3.24E-03	1.33E-05	7.64E-04
Musc Foot-L	396.66					
Musc Foot-L#2	45.52	0.66	4.37E-03	7.00E-04	9.59E-05	6.58E-03
Musc Foot-R	297.88					
Musc forearm-L#1	420.57	3.97	7.07E-03	1.11E-03	1.68E-05	1.78E-03
Musc forearm-L#2	276.77	2.40	8.57E-03	1.07E-03	3.10E-05	3.56E-03
Musc forearm-R#1	490.16	5.00	9.30E-03	1.24E-03	1.90E-05	1.86E-03
Musc forearm-R#2	252.09	2.06	7.98E-03	1.22E-03	3.16E-05	3.86E-03
Musc hand-L	149.76					
Musc hand-R	160.94	1.37	6.33E-03	9.70E-04	3.94E-05	4.64E-03
Musc L back#1	538.40	3.96	9.21E-03	1.93E-03	1.71E-05	2.33E-03
Musc L back#2	532.20	5.48	9.46E-03	2.24E-03	1.78E-05	1.73E-03
Musc R front#3	561.00	3.70	6.09E-03	1.23E-03	1.09E-05	1.65E-03
Musc R front#4	853.70	4.69	1.71E-02	1.41E-03	2.00E-05	3.64E-03
Musc Thigh-L lower	2226.74					
Musc Thigh-L upper	3086.23					
Musc Thigh-R lower	2496.80					
Musc Thigh-R upper	2851.75	22.03	6.94E-02	8.96E-03	2.43E-05	3.15E-03
Musc up arm-L#1	699.04	6.21	8.74E-03	1.99E-03	1.25E-05	1.41E-03
Musc up arm-L#2	564.13	5.49	7.27E-03	1.49E-03	1.29E-05	1.32E-03
Musc up arm-R#1	609.48	5.34	1.15E-02	1.60E-03	1.88E-05	2.15E-03
Musc up arm-R#2	595.02	5.77	6.80E-03	1.51E-03	1.14E-05	1.18E-03
Musc vert column	323.90	6.01	2.64E-02	2.53E-03	8.15E-05	4.39E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Muscle head	763.72					
Muscle-R Ribs	471.20	4.63	2.19E-02	1.69E-03	4.64E-05	4.72E-03
Pancreas	248.10	1.11	2.39E-01	8.81E-03	9.62E-04	2.15E-01
Pancreas #2	41.60	0.07	1.52E-02	1.36E-03	3.66E-04	2.31E-01
Penis	111.96	0.79	5.10E-03	9.53E-04	4.56E-05	6.45E-03
Prostate	27.18	0.29	-3.69E-04	7.91E-04	-1.36E-05	-1.28E-03
Salvary gland	64.39	0.33	1.30E-03	5.73E-04	2.02E-05	3.93E-03
Skin Calf-L lower	316.60	1.67	2.77E-03	6.37E-04	8.74E-06	1.66E-03
Skin Calf-L upper	671.36	3.53	5.90E-03	9.47E-04	8.79E-06	1.67E-03
Skin Calf-R lower	328.47	1.83	3.93E-03	7.13E-04	1.20E-05	2.15E-03
Skin Calf-R upper	680.09					
Skin Foot-L	394.62	1.95	9.83E-03	1.10E-03	2.49E-05	5.05E-03
Skin Foot-R	410.54	2.04	1.86E-02	1.46E-03	4.52E-05	9.12E-03
Skin forearm-L	446.85	1.70	1.41E-02	1.79E-03	3.15E-05	8.28E-03
Skin forearm-R	408.54					
Skin Hand wound	36.87					
Skin hand-L	175.06					
Skin hand-R	107.49					
Skin head	1341.86	5.18	2.91E-02	2.61E-03	2.17E-05	5.61E-03
Skin L back#1	1431.81					
Skin L back#2	1573.93	3.12	1.20E-02	1.52E-03	7.62E-06	3.85E-03
Skin L back#3	1545.94	2.51	7.60E-03	9.70E-04	4.92E-06	3.03E-03
Skin L back#4	1839.40	2.74	6.27E-03	1.33E-03	3.41E-06	2.29E-03
Skin L front#1	2189.40	7.31	3.41E-02	3.10E-03	1.56E-05	4.66E-03
Skin L front#2	2689.09	5.92	7.81E-02	5.13E-03	2.91E-05	1.32E-02
Skin L front#3	1204.93	1.69	6.97E-03	1.07E-03	5.78E-06	4.13E-03
Skin L front#4	1537.96	2.67	1.09E-02	1.67E-01	7.09E-06	4.08E-03
Skin R back#1	2536.80					
Skin R back#2	2535.93	6.96	2.78E-02	1.93E-03	1.09E-05	3.99E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin R back#3	837.93	1.62	1.51E-02	2.22E-03	1.81E-05	9.35E-03
Skin R back#4a	1114.13	2.08	8.27E-03	2.17E-03	7.42E-06	3.98E-03
Skin R back#4b	737.08					
Skin R front#1	2224.87					
Skin R front#2	2706.83					
Skin R front#4	732.21	1.56	5.10E-03	8.87E-04	6.97E-06	3.27E-03
Skin Thigh-L lower	1444.70	5.03	2.10E-02	2.09E-03	1.45E-05	4.18E-03
Skin Thigh-L upper	2208.81	6.94	3.04E-02	2.45E-03	1.38E-05	4.38E-03
Skin Thigh-R lower	2459.20	25.31	3.73E-02	3.73E-03	1.52E-05	1.47E-03
Skin Thigh-R lower#2	1131.26	3.72	1.79E-02	1.94E-03	1.59E-05	4.82E-03
Skin Thigh-R upper	2233.28	6.79	2.52E-02	2.36E-03	1.13E-05	3.71E-03
Skin up arm-L#1	706.96	1.93	9.00E-03	1.25E-03	1.27E-05	4.65E-03
Skin up arm-L#2	539.59	1.61	6.50E-03	9.54E-04	1.21E-05	4.04E-03
Skin up arm-R#1	512.55	1.14	6.40E-03	1.22E-03	1.25E-05	5.64E-03
Skin up arm-R#2	606.42	1.40	5.13E-03	1.36E-03	8.45E-06	3.65E-03
Skin upper R#1	2157.53	4.24	1.48E-02	1.80E-03	6.86E-06	3.49E-03
Skin with fat	66.49	0.13	1.27E-03	4.97E-04	1.91E-05	9.75E-03
Spleen	203.90	1.89	5.55E-01	1.97E-02	2.72E-03	2.93E-01
Stomach	203.30	1.16	9.30E-02	5.46E-03	4.58E-04	8.03E-02
Thyroid	11.80	0.11	4.54E-04	7.29E-04	3.85E-05	4.25E-03
Tongue	113.15	0.97	3.30E-03	7.07E-04	2.92E-05	3.41E-03
Trachea	31.94	0.78	2.48E-02	2.67E-03	7.77E-04	3.16E-02
Bones						
Calcaneus	71.99	20.19	6.87E-02	4.26E-03	9.54E-04	3.40E-03
Capitate	7.56	1.83	6.69E-03	1.35E-03	8.85E-04	3.65E-03
Clavicle Acrom	19.96	4.68	1.24E-02	9.72E-04	6.23E-04	2.66E-03
Clavicle Shaft	23.03	8.53	1.64E-02	1.85E-03	7.11E-04	1.92E-03
Clavicle SE	20.36	3.90	1.21E-02	1.16E-03	5.96E-04	3.11E-03
Coccyx	6.31					

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Costal cart-L	130.71					
Costal cart-R	144.04	11.87	3.03E-02	2.99E-03	2.11E-04	2.55E-03
Costal Cart-Rib	10.58	0.19				
Cuboid	24.33	5.34	1.88E-02	1.81E-03	7.74E-04	3.52E-03
Femur DE	260.28	54.86	1.75E-01	1.52E-02	6.71E-04	3.18E-03
Femur DS	146.96	51.45	9.99E-02	6.26E-03	6.80E-04	1.94E-03
Femur MS	155.76	77.96	1.21E-01	9.49E-03	7.76E-04	1.55E-03
Femur PE	269.36	63.99	2.14E-01	1.15E-02	7.95E-04	3.35E-03
Femur PS	142.44	70.11	1.42E-01	1.11E-02	9.95E-04	2.02E-03
Fibula DE	21.42	5.79	1.94E-02	1.83E-03	9.05E-04	3.35E-03
Fibula DS	41.94	20.61	2.53E-02	2.55E-03	6.02E-04	1.23E-03
Fibula PE	17.48	3.16	1.28E-02	9.18E-04	7.35E-04	4.06E-03
Fibula PS	38.98	18.50	2.95E-03	8.98E-04	7.58E-05	1.60E-04
Fingernails-R	1.13					
Frontal #1	40.36	21.70	3.84E-02	2.83E-03	9.51E-04	1.77E-03
Frontal #2	16.37	8.87	1.88E-02	2.73E-03	1.15E-03	2.12E-03
Frontal #3	21.99	9.20	2.86E-02	2.08E-03	1.30E-03	3.11E-03
Ft Phal D1	3.45	0.84	4.13E-03	8.70E-04	1.20E-03	4.92E-03
Ft Phal D2	0.52	0.12	-8.67E-06	4.38E-04	-1.67E-05	-7.29E-05
Ft Phal D3	0.74	0.13	1.27E-03	4.13E-04	1.71E-03	1.01E-02
Ft Phal D4	0.57	0.10	8.00E-04	3.97E-04	1.40E-03	8.25E-03
Ft Phal D5	0.57	0.14	3.65E-03	1.54E-03	6.40E-03	2.61E-02
Ft Phal M2	1.03	0.25	-3.39E-04	9.38E-04	-3.29E-04	-1.33E-03
Ft Phal M3	0.73	0.17	5.68E-04	9.68E-04	7.78E-04	3.44E-03
Ft Phal M4	0.47	0.09	-5.46E-04	1.88E-03	-1.16E-03	-5.87E-03
Ft Phal P1	8.84	2.83	5.09E-03	1.02E-03	5.75E-04	1.80E-03
Ft Phal P2	2.58	0.84				
Ft Phal P3	2.22	0.63	3.07E-03	7.67E-04	1.38E-03	4.87E-03
Ft Phal P4	1.90	0.46	1.23E-03	3.10E-04	6.47E-04	2.65E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal P5	1.88	0.54	2.30E-03	6.50E-04	1.22E-03	4.27E-03
Hamate	6.22	1.44	8.12E-02	8.84E-04	1.31E-02	5.65E-02
Humerus DE	69.34	22.16	3.50E-02	4.81E-03	5.05E-04	1.58E-03
Humerus DS	67.89	35.09	5.25E-02	6.23E-03	7.73E-04	1.50E-03
Humerus PE	101.17	18.00	7.22E-02	7.72E-03	7.14E-04	4.01E-03
Humerus PS	90.13	38.32	5.68E-02	8.20E-03	6.31E-04	1.48E-03
I cuneiform	7.39	2.04	5.87E-03	1.03E-03	7.94E-04	2.88E-03
Ilium-R	281.45	65.03	2.71E-01	1.33E-02	9.63E-04	4.17E-03
Ischium-R	287.64	66.42	2.36E-01	1.67E-02	8.19E-04	3.55E-03
L cuneiform	11.36	2.70	1.06E-02	1.30E-03	9.36E-04	3.94E-03
Lunate	4.62	1.12	1.69E-03	9.47E-04	3.66E-04	1.52E-03
M cuneiform	20.13	5.02				
Metacarpal #1	9.90	2.62	6.57E-03	4.66E-04	6.64E-04	2.51E-03
Metacarpal #2	14.50	4.60	1.29E-02	9.64E-04	8.88E-04	2.80E-03
Metacarpal #3	13.14	4.18	1.14E-02	1.15E-03	8.71E-04	2.74E-03
Metacarpal #4	8.60	2.53	9.00E-03	1.08E-03	1.05E-03	3.56E-03
Metacarpal #5	8.18	2.25	7.77E-03	9.90E-04	9.49E-04	3.45E-03
Metatars 1	29.14	8.96	2.22E-02	1.03E-03	7.62E-04	2.48E-03
Metatars 2	12.98	4.53	1.44E-02	1.20E-03	1.11E-03	3.17E-03
Metatars 3	11.25	3.73	1.08E-02	8.15E-04	9.59E-04	2.90E-03
Metatars 4	12.20	4.40	1.05E-02	1.61E-03	8.57E-04	2.38E-03
Metatars 5	11.88	4.31	1.71E-02	2.01E-03	1.44E-03	3.97E-03
Nasal Cartilage	3.83					
Navicular	20.57	5.63				
Occipital	51.39	25.56	6.10E-02	4.87E-03	1.19E-03	2.39E-03
Parietal #1	66.47	33.98	7.21E-02	8.38E-03	1.08E-03	2.12E-03
Parietal #2	43.80	22.93	5.13E-02	4.30E-03	1.17E-03	2.24E-03
Patella-R	49.07	13.82	4.55E-02	3.46E-03	9.28E-04	3.29E-03
Phalanges D1	2.32	0.58				

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Phalanges D2	1.48	0.37	1.45E-03	7.61E-04	9.78E-04	3.93E-03
Phalanges D3	1.29	0.31	3.60E-03	8.51E-04	2.79E-03	1.17E-02
Phalanges D4	1.02	0.25	1.81E-03	1.55E-03	1.77E-03	7.33E-03
Phalanges D5	0.78	0.18	1.81E-03	9.21E-04	2.33E-03	1.03E-02
Phalanges M2	2.47	0.76	2.62E-03	4.87E-04	1.06E-03	3.45E-03
Phalanges M3	3.23	1.03	2.84E-03	8.24E-04	8.78E-04	2.75E-03
Phalanges M4	2.38	0.76	1.84E-03	6.44E-04	7.74E-04	2.44E-03
Phalanges M5	1.54	0.43				
Phalanges P1	4.61	1.32				
Phalanges P2	6.34	1.91	5.28E-03	1.26E-03	8.32E-04	2.76E-03
Phalanges P3	7.48	2.45	6.40E-03	8.20E-04	8.56E-04	2.62E-03
Phalanges P4	5.56	1.81	5.20E-03	7.57E-04	9.35E-04	2.87E-03
Phalanges P5	4.04	1.14	4.01E-03	8.67E-04	9.92E-04	3.53E-03
Pisiform	2.26	0.46	2.87E-03	7.21E-04	1.27E-03	6.30E-03
R-Rib #1	19.00	4.77	1.66E-02	1.76E-03	8.75E-04	3.49E-03
R-Rib #2	23.96	5.64	2.01E-02	1.77E-03	8.39E-04	3.56E-03
R-Rib #3	27.71	5.95	1.15E-01	5.73E-03	4.14E-03	1.93E-02
R-Rib #4	36.50	7.97	2.83E-02	2.14E-03	7.76E-04	3.56E-03
R-Rib #5	37.81	9.05	3.40E-02	2.32E-03	9.00E-04	3.76E-03
R-Rib #6	38.72	9.49	3.41E-02	2.18E-03	8.81E-04	3.59E-03
R-Rib #7	40.80	10.59	4.01E-02	2.60E-03	9.84E-04	3.79E-03
R-Rib #8	32.43	9.00	2.80E-02	1.92E-03	8.63E-04	3.11E-03
R-Rib #9	39.73	10.55	3.59E-02	2.61E-03	9.03E-04	3.40E-03
R-Rib #10	30.56	8.86	2.92E-02	1.86E-03	9.56E-04	3.30E-03
R-Rib #11	23.29	6.96	2.14E-02	1.83E-03	9.17E-04	3.07E-03
R-Rib #12	11.15	3.04	1.06E-02	1.23E-03	9.54E-04	3.50E-03
Radius DE	18.35	4.97	1.40E-02	6.47E-04	7.62E-04	2.81E-03
Radius DS	23.43	12.30	1.72E-02	2.22E-03	7.35E-04	1.40E-03
Radius PE	8.32	2.02	9.89E-03	8.86E-04	1.19E-03	4.89E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius PS	30.86	15.09	2.46E-02	2.10E-03	7.96E-04	1.63E-03
Sacrum	413.25					
Scap spine	82.57	23.52	6.15E-02	6.93E-03	7.45E-04	2.61E-03
Scaphoid	5.86	1.45	6.62E-03	1.25E-03	1.13E-03	4.56E-03
Scapula DE	49.43	17.16	4.36E-02	4.10E-03	8.82E-04	2.54E-03
Scapula PE	22.16	6.66	1.83E-02	2.93E-03	8.25E-04	2.74E-03
Sesamoid-Ft	8.23	0.93	3.79E-03	9.90E-04	4.61E-04	4.08E-03
Sesamoids-R	0.95	0.15	1.07E-03	6.48E-04	1.13E-03	7.27E-03
Spinal cord	47.43	0.42	2.97E-03	5.70E-04	6.25E-05	7.06E-03
Sternum	144.89	22.00	9.31E-02	5.83E-03	6.43E-04	4.23E-03
Talus	129.29	30.03	8.52E-02	6.49E-03	6.59E-04	2.84E-03
Temporal #1	17.82	9.58	2.01E-02	8.48E-04	1.13E-03	2.09E-03
Temporal #2	73.39	29.89	5.45E-02	4.64E-03	7.43E-04	1.82E-03
Temporal #3	35.55	9.40	3.05E-02	2.87E-03	8.57E-04	3.24E-03
Tibia DE	84.47	22.11	8.00E-02	4.72E-03	9.47E-04	3.62E-03
Tibia DS	124.81	58.24	8.02E-02	6.73E-03	6.42E-04	1.38E-03
Tibia PE	182.50	33.26	1.28E-01	8.04E-03	7.02E-04	3.86E-03
Tibia PS	179.25	71.95	1.21E-01	1.06E-02	6.74E-04	1.68E-03
Toenails-Ft	1.72					
Trapezium	5.50	1.20	5.52E-03	1.33E-03	1.00E-03	4.61E-03
Trapezoid	3.19	0.78	2.95E-03	8.98E-04	9.26E-04	3.79E-03
Triangular	3.39	0.83	3.99E-03	1.01E-03	1.18E-03	4.82E-03
Ulna DE	5.70	1.30	5.30E-03	9.70E-04	9.30E-04	4.07E-03
Ulna DS	19.23	9.76	1.09E-02	1.16E-03	5.68E-04	1.12E-03
Ulna PE	44.51	15.85	3.10E-02	3.55E-03	6.96E-04	1.96E-03
Ulna PS	35.61	19.00	2.08E-02	2.31E-03	5.84E-04	1.09E-03
Vert C-1 Atlas	30.32	8.29	2.80E-02	2.43E-03	9.23E-04	3.38E-03
Vert C-2 arch	12.77	3.57	1.19E-02	1.48E-03	9.35E-04	3.34E-03
Vert C-2 body	16.42	4.76	2.03E-02	1.71E-03	1.24E-03	4.27E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert C-3 arch	11.48	3.26	9.92E-03	1.60E-03	8.64E-04	3.04E-03
Vert C-3 body	7.34	1.64	7.44E-03	1.19E-03	1.01E-03	4.55E-03
Vert C-4 arch	11.90	3.82	1.10E-02	1.28E-03	9.25E-04	2.88E-03
Vert C-4 body	9.19	2.49	8.11E-03	1.16E-03	8.82E-04	3.25E-03
Vert C-5 arch	11.17	3.41	1.02E-02	1.37E-03	9.10E-04	2.98E-03
Vert C-5 body	9.03	2.31	1.02E-02	1.16E-03	1.13E-03	4.42E-03
Vert C-6 arch	11.09	3.05	1.33E-02	1.52E-03	1.20E-03	4.35E-03
Vert C-6 body	12.00	2.94	8.97E-03	1.16E-03	7.47E-04	3.05E-03
Vert C-7 arch	14.98	3.98	9.84E-03	1.34E-03	6.57E-04	2.48E-03
Vert C-7 body	13.52	2.79	1.03E-02	1.05E-03	7.60E-04	3.69E-03
Vert from ribs	10.96	1.70	5.00E-03	8.67E-04	4.56E-04	2.94E-03
Vert L-1 arch	33.88	7.54	4.49E-02	2.75E-03	1.32E-03	5.95E-03
Vert L-1 body	56.98	8.41	2.99E-02	2.16E-03	5.24E-04	3.55E-03
Vert L-3 arch	42.27	10.61	3.69E-02	2.32E-03	8.74E-04	3.48E-03
Vert L-3 body	63.21	9.13	4.71E-02	2.67E-03	7.45E-04	5.16E-03
Vert L-5 arch	52.78	11.80	4.41E-02	2.81E-03	8.35E-04	3.74E-03
Vert L-5 body	71.47	11.73	4.35E-02	2.81E-03	6.09E-04	3.71E-03
Vert T-1 arch	27.89	6.92	2.58E-02	2.05E-03	9.26E-04	3.73E-03
Vert T-1 body	15.66	2.99	1.66E-02	1.51E-03	1.06E-03	5.56E-03
Vert T-3 arch	16.33	4.01	1.43E-02	1.55E-03	8.76E-04	3.57E-03
Vert T-3 body	17.11	3.14	1.68E-02	1.77E-03	9.79E-04	5.33E-03
Vert T-5 arch	19.66	4.48	2.37E-02	1.89E-03	1.21E-03	5.29E-03
Vert T-5 body	22.09	4.29	1.64E-02	1.48E-03	7.44E-04	3.83E-03
Vert T-7 arch	18.60	4.58	1.84E-02	1.86E-03	9.90E-04	4.02E-03
Vert T-7 body	27.79	5.21	2.32E-02	2.09E-03	8.35E-04	4.46E-03
Vert T-8 arch	19.77	4.88	1.97E-02	1.66E-03	9.95E-04	4.03E-03
Vert T-8 body	33.13	6.14	2.09E-02	1.59E-03	6.31E-04	3.41E-03
Vert T-9 arch	20.42	5.08	1.69E-02	1.69E-03	8.28E-04	3.33E-03
Vert T-9 body	41.49	7.37	2.73E-02	1.93E-03	6.59E-04	3.71E-03

Table 20. ^{241}Am in the Tissues of USTUR Case 0262

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-10 arch	40.49	5.73	2.35E-02	1.95E-03	5.80E-04	4.10E-03
Vert T-10 body	22.34	8.01	2.90E-02	2.07E-03	1.30E-03	3.62E-03
Vert T-11 arch	24.59	5.60	2.35E-02	2.44E-03	9.55E-04	4.19E-03
Vert T-11 body	48.75	8.67	3.74E-02	2.96E-03	7.66E-04	4.31E-03
Vert T-12 arch	49.67	5.41	2.61E-02	2.14E-03	5.26E-04	4.83E-03
Vert T-12 body	22.09	8.82	3.76E-02	2.28E-03	1.70E-03	4.27E-03
	87118.39	1954.46	17.26			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
		I	Intermediate	t	thoracic
				l	lumbar

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	13.66	0.06	-1.00E-04	2.00E-04	-7.32E-06	-1.56E-03
Adrenal peri	1.22		-6.67E-05	2.00E-04	-5.47E-05	
Adrenal-R	9.26	0.05	-1.67E-04	2.00E-04	-1.80E-05	-3.21E-03
Aorta, decend thoracic	29.62	0.34	6.33E-04	3.00E-04	2.14E-05	1.86E-03
Aortic Arch	46.28	0.44	6.00E-04	4.00E-04	1.30E-05	1.38E-03
Bladder	130.65	0.80	-3.33E-05	2.00E-04	-2.55E-07	-4.15E-05
Cerebellum #1	63.84	0.86	1.33E-04	3.00E-04	2.09E-06	1.55E-04
Cerebellum #2	14.68	0.23	2.33E-04	3.00E-04	1.59E-05	1.01E-03
Cerebrum	1051.72	13.65	9.33E-04	5.00E-04	8.87E-07	6.84E-05
Diaphragm #1	53.36		-3.33E-04	3.00E-04	-6.25E-06	
Diaphragm #2	33.78	0.23	2.00E-04	3.00E-04	5.92E-06	8.70E-04
Duodenum	25.67	0.15	1.00E-04	3.00E-04	3.90E-06	6.58E-04
Dura mater	49.73	0.77	1.93E-03	5.00E-04	3.89E-05	2.51E-03
Ear-L	20.91	0.18	3.67E-04	4.00E-04	1.75E-05	2.07E-03
Ear-R	20.56	0.21	3.00E-04	3.00E-04	1.46E-05	1.46E-03
Epiglottis	1.24		-6.67E-03	1.50E-02	-5.38E-03	
Esophagus	51.32	0.39	5.00E-04	4.00E-04	9.74E-06	1.28E-03
Eyes	8.38	0.06	-2.67E-04	4.00E-04	-3.18E-05	-4.23E-03
Gall Bladder	9.47	0.08	1.00E-03	4.00E-04	1.06E-04	1.25E-02
Gall Bladder scraps	2.53	0.01	2.33E-04	4.00E-04	9.22E-05	2.33E-02
Gland, lacrimal	3.78	0.03	4.68E-04	5.00E-04	1.24E-04	1.38E-02
Hair	16.08	0.15	-1.33E-04	4.00E-04	-8.29E-06	-9.07E-04
Heart	224.65	1.88	6.67E-04	4.00E-04	2.97E-06	3.55E-04
Intestine-large	503.24	1.93				
Intestine-small	481.01	1.06	-1.33E-04	3.00E-04	-2.77E-07	-1.25E-04
Kidney scraps	3.61	0.02	4.44E-05	2.00E-04	1.23E-05	2.22E-03
Kidney-L	115.98	1.07	5.67E-04	3.00E-04	4.89E-06	5.30E-04
Kidney-L, Fascia	115.39	0.50	-6.67E-05	2.00E-04	-5.78E-07	-1.33E-04
Kidney-R	97.29	0.82	5.67E-04	4.00E-04	5.82E-06	6.94E-04

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Kidney-R, Fascia	139.49	0.51	4.67E-04	4.00E-04	3.35E-06	9.20E-04
Larynx	49.26	1.79	1.13E-03	4.00E-04	2.30E-05	6.33E-04
Liver	1438.28	17.36	3.30E-01	2.09E-02	2.29E-04	1.90E-02
Liver scrap	4.55	0.05	6.67E-01	1.20E+00	1.47E-01	1.33E+01
LN, Carinal	0.78		4.00E-04	3.00E-04	5.13E-04	
LN, L-Lung	0.52	0.01	1.93E-03	6.00E-04	3.70E-03	1.93E-01
LN, Mediastinal	2.26	0.05	2.68E-02	1.00E-03	1.19E-02	5.96E-01
LN, Mesenteric	0.41		1.87E-03	5.00E-04	4.55E-03	
LN, peri-aortic + fat	90.97	0.44	1.30E-03	5.00E-04	1.43E-05	2.98E-03
LN, peri-Duodenal	1.29	0.01	1.67E-04	3.00E-04	1.29E-04	1.67E-02
LN, peri-M.S.	5.20	0.03	4.00E-04	4.00E-04	7.69E-05	1.43E-02
LN, peri-Pancreatic#2	10.62	0.06	3.00E-04	2.00E-04	2.83E-05	4.69E-03
LN, R-Lung	1.79	0.02	3.40E-03	6.00E-04	1.90E-03	1.70E-01
Lung scrap w/ metastases	125.64	8.66	-4.02E-01	6.69E-01	-3.20E-03	-4.64E-02
Lung-L	426.97	10.67	2.78E-02	2.50E-03	6.51E-05	2.61E-03
Lung-R	383.76	7.63	2.31E-02	2.40E-03	6.01E-05	3.02E-03
Meninges, part	3.32	0.06	-6.00E-04	1.00E-03	-1.81E-04	-1.00E-02
Mesentary scrap	5.50	0.05	2.33E-04	4.00E-04	4.24E-05	4.67E-03
Mesentery, Gastric	31.03	0.06	3.33E-05	2.00E-04	1.07E-06	5.56E-04
Midbrain, pons	19.31	0.28				
Musc calf-L lower	490.48	3.62	1.17E-03	1.30E-03	2.38E-06	3.22E-04
Musc calf-L upper	327.52	2.38	2.17E-03	2.00E-03	6.62E-06	9.10E-04
Musc calf-R lower	361.39	2.62	-2.00E-03	1.00E-03	-5.53E-06	-7.63E-04
Musc calf-R upper	402.35	3.02	5.00E-04	1.10E-03	1.24E-06	1.66E-04
Musc foot-L	310.77	1.48	1.67E-04	3.00E-04	5.36E-07	1.13E-04
Musc foot-R	310.18	2.04	-3.33E-04	1.20E-03	-1.07E-06	-1.63E-04
Musc forearm-L#1	455.41	4.44	8.33E-04	1.30E-03	1.83E-06	1.88E-04
Musc forearm-R#1	456.58	4.58	6.60E-03	1.50E-03	1.45E-05	1.44E-03
Musc hand-L #1	103.63	0.95	6.03E-04	9.00E-04	5.82E-06	6.33E-04
Musc hand-L #2	13.05	0.18	1.34E-04	3.00E-04	1.02E-05	7.54E-04

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc hand-L #3	19.22	0.17	-1.33E-04	2.00E-04	-6.94E-06	-7.98E-04
Musc hand-R	141.88	1.28	1.33E-03	1.40E-03	9.40E-06	1.04E-03
Musc L back#1	645.42	10.30	5.33E-03	1.80E-03	8.26E-06	5.18E-04
Musc L back#2	306.51	2.80	1.50E-03	1.80E-03	4.89E-06	5.36E-04
Musc L back#3	415.91	2.60	5.33E-04	4.00E-04	1.28E-06	2.05E-04
Musc L back#4	536.44	3.23	5.67E-04	3.00E-04	1.06E-06	1.75E-04
Musc L front#1	600.53	4.79	6.67E-04	1.00E-03	1.11E-06	1.39E-04
Musc L front#2	200.11	1.59	1.50E-03	1.40E-03	7.50E-06	9.43E-04
Musc L front#3	458.22	4.11	1.37E-03	4.00E-04	2.98E-06	3.33E-04
Musc L front#4	362.85	2.13	3.17E-03	1.40E-03	8.73E-06	1.49E-03
Musc R back#1	1108.47	11.19	1.83E-03	1.20E-03	1.65E-06	1.64E-04
Musc R back#2	308.58	2.78	1.83E-03	3.00E-03	5.94E-06	6.59E-04
Musc R back#3	408.86	5.86	1.35E-03	1.70E-03	3.30E-06	2.30E-04
Musc R back#4	641.00	3.86	2.00E-03	1.40E-03	3.12E-06	5.18E-04
Musc R front#1	450.24	3.73	1.07E-03	4.00E-04	2.37E-06	2.86E-04
Musc R front#2	116.75	1.01	6.67E-04	3.00E-04	5.71E-06	6.60E-04
Musc R front#3	474.10	3.60	1.67E-04	9.00E-04	3.52E-07	4.63E-05
Musc R front#4	284.86	2.15	3.00E-03	2.00E-03	1.05E-05	1.40E-03
Musc scrap Vert	19.51	0.16				
Musc thigh-L lower	892.90	7.03	6.67E-04	1.20E-03	7.47E-07	9.48E-05
Musc thigh-L upper	1072.96	8.70	3.00E-03	1.30E-03	2.80E-06	3.45E-04
Musc thigh-R lower	671.20	5.94	1.67E-04	1.90E-03	2.48E-07	2.81E-05
Musc thigh-R upper	992.01	8.05	2.67E-03	1.70E-03	2.69E-06	3.31E-04
Musc up arm-L#1	663.35	7.25	1.00E-03	6.00E-04	1.51E-06	1.38E-04
Musc up arm-R#1	689.93	7.00	1.67E-03	1.30E-03	2.42E-06	2.39E-04
Musc-peri-vert	25.35	0.16	2.33E-04	2.00E-04	9.20E-06	1.46E-03
Muscle index finger - R	3.76	0.02	2.33E-03	2.20E-03	6.21E-04	1.17E-01
Muscle - tumor	2.99	0.25	-1.67E-04	8.00E-04	-5.58E-05	-6.67E-04
Muscle head	551.11	4.91	-7.20E-03	5.20E-03	-1.31E-05	-1.47E-03
Muscle scrap,spine & rib	624.96	12.02	3.13E-03	1.10E-03	5.01E-06	2.61E-04

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Pancreas	19.28	0.12	1.00E-04	2.00E-04	5.19E-06	8.06E-04
Pancreas, part	8.59	0.14	2.67E-04	3.00E-04	3.10E-05	1.90E-03
Penis	84.49	0.60	6.67E-04	6.00E-04	7.89E-06	1.11E-03
Peri-duodenal tissue	61.48	0.17	2.33E-04	3.00E-04	3.80E-06	1.41E-03
Pericardium	44.72	0.14	1.00E-04	4.00E-04	2.24E-06	6.94E-04
Pituitary	0.22	0.00	-3.33E-05	2.00E-04	-1.52E-04	-3.33E-02
Prostate	37.01	0.25	3.00E-04	3.00E-04	8.11E-06	1.19E-03
Salivary gland	30.25	0.23				
Skin calf-L #1	310.07	1.28	5.91E-04	5.00E-04	1.91E-06	4.64E-04
Skin calf-L #2	156.11	0.78	6.00E-04	6.00E-04	3.84E-06	7.65E-04
Skin calf-R #1	384.68	1.34	8.00E-04	6.00E-04	2.08E-06	5.97E-04
Skin calf-R #2	194.61	0.89	5.68E-05	5.00E-04	2.92E-07	6.42E-05
Skin foot-L	292.06	1.79				
Skin foot-R	341.06	1.74	-6.67E-05	3.00E-04	-1.95E-07	-3.83E-05
Skin forearm-L	125.78	0.72				
Skin forearm-R	140.40	0.92				
Skin hand-L	79.50	0.54	6.67E-05	3.00E-04	8.39E-07	1.24E-04
Skin hand-R	93.32	0.63	9.33E-04	1.00E-03	1.00E-05	1.49E-03
Skin head	522.52	3.40				
Skin Index Finger - R	9.02	0.07				
Skin L back#1	273.48	1.43				
Skin L back#2	256.73	1.35	2.67E-04	3.00E-04	1.04E-06	1.97E-04
Skin L back#3	344.16	1.31	1.67E-04	3.00E-04	4.85E-07	1.27E-04
Skin L back#4	346.37	1.41	7.33E-04	7.00E-04	2.12E-06	5.21E-04
Skin L front#1	169.11	0.88				
Skin L front#2	102.48	0.56	-1.00E-04	1.00E-04	-9.76E-07	-1.80E-04
Skin L front#3	113.27	0.59	2.00E-04	3.00E-04	1.77E-06	3.42E-04
Skin L front#4	103.74	0.63	1.33E-04	2.00E-04	1.29E-06	2.11E-04
Skin R back#1	348.83	1.57	1.33E-04	5.00E-04	3.82E-07	8.49E-05
Skin R back#2	285.31	1.68				

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin R back#3	355.95	1.37	3.00E-04	3.00E-04	8.43E-07	2.20E-04
Skin R back#4	410.51	1.40	5.67E-04	4.00E-04	1.38E-06	4.05E-04
Skin R front#1	111.59	0.58				
Skin R front#2	138.37	0.71	3.33E-04	7.00E-04	2.41E-06	4.69E-04
Skin R front#3	170.06	0.85	-1.33E-04	4.00E-04	-7.84E-07	-1.58E-04
Skin R front#4	125.17	0.55				
Skin thigh-L #1	899.02	3.68				
Skin thigh-L #2	497.93	1.69	6.34E-04	4.00E-04	1.27E-06	3.74E-04
Skin thigh-R #1	832.37	3.42	3.07E-03	1.10E-03	3.68E-06	8.96E-04
Skin thigh-R #2	554.78	1.25	1.17E-03	2.50E-03	2.10E-06	9.30E-04
Skin up arm-L	268.59	1.25				
Skin up arm-R	281.00	1.40				
Skin, thumb - L	10.62	0.08	6.01E-04	4.00E-04	5.66E-05	7.90E-03
Soft Tissue from bones	170.10	4.95				
Spinal col mus + conn tiss	1077.27	12.56	3.00E-03	8.00E-04	2.79E-06	2.39E-04
Spinal cord	28.48	0.42	5.00E-04	1.30E-03	1.76E-05	1.19E-03
Spleen	38.71	0.39	1.40E-03	4.00E-04	3.62E-05	3.57E-03
Stomach	101.97	0.73	1.17E-03	4.00E-04	1.14E-05	1.59E-03
Testis-L	21.18	0.07	8.67E-04	3.00E-04	4.09E-05	1.20E-02
Testis-R	22.71	0.18	3.33E-04	3.00E-04	1.47E-05	1.84E-03
Thoracic metastatic nodules	1.67	0.49	-3.34E-04	3.00E-04	-2.00E-04	-6.76E-04
Thyroid	12.89	0.10	3.33E-05	3.00E-04	2.59E-06	3.21E-04
Tongue	71.08	0.71	2.00E-04	4.00E-04	2.81E-06	2.82E-04
Trachea	19.66	0.33	2.35E-02	2.00E-03	1.20E-03	7.10E-02
Tumor, L-Lung	18.13	5.35	4.00E-04	4.00E-04	2.21E-05	7.48E-05
Tumor, liver	0.65	0.08	6.67E-05	2.00E-04	1.03E-04	8.34E-04
Tumor, R-Lung	12.06	3.79	4.00E-04	3.00E-04	3.32E-05	1.06E-04
Vein, large	2.30	0.02	1.00E-04	3.00E-04	4.35E-05	5.00E-03
Vena Cava	11.43	0.07	4.67E-04	5.00E-04	4.08E-05	6.67E-03
Bones						

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Bone tumor & bits	9.77	1.51	1.50E-03	1.50E-03	1.54E-04	9.93E-04
Calcaneus	113.94		5.67E-03	8.00E-04	4.97E-05	
Canine RL3	1.53	1.13	1.33E-04	3.00E-04	8.71E-05	1.18E-04
Canine RU3	1.97	1.45	-2.00E-04	2.00E-04	-1.02E-04	-1.38E-04
Capitate	7.02	2.17	1.07E-03	4.00E-04	1.52E-04	4.92E-04
Clav Acrom	19.24	3.46	7.00E-04	4.00E-04	3.64E-05	2.02E-04
Clav Shaft	24.61	11.82	1.07E-03	4.00E-04	4.34E-05	9.03E-05
Clavicl SE	15.45	4.43	2.00E-04	2.00E-04	1.29E-05	4.52E-05
Coccyx	6.19	0.70	2.33E-04	4.00E-04	3.77E-05	3.32E-04
Costal Cart. L + R combined	196.51	4.40	1.00E-03	7.00E-04	5.09E-06	2.27E-04
Cuboid	22.24	4.44	1.20E-03	4.00E-04	5.40E-05	2.70E-04
Femur DE	285.94	57.22	3.20E-02	1.25E-02	1.12E-04	5.59E-04
Femur DS	130.22	45.36	7.17E-03	1.10E-03	5.50E-05	1.58E-04
Femur MS	104.85	46.73	3.07E-02	8.40E-03	2.93E-04	6.56E-04
Femur PE	229.82	38.17	4.97E-02	1.78E-02	2.16E-04	1.30E-03
Femur PS	111.95	43.99				
Fibula DE	23.64	5.95	1.43E-03	5.00E-04	6.07E-05	2.41E-04
Fibula DS	37.17	18.18	1.60E-03	5.00E-04	4.30E-05	8.80E-05
Fibula PE	22.64	3.31	9.34E-04	4.00E-04	4.12E-05	2.82E-04
Fibula PS	33.91	15.94	1.83E-03	5.00E-04	5.41E-05	1.15E-04
Fingernails-R	0.87	0.01	6.01E-04	6.00E-04	6.91E-04	1.00E-01
Fluid from pelvis	15.73	0.03	1.00E-04	2.00E-04	6.36E-06	3.03E-03
Frontal #1	32.34	18.64	3.47E-03	1.00E-03	1.07E-04	1.86E-04
Frontal #2	42.44	24.43	4.87E-03	9.00E-04	1.15E-04	1.99E-04
Frontal #3	23.97	11.76	3.67E-03	7.00E-04	1.53E-04	3.12E-04
Ft Phal D1	3.21	0.43	6.67E-05	3.00E-04	2.08E-05	1.55E-04
Ft Phal D2	0.60	0.07	1.43E-04	3.00E-04	2.38E-04	2.20E-03
Ft Phal D3	0.72	0.08	-3.33E-05	2.00E-04	-4.63E-05	-4.17E-04
Ft Phal D4	0.65	0.07	1.88E-04	3.00E-04	2.88E-04	2.68E-03
Ft Phal D5	0.35	0.03	6.67E-05	2.00E-04	1.90E-04	2.02E-03

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal M2	0.86	0.15	1.00E-04	2.00E-04	1.16E-04	6.49E-04
Ft Phal M3	0.67	0.13	2.00E-04	3.00E-04	2.99E-04	1.54E-03
Ft Phal M4	0.54	0.08	2.00E-04	3.00E-04	3.70E-04	2.44E-03
Ft Phal M5	0.37	0.05	3.33E-05	3.00E-04	9.01E-05	6.67E-04
Ft Phal P1	7.70	1.96	4.67E-04	3.00E-04	6.06E-05	2.39E-04
Ft Phal P2	2.96	0.80	-1.21E-03	7.00E-04	-4.10E-04	-1.53E-03
Ft Phal P3	2.28	0.51	8.67E-04	9.00E-04	3.80E-04	1.69E-03
Ft Phal P4	2.11	0.49	6.67E-05	3.00E-04	3.16E-05	1.35E-04
Ft Phal P5	1.76	0.35	1.07E-04	3.00E-04	6.09E-05	3.04E-04
Hamate	5.11	1.45	1.07E-03	5.00E-04	2.09E-04	7.38E-04
Humerus DE	66.77	23.39	4.57E-03	8.00E-04	6.84E-05	1.95E-04
Humerus DS	63.59	29.86	2.67E-03	6.00E-04	4.19E-05	8.93E-05
Humerus PE	97.90	17.33	2.00E-04	4.00E-04	2.04E-06	1.15E-05
Humerus PS	65.56	25.70	3.13E-03	7.00E-04	4.78E-05	1.22E-04
Hyoid	3.82	0.79	7.33E-04	4.00E-04	1.92E-04	9.25E-04
I cuneiform	7.88	2.02	5.68E-04	5.00E-04	7.20E-05	2.81E-04
Ilium-R	207.92	45.51	1.27E-02	2.90E-03	6.09E-05	2.78E-04
Incisor RL1	0.66	0.51	-6.67E-05	2.00E-04	-1.01E-04	-1.32E-04
Incisor RL2	0.75	0.57	2.33E-04	3.00E-04	3.11E-04	4.10E-04
Incisor RU1	1.49	1.10	-1.33E-04	3.00E-04	-8.95E-05	-1.21E-04
Incisor RU2	0.99	0.75	3.33E-05	5.00E-04	3.37E-05	4.46E-05
Ischium-R	235.21	40.73	1.82E-02	3.30E-03	7.72E-05	4.46E-04
L cuneiform	11.39	2.71	1.27E-03	8.00E-04	1.11E-04	4.68E-04
L-Rib #1, tumor	7.29	0.82	6.67E-05	2.00E-04	9.14E-06	8.17E-05
L-Rib #1, VE	10.43	2.45	1.03E-03	4.00E-04	9.91E-05	4.22E-04
L-Rib #2, MS	6.88	0.85	8.67E-04	4.00E-04	1.26E-04	1.02E-03
L-Rib #2, SE	5.28	0.75	2.00E-04	5.00E-04	3.79E-05	2.66E-04
L-Rib #2, VE	11.91	2.16	3.00E-04	3.00E-04	2.52E-05	1.39E-04
L-Rib #3, SE	25.30	4.30	2.53E-03	8.00E-04	1.00E-04	5.89E-04
L-Rib #4, MS	18.21	2.80	4.00E-04	3.00E-04	2.20E-05	1.43E-04

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
L-Rib #4, SE	19.69	2.75	1.33E-03	4.00E-04	6.77E-05	4.84E-04
L-Rib #4, VE	10.34	1.61	1.97E-03	8.00E-04	1.90E-04	1.22E-03
L-Rib #5, MS	14.95	1.90	1.03E-03	5.00E-04	6.91E-05	5.45E-04
L-Rib #5, SE	13.89	1.87	1.07E-03	4.00E-04	7.68E-05	5.69E-04
L-Rib #5, VE	14.59	2.45	6.00E-04	4.00E-04	4.11E-05	2.45E-04
L-Rib #6, MS	11.83	2.57	1.93E-03	8.00E-04	1.63E-04	7.52E-04
L-Rib #6, SE	15.02	2.12	7.34E-04	5.00E-04	4.88E-05	3.46E-04
L-Rib #6, VE	17.54	3.74	1.80E-03	6.00E-04	1.03E-04	4.81E-04
L-Rib #7, MS	13.27	2.80	8.67E-04	4.00E-04	6.54E-05	3.10E-04
L-Rib #7, SE	11.68	1.77	7.33E-04	3.00E-04	6.28E-05	4.15E-04
L-Rib #7, VE	12.18	2.75	3.34E-04	3.00E-04	2.74E-05	1.21E-04
L-Rib #7, VE tumor	14.81	2.58	1.30E-03	4.00E-04	8.78E-05	5.03E-04
L-Rib #8, MS	12.05	1.66	8.01E-04	3.00E-04	6.65E-05	4.82E-04
L-Rib #8, SE	14.25	2.06	4.33E-04	3.00E-04	3.04E-05	2.11E-04
L-Rib #8, VE	26.94	5.76	2.47E-03	8.00E-04	9.16E-05	4.29E-04
L-Rib #9, MS-1	11.03	2.32	1.03E-03	4.00E-04	9.37E-05	4.46E-04
L-Rib #9, MS-2	9.68	1.57	4.33E-04	3.00E-04	4.48E-05	2.76E-04
L-Rib #9, SE	11.27	1.85	9.33E-04	4.00E-04	8.28E-05	5.04E-04
L-Rib #9, VE	13.61	2.64	-2.27E-03	2.40E-03	-1.67E-04	-8.58E-04
L-Rib #10, MS	12.38	2.92	8.33E-04	4.00E-04	6.73E-05	2.86E-04
L-Rib #10, SE	8.43	1.03	7.00E-04	3.00E-04	8.30E-05	6.80E-04
L-Rib #10, VE	19.22	3.57	6.67E-05	6.00E-04	3.47E-06	1.87E-05
L-Rib #11, MS	8.01	2.42	8.33E-04	4.00E-04	1.04E-04	3.45E-04
L-Rib #11, SE	6.06		6.00E-04	6.00E-04	9.91E-05	
L-Rib #11, VE	11.16	1.79	4.67E-04	3.00E-04	4.18E-05	2.61E-04
L-Rib #12, MS	16.74	2.28	7.33E-04	3.00E-04	4.38E-05	3.22E-04
L-Rib #12, SE	5.91	0.63	3.34E-05	3.00E-04	5.64E-06	5.30E-05
L-Rib #12, VE	8.17	1.12	1.00E-03	4.00E-04	1.23E-04	8.96E-04
Lunate	3.75	1.07	3.57E-05	4.00E-04	9.52E-06	3.34E-05
M cuneiform	18.87	4.68	3.00E-04	3.00E-04	1.59E-05	6.41E-05

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Mandible	47.74	24.95	1.97E-03	5.00E-04	4.12E-05	7.89E-05
Maxilla	33.31	11.81	2.50E-03	6.00E-04	7.51E-05	2.12E-04
Metacarpal #1	9.51	3.22				
Metacarpal #2	13.77	4.93				
Metacarpal #3	12.22	4.48	8.13E-04	3.00E-04	6.65E-05	1.81E-04
Metacarpal #4	7.29	2.49	7.14E-04	4.00E-04	9.80E-05	2.87E-04
Metacarpal #5	6.66	2.24	1.14E-03	6.00E-04	1.72E-04	5.11E-04
Metatars 1	27.10	6.88	1.93E-03	6.00E-04	7.13E-05	2.81E-04
Metatars 2	14.29	4.25	1.47E-03	4.00E-04	1.03E-04	3.45E-04
Metatars 3	12.58	3.64	4.67E-04	3.00E-04	3.71E-05	1.28E-04
Metatars 4	13.29	3.80	5.67E-04	3.00E-04	4.26E-05	1.49E-04
Metatars 5	13.26	3.83	8.00E-04	4.00E-04	6.03E-05	2.09E-04
Misc bone & tumor fragment	181.10	23.38	3.15E-02	1.63E-02	1.74E-04	1.35E-03
Molar RL6	1.96	1.34	6.33E-04	4.00E-04	3.23E-04	4.73E-04
Molar RL7	1.56	1.04	1.00E-04	6.00E-04	6.41E-05	9.65E-05
Molar RL8	2.54	1.91	1.67E-04	3.00E-04	6.56E-05	8.72E-05
Molar RU6	1.81	1.24				
Molar RU7	1.91	1.39	2.67E-04	3.00E-04	1.40E-04	1.92E-04
Molar RU8	1.94	1.51	4.00E-04	4.00E-04	2.06E-04	2.66E-04
Nasal Cart.	6.91	0.12	-2.01E-04	4.00E-04	-2.90E-05	-1.66E-03
Nasal Septa	3.56	0.29	3.33E-04	3.00E-04	9.36E-05	1.16E-03
Navicular	24.21	5.89	1.92E-03	6.00E-04	7.92E-05	3.25E-04
Occipital	65.80	37.64				
Parietal #1	58.36	33.08	1.47E-02	1.27E-02	2.51E-04	4.44E-04
Parietal #2	90.83	52.03	1.87E-02	1.12E-02	2.06E-04	3.59E-04
Patella-R	33.41	10.14	1.37E-03	4.00E-04	4.09E-05	1.35E-04
Phalanges D1	2.09	0.50	3.57E-04	3.00E-04	1.71E-04	7.11E-04
Phalanges D2	1.03	0.22				
Phalanges D3	1.17	0.28	5.67E-04	4.00E-04	4.85E-04	2.05E-03
Phalanges D4	1.03	0.19	8.67E-04	7.00E-04	8.41E-04	4.66E-03

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Phalanges D5	0.71	0.17	3.57E-04	4.00E-04	5.03E-04	2.15E-03
Phalanges M2	2.32	0.83	1.43E-04	2.00E-04	6.16E-05	1.73E-04
Phalanges M3	3.16	1.18	-3.57E-05	4.00E-04	-1.13E-05	-3.02E-05
Phalanges M4	2.39	0.90	4.06E-04	3.00E-04	1.70E-04	4.51E-04
Phalanges M5	1.34	0.47	7.14E-05	2.00E-04	5.33E-05	1.53E-04
Phalanges P1	5.09	1.76				
Phalanges P2	5.92	2.22	4.61E-04	3.00E-04	7.78E-05	2.08E-04
Phalanges P3	7.22	2.80	3.67E-04	3.00E-04	5.08E-05	1.31E-04
Phalanges P4	5.54	2.10	7.00E-04	4.00E-04	1.26E-04	3.34E-04
Phalanges P5	3.43	1.21	4.67E-04	3.00E-04	1.36E-04	3.85E-04
Pisiform	2.32	0.53				
Premolar RL4	1.34	1.00	-6.67E-05	2.00E-04	-4.98E-05	-6.64E-05
Premolar RL5	1.38	1.03	2.67E-04	3.00E-04	1.93E-04	2.59E-04
Premolar RU4	1.19	0.93	-7.67E-04	7.00E-04	-6.45E-04	-8.23E-04
Premolar RU5	1.07	0.79	4.67E-04	6.00E-04	4.36E-04	5.90E-04
Process, broken	0.14	0.04	6.67E-04	1.20E-03	4.76E-03	1.67E-02
R-Rib #1	24.34	2.92	1.03E-03	4.00E-04	4.25E-05	3.54E-04
R-Rib #2 w/o tumor	13.55	1.90	1.07E-03	1.20E-03	7.87E-05	5.61E-04
R-Rib #3, MS	11.07	0.96	1.00E-04	3.00E-04	9.03E-06	1.04E-04
R-Rib #3, SE	12.27	2.46	1.43E-03	5.00E-04	1.17E-04	5.82E-04
R-Rib #3, VE	11.64	2.19	2.33E-04	3.00E-04	2.01E-05	1.07E-04
R-Rib #4, MS	10.38	1.44	8.00E-04	4.00E-04	7.71E-05	5.56E-04
R-Rib #4, SE	10.88	1.64	4.00E-04	4.00E-04	3.68E-05	2.44E-04
R-Rib #4, VE	14.37	3.18	1.60E-03	7.00E-04	1.11E-04	5.04E-04
R-Rib #5, SE	26.69	2.54	6.00E-04	7.00E-04	2.25E-05	2.36E-04
R-Rib #5, VE	23.84	5.07	1.87E-03	9.00E-04	7.83E-05	3.68E-04
R-Rib #6, MS	16.72	2.78	2.10E-03	5.00E-04	1.26E-04	7.57E-04
R-Rib #6, SE	11.41	2.91	6.00E-04	4.00E-04	5.26E-05	2.06E-04
R-Rib #6, VE	13.71	2.36	1.03E-03	4.00E-04	7.54E-05	4.38E-04
R-Rib #7, MS	9.64	2.19	1.07E-03	6.00E-04	1.11E-04	4.88E-04

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
R-Rib #7, SE	6.13	0.81	-5.00E-04	6.00E-04	-8.16E-05	-6.17E-04
R-Rib #7, SE tumor	7.06	1.38	3.67E-04	3.00E-04	5.20E-05	2.66E-04
R-Rib #7, VE	10.90	2.29	9.34E-04	4.00E-04	8.57E-05	4.08E-04
R-Rib #7, VE tumor	14.73	2.73	2.44E-03	9.00E-04	1.66E-04	8.93E-04
R-Rib #8, MS	12.14	2.17	8.67E-04	1.10E-03	7.14E-05	3.99E-04
R-Rib #8, SE	16.97	1.43	1.00E-03	3.00E-04	5.89E-05	6.99E-04
R-Rib #8, VE + tumor	130.86	33.63	1.30E-02	9.30E-03	9.93E-05	3.87E-04
R-Rib #9,MS	8.85	1.74	1.80E-03	5.00E-04	2.03E-04	1.04E-03
R-Rib #9,SE	8.53	1.93	4.00E-04	3.00E-04	4.69E-05	2.07E-04
R-Rib #9,VE	18.87	3.63	1.63E-03	4.00E-04	8.66E-05	4.50E-04
R-Rib #10, MS	11.11	2.58	7.67E-04	4.00E-04	6.90E-05	2.97E-04
R-Rib #10, SE	6.11	0.27	8.33E-04	4.00E-04	1.36E-04	3.08E-03
R-Rib #10, tumor	15.14	2.34	9.01E-04	4.00E-04	5.95E-05	3.85E-04
R-Rib #10, VE	9.60	1.90	5.33E-04	3.00E-04	5.56E-05	2.81E-04
R-Rib #11, MS	7.12	1.67	2.67E-04	4.00E-04	3.75E-05	1.60E-04
R-Rib #11, SE	4.24	0.63	2.33E-04	1.30E-03	5.51E-05	3.72E-04
R-Rib #11, VE	12.14	1.84	6.00E-04	5.00E-04	4.94E-05	3.27E-04
R-Rib #12, SE	9.26	0.80	6.67E-05	3.00E-04	7.20E-06	8.35E-05
R-Rib #12, VE	68.49	5.89	1.33E-04	6.00E-04	1.95E-06	2.27E-05
Radius DE	21.12	5.96	1.93E-03	6.00E-04	9.15E-05	3.25E-04
Radius DS	25.84	14.34	9.33E-04	8.00E-04	3.61E-05	6.51E-05
Radius PE	8.31	2.52	1.09E-02	1.20E-03	1.31E-03	4.33E-03
Radius PS	32.50	16.51	2.27E-03	5.00E-04	6.97E-05	1.37E-04
Rib costal cart	10.58		4.67E-04	3.00E-04	4.41E-05	
Rib end & tumor	6.65	0.62	3.34E-05	3.00E-04	5.02E-06	5.39E-05
Sacrum central "A"	13.15	8.05				
Sacrum central "B"	35.51	21.86	6.67E-03	1.90E-03	1.88E-04	3.05E-04
Sacrum central "C"	44.43	19.85	1.69E-03	9.00E-04	3.80E-05	8.51E-05
Sacrum central anterior piece	35.66	11.52	-4.00E-04	1.30E-03	-1.12E-05	-3.47E-05
Sacrum central lump	28.38	9.18	-3.33E-04	5.00E-04	-1.17E-05	-3.63E-05

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Sacrum left "A"	52.33	23.26				
Sacrum left "B"	202.15	99.42	7.00E-03	2.40E-03	3.46E-05	7.04E-05
Sacrum left "C"	37.87	17.21	-4.50E-03	1.47E-02	-1.19E-04	-2.61E-04
Sacrum right "A"	151.13	86.48	8.10E-03	3.70E-03	5.36E-05	9.37E-05
Sacrum right "B"	111.76	55.72	1.03E-02	2.60E-03	9.25E-05	1.85E-04
Sacrum right "C"	22.06	10.35	-4.00E-04	1.70E-03	-1.81E-05	-3.86E-05
Sacrum right sacrum lump	84.51	37.84	4.00E-04	1.00E-03	4.73E-06	1.06E-05
Scap spine	56.31	13.11	3.80E-03	7.00E-04	6.75E-05	2.90E-04
Scap spine, tumor	46.91	10.59	3.14E-03	9.00E-04	6.68E-05	2.96E-04
Scaphoid	6.13	1.79				
Scapula DE	40.07	13.29	3.17E-03	6.00E-04	7.90E-05	2.38E-04
Scapula PE	24.13	4.91	1.83E-03	6.00E-04	7.60E-05	3.74E-04
Sesamoids-R	0.86	0.17	-1.43E-04	1.00E-04	-1.66E-04	-8.50E-04
Talus	72.42	80.82	4.00E-03	6.00E-04	5.52E-05	4.95E-05
Temporal #1	18.49	8.10	8.00E-04	5.00E-04	4.33E-05	9.88E-05
Temporal #2	111.62	44.31	8.00E-03	5.50E-03	7.17E-05	1.81E-04
Temporal #3	6.88	3.03	2.00E-04	3.00E-04	2.91E-05	6.59E-05
Tibia DE	79.63	19.46	6.33E-04	3.00E-03	7.95E-06	3.25E-05
Tibia DS	120.09	56.77	2.33E-03	6.00E-04	1.94E-05	4.11E-05
Tibia PE	192.75	34.78	3.00E-04	3.00E-04	1.56E-06	8.63E-06
Tibia PS	152.69	64.18	2.53E-03	1.20E-03	1.66E-05	3.95E-05
Trapezium	4.54	1.21	-2.00E-04	4.00E-04	-4.41E-05	-1.65E-04
Trapezoid	2.77	0.82	7.08E-04	5.00E-04	2.56E-04	8.62E-04
Triangular	2.66	0.75	3.58E-04	5.00E-04	1.34E-04	4.74E-04
Tumor from R-Rib #2	24.31	2.35	2.00E-04	3.00E-04	8.23E-06	8.52E-05
Tumor-Outside L. Orbit	1.06	0.06	4.34E-04	6.00E-04	4.09E-04	6.88E-03
Ulna DE	5.84	1.38	-1.33E-04	2.00E-04	-2.28E-05	-9.65E-05
Ulna DS	21.89	11.15	1.07E-03	4.00E-04	4.87E-05	9.57E-05
Ulna PE	40.35	14.89	3.77E-03	6.00E-04	9.33E-05	2.53E-04
Ulna PS	35.18	19.44	1.33E-03	5.00E-04	3.79E-05	6.86E-05

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert C-1	33.70	8.28				
Vert C-2 arch	12.38	3.41				
Vert C-2 body	20.46	3.02	1.67E-04	3.00E-04	8.15E-06	5.52E-05
Vert C-3 arch	12.08	3.35				
Vert C-3 body	9.08	1.59	9.15E-04	3.00E-04	1.01E-04	5.76E-04
Vert C-4 arch	10.67	2.89	1.43E-03	1.00E-03	1.34E-04	4.97E-04
Vert C-4 body	12.33	2.31				
Vert C-5 arch	14.42					
Vert C-5 arch #1	4.44	0.73	4.00E-04	3.00E-04	9.01E-05	5.46E-04
Vert C-5 arch #2	6.46	1.17	4.67E-04	3.00E-04	7.23E-05	4.00E-04
Vert C-5 body	13.39	1.66	5.00E-04	4.00E-04	3.74E-05	3.01E-04
Vert C-5 dorsal arch part	3.19	0.91				
Vert C-6 arch	11.42	2.51	1.30E-03	5.00E-04	1.14E-04	5.19E-04
Vert C-6 body	9.55	1.62				
Vert C-7 arch	16.35	3.83	1.30E-03	4.00E-04	7.95E-05	3.40E-04
Vert C-7 body	15.42	1.98	8.34E-04	4.00E-04	5.41E-05	4.22E-04
Vert L-1 arch	35.30	6.62	3.07E-03	3.00E-03	8.69E-05	4.64E-04
Vert L-1 body	78.84	8.47	1.67E-03	8.00E-04	2.11E-05	1.97E-04
Vert L-2 arch	31.84	6.17	1.40E-03	8.00E-04	4.40E-05	2.27E-04
Vert L-2 body	72.49	9.80	8.00E-04	7.00E-04	1.10E-05	8.16E-05
Vert L-2 wedge	6.11	0.73	-6.67E-05	3.00E-04	-1.09E-05	-9.12E-05
Vert L-3 arch	34.53	8.10	2.60E-03	9.00E-04	7.53E-05	3.21E-04
Vert L-3 body	39.47	5.37	1.47E-03	4.00E-04	3.72E-05	2.74E-04
Vert L-3 wedge	9.27	0.84	-2.33E-04	2.00E-04	-2.52E-05	-2.77E-04
Vert L-3,4 or 5 wedge	5.21	0.74	2.33E-04	3.00E-04	4.48E-05	3.16E-04
Vert L-4 body	67.13	6.96	9.33E-04	1.60E-03	1.39E-05	1.34E-04
Vert L-5 arch	49.92	13.39	4.00E-03	1.40E-03	8.02E-05	2.99E-04
Vert L-5 body	60.93	6.92	3.20E-03	1.00E-03	5.25E-05	4.62E-04
Vert T-1 arch #1	3.85	0.84	6.67E-05	9.00E-04	1.73E-05	7.95E-05
Vert T-1 arch #2	6.00	0.86	-6.67E-05	3.00E-04	-1.11E-05	-7.77E-05

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-1 body	11.95	1.71	-6.67E-05	5.00E-04	-5.58E-06	-3.91E-05
Vert T-1 dorsal arch part	12.68	3.26	4.67E-04	4.00E-04	3.68E-05	1.43E-04
Vert T-2 arch #1	8.54	2.12	1.47E-03	7.00E-04	1.72E-04	6.92E-04
Vert T-2 arch #2	3.05	0.94				
Vert T-2 body	16.93	2.41	6.33E-04	8.00E-04	3.74E-05	2.63E-04
Vert T-2 dorsal arch part	11.45	3.29				
Vert T-3 arch	23.45	4.80	1.33E-04	3.00E-04	5.69E-06	2.78E-05
Vert T-3 body	68.17	16.83	2.53E-03	1.60E-03	3.72E-05	1.51E-04
Vert T-4 arch #1	8.46	1.36	1.33E-04	3.00E-04	1.58E-05	9.78E-05
Vert T-4 body	20.55	1.93	1.00E-03	4.00E-04	4.87E-05	5.19E-04
Vert T-4 dorsal arch part	12.91	2.82	1.67E-04	3.00E-04	1.29E-05	5.91E-05
Vert T-5 arch	24.55	4.81				
Vert T-5 body	32.75	3.27	2.60E-03	1.70E-03	7.94E-05	7.96E-04
Vert T-6 arch a-1	10.71	2.40	-2.67E-04	8.00E-04	-2.49E-05	-1.11E-04
Vert T-6 body	12.92	1.78	1.23E-03	5.00E-04	9.55E-05	6.92E-04
Vert T-6 dorsal arch part	18.41	4.26				
Vert T-7 arch	20.45	5.06				
Vert T-7 body	57.67	12.24	2.20E-03	1.20E-03	3.81E-05	1.80E-04
Vert T-8 arch	22.44	5.84	6.67E-04	6.00E-04	2.97E-05	1.14E-04
Vert T-8 body	33.54	7.64				
Vert T-9 arch	28.76	5.81				
Vert T-9 body	82.22	14.18	7.33E-04	2.40E-03	8.92E-06	5.17E-05
Vert T-10 arch	28.51	6.71	7.33E-04	7.00E-04	2.57E-05	1.09E-04
Vert T-10 body	45.14	7.63				
Vert T-11 arch	30.70	5.61				
Vert T-11 body	30.64	5.59				

Table 21. ^{238}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-12 arch	32.27	5.56				
Vert T-12 body	27.90	2.32	1.13E-03	4.00E-04	4.06E-05	4.88E-04
Vert T-12 wedge	3.42	0.45	5.67E-04	4.00E-04	1.66E-04	1.25E-03
	41950.93	2425.10	1.25			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	13.66	0.06	1.48E-02	1.30E-03	1.09E-03	2.32E-01
Adrenal	1.22		2.00E-04	2.00E-04	1.64E-04	
Adrenal-R	9.26	0.05	1.15E-02	1.20E-03	1.24E-03	2.21E-01
Aorta, decend thoracic	29.62	0.34	9.86E-02	4.40E-03	3.33E-03	2.90E-01
Aortic Arch	46.28	0.44	1.37E-01	6.00E-03	2.95E-03	3.13E-01
Bladder	130.65	0.80	2.44E-02	1.80E-03	1.87E-04	3.03E-02
Cerebellum #1	63.84	0.86	5.61E-02	3.20E-03	8.79E-04	6.52E-02
Cerebellum #2	14.68	0.23	1.12E-02	1.10E-03	7.65E-04	4.88E-02
Cerebrum	1051.72	13.65	3.09E-01	1.26E-02	2.94E-04	2.26E-02
Diaphragm #1	53.36		2.06E-02	2.40E-03	3.86E-04	
Diaphragm #2	33.78	0.23	1.64E-02	1.40E-03	4.86E-04	7.13E-02
Duodenum	25.67	0.15	7.27E-03	8.00E-04	2.83E-04	4.78E-02
Dura	49.73	0.77	5.68E-02	2.80E-03	1.14E-03	7.37E-02
Ear-L	20.91	0.18	1.37E-02	1.50E-03	6.57E-04	7.76E-02
Ear-R	20.56	0.21	1.34E-02	1.40E-03	6.50E-04	6.52E-02
Epiglottis	1.24		-1.00E-02	6.30E-03	-8.06E-03	
Esophagus	51.32	0.39	7.50E-02	3.70E-03	1.46E-03	1.92E-01
Eyes	8.38	0.06	2.87E-03	9.00E-04	3.42E-04	4.55E-02
Gall Bladder	9.47	0.08	2.28E-01	8.70E-03	2.40E-02	2.84E+00
Gall Bladder scraps	2.53	0.01	2.08E-02	1.80E-03	8.21E-03	2.08E+00
Gland, lacrimal	3.78	0.03	3.01E-03	8.00E-04	7.95E-04	8.84E-02
Hair	16.08	0.15	5.07E-03	8.00E-04	3.15E-04	3.45E-02
Heart	224.65	1.88	1.88E-01	7.40E-03	8.38E-04	1.00E-01
Intestine-large	503.24	1.93	5.39E-02	3.90E-03	1.07E-04	2.79E-02
Intestine-small	481.01	1.06	7.23E-02	3.40E-03	1.50E-04	6.80E-02
Kidney scraps	3.61	0.02	3.64E-03	7.00E-04	1.01E-03	1.82E-01
Kidney-L	115.98	1.07	9.04E-02	4.10E-03	7.80E-04	8.45E-02
Kidney-L, Fascia	115.39	0.50	6.33E-04	3.00E-04	5.49E-06	1.26E-03

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Kidney-R	97.29	0.82	8.21E-02	4.50E-03	8.44E-04	1.01E-01
Kidney-R, Fascia	139.49	0.51	3.24E-02	2.20E-03	2.32E-04	6.39E-02
Larynx	49.26	1.79	1.30E-01	5.50E-03	2.65E-03	7.28E-02
Liver	1438.28	17.36	7.46E+01	2.42E+00	5.19E-02	4.30E+00
Liver scrap	4.55	0.05	1.17E+00	1.07E+00	2.56E-01	2.33E+01
LN, Carinal	0.78		6.29E-02	3.20E-03	8.06E-02	
LN, L-Lung	0.52	0.01	5.15E-01	1.88E-02	9.85E-01	5.15E+01
LN, Mediastinal	2.26	0.05	2.83E+00	8.98E-02	1.25E+00	6.28E+01
LN, Mesentery	0.41		5.67E-04	3.00E-04	1.38E-03	
LN, peri-aortic + fat	90.97	0.44	2.87E-01	1.20E-02	3.16E-03	6.58E-01
LN, peri-Duodenal	1.29	0.01	2.07E-03	5.00E-04	1.60E-03	2.07E-01
LN, peri-M.S.	5.20	0.03	6.94E-02	3.40E-03	1.33E-02	2.48E+00
LN, peri-Pancreatic#2	10.62	0.06	6.76E-02	3.30E-03	6.37E-03	1.06E+00
LN, R-Lung	1.79	0.02	7.58E-01	2.61E-02	4.24E-01	3.79E+01
Lung scrap w/ metastises	125.64	8.66	2.68E+00	1.14E+00	2.13E-02	3.09E-01
Lung-L	426.97	10.67	5.78E+00	1.88E-01	1.35E-02	5.42E-01
Lung-R	383.76	7.63	4.80E+00	1.61E-01	1.25E-02	6.29E-01
Meninges, part	3.32	0.06	3.67E-03	1.70E-03	1.10E-03	6.11E-02
Mesentary scrap	5.50	0.05	1.93E-03	5.00E-04	3.52E-04	3.87E-02
Mesentery, Gastric	31.03	0.06	4.57E-02	2.60E-03	1.47E-03	7.62E-01
Midbrain, pons	19.31	0.28				
Musc calf-L lower	490.48	3.62	2.12E-01	1.10E-02	4.31E-04	5.84E-02
Musc calf-L upper	327.52	2.38	1.72E-01	1.15E-02	5.24E-04	7.21E-02
Musc calf-R lower	361.39	2.62	6.57E-02	6.10E-03	1.82E-04	2.51E-02
Musc calf-R upper	402.35	3.02	1.72E-01	1.08E-02	4.26E-04	5.68E-02
Musc foot-L	310.77	1.48	1.45E-01	5.80E-03	4.66E-04	9.78E-02
Musc foot-R	310.18	2.04	1.70E-02	3.30E-03	5.48E-05	8.33E-03
Musc forearm-L#1	455.41	4.44	1.30E-01	8.50E-03	2.86E-04	2.93E-02
Musc forearm-R#1	456.58	4.58	1.36E-01	7.40E-03	2.98E-04	2.97E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc hand-L #1	103.63	0.95	3.59E-02	3.60E-03	3.47E-04	3.77E-02
Musc hand-L #2	13.05	0.18	9.08E-03	1.10E-03	6.96E-04	5.13E-02
Musc hand-L #3	19.22	0.17	7.37E-03	1.00E-03	3.83E-04	4.41E-02
Musc hand-R	141.88	1.28	3.87E-02	4.70E-03	2.73E-04	3.02E-02
Musc L back#1	645.42	10.30	2.15E-01	1.10E-02	3.33E-04	2.09E-02
Musc L back#2	306.51	2.80	7.65E-02	7.60E-03	2.50E-04	2.73E-02
Musc L back#3	415.91	2.60	9.52E-02	4.20E-03	2.29E-04	3.66E-02
Musc L back#4	536.44	3.23	1.88E-01	7.00E-03	3.50E-04	5.81E-02
Musc L front#1	600.53	4.79	1.83E-01	1.06E-02	3.05E-04	3.83E-02
Musc L front#2	200.11	1.59	6.12E-02	6.00E-03	3.06E-04	3.85E-02
Musc L front#3	458.22	4.11	1.76E-01	6.60E-03	3.85E-04	4.29E-02
Musc L front#4	362.85	2.13	9.53E-02	6.60E-03	2.63E-04	4.48E-02
Musc R back#1	1108.47	11.19	2.99E-01	1.37E-02	2.69E-04	2.67E-02
Musc R back#2	308.58	2.78	2.02E-01	1.83E-02	6.54E-04	7.25E-02
Musc R back#3	408.86	5.86	2.12E-01	1.35E-02	5.19E-04	3.62E-02
Musc R back#4	641.00	3.86	1.86E-01	1.09E-02	2.90E-04	4.82E-02
Musc R front#1	450.24	3.73	3.25E-01	1.12E-02	7.21E-04	8.71E-02
Musc R front#2	116.75	1.01	3.02E-02	1.80E-03	2.59E-04	2.99E-02
Musc R front#3	474.10	3.60	1.58E-01	9.80E-03	3.33E-04	4.39E-02
Musc R front#4	284.86	2.15	9.80E-02	7.30E-03	3.44E-04	4.56E-02
Musc scrap Vert	19.51	0.16				
Musc thigh-L lower	892.90	7.03	3.37E-01	1.53E-02	3.77E-04	4.79E-02
Musc thigh-L upper	1072.96	8.70	4.23E-01	1.72E-02	3.95E-04	4.87E-02
Musc thigh-R lower	671.20	5.94	2.19E-01	1.27E-02	3.27E-04	3.69E-02
Musc thigh-R upper	992.01	8.05	3.98E-01	1.87E-02	4.01E-04	4.94E-02
Musc up arm-L#1	663.35	7.25	1.99E-01	8.00E-03	2.99E-04	2.74E-02
Musc up arm-R#1	689.93	7.00	1.88E-01	1.11E-02	2.73E-04	2.69E-02
Muscle index finger - R	3.76	0.02				
Muscle - tumor	2.99	0.25	7.33E-03	2.00E-03	2.45E-03	2.93E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Muscle head	551.11	4.91	2.44E-01	2.72E-02	4.42E-04	4.96E-02
Muscle scrap,spine & rib	624.96	12.02	4.97E-01	1.89E-02	7.95E-04	4.14E-02
Pancreas	19.28	0.12	8.60E-03	1.00E-03	4.46E-04	6.94E-02
Pancreas, part	8.59	0.14	4.13E-03	9.00E-04	4.81E-04	2.95E-02
Penis	84.49	0.60	2.14E-02	2.40E-03	2.53E-04	3.55E-02
Peri-duodenal tissue	61.48	0.17	2.83E-02	2.00E-03	4.61E-04	1.71E-01
Peri-vert. muscle	25.35	0.16	1.25E-02	1.10E-03	4.94E-04	7.83E-02
Pericardium	44.72	0.14	6.77E-03	1.00E-03	1.51E-04	4.70E-02
Pituitary	0.22	0.00	3.33E-04	2.00E-04	1.52E-03	3.33E-01
Prostate	37.01	0.25	7.24E-03	8.00E-04	1.95E-04	2.87E-02
Salivary gland	30.25	0.23				
Skin calf-L #1	310.07	1.28	1.35E-01	6.70E-03	4.36E-04	1.06E-01
Skin calf-L #2	156.11	0.78	1.45E-01	7.10E-03	9.30E-04	1.85E-01
Skin calf-R #1	384.68	1.34	1.06E-01	5.40E-03	2.76E-04	7.93E-02
Skin calf-R #2	194.61	0.89	1.52E-01	8.00E-03	7.80E-04	1.72E-01
Skin foot-L	292.06	1.79				
Skin foot-R	341.06	1.74	1.31E-01	6.40E-03	3.84E-04	7.52E-02
Skin forearm-L	125.78	0.72				
Skin forearm-R	140.40	0.92				
Skin hand-L	79.50	0.54	3.34E-02	2.40E-03	4.21E-04	6.21E-02
Skin hand-R	93.32	0.63	3.85E-02	4.60E-03	4.13E-04	6.14E-02
Skin head	522.52	3.40				
Skin Index Finger - R	9.02	0.07				
Skin L back#1	273.48	1.43				
Skin L back#2	256.73	1.35	7.51E-02	3.70E-03	2.93E-04	5.55E-02
Skin L back#3	344.16	1.31	5.36E-02	2.90E-03	1.56E-04	4.10E-02
Skin L back#4	346.37	1.41	6.95E-02	4.80E-03	2.01E-04	4.94E-02
Skin L front#1	169.11	0.88				
Skin L front#2	102.48	0.56	3.96E-02	2.40E-03	3.86E-04	7.12E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin L front#3	113.27	0.59	3.81E-02	2.30E-03	3.36E-04	6.51E-02
Skin L front#4	103.74	0.63	1.90E-02	1.60E-03	1.83E-04	3.01E-02
Skin R back#1	348.83	1.57	1.20E-01	6.20E-03	3.44E-04	7.64E-02
Skin R back#2	285.31	1.68				
Skin R back#3	355.95	1.37	5.70E-02	3.10E-03	1.60E-04	4.17E-02
Skin R back#4	410.51	1.40	6.26E-02	3.20E-03	1.52E-04	4.47E-02
Skin R front#1	111.59	0.58				
Skin R front#2	138.37	0.71	4.69E-02	3.40E-03	3.39E-04	6.60E-02
Skin R front#3	170.06	0.85	3.90E-02	2.50E-03	2.29E-04	4.61E-02
Skin R front#4	125.17	0.55				
Skin thigh-L #1	899.02	3.68				
Skin thigh-L #2	497.93	1.69	1.23E-01	5.80E-03	2.47E-04	7.26E-02
Skin thigh-R #1	832.37	3.42	1.80E-01	8.60E-03	2.16E-04	5.26E-02
Skin thigh-R #2	554.78	1.25	6.72E-02	7.90E-03	1.21E-04	5.36E-02
Skin up arm-L	268.59	1.25				
Skin up arm-R	281.00	1.40				
Skin, thumb - L	10.62	0.08	6.34E-03	1.20E-03	5.97E-04	8.34E-02
Soft Tissue from bones	170.10	4.95				
Spinal col mus + conn tiss	1077.27	12.56	5.38E-01	1.84E-02	4.99E-04	4.28E-02
Spinal cord	28.48	0.42	1.75E-02	3.40E-03	6.14E-04	4.17E-02
Spleen	38.71	0.39	3.76E-01	1.32E-02	9.72E-03	9.60E-01
Stomach	101.97	0.73	5.16E-02	2.70E-03	5.06E-04	7.05E-02
Testis-L	21.18	0.07	6.22E-02	3.10E-03	2.94E-03	8.64E-01
Testis-R	22.71	0.18	4.67E-02	2.60E-03	2.06E-03	2.58E-01
Thoracic metastatic nodules	1.67	0.49	4.21E-03	8.00E-04	2.53E-03	8.52E-03
Thyroid	12.89	0.10	1.80E-02	1.40E-03	1.39E-03	1.73E-01
Tongue	71.08	0.71	5.80E-02	3.40E-03	8.16E-04	8.17E-02
Trachea	19.66	0.33	1.87E-02	1.80E-03	9.51E-04	5.65E-02
Tumor, L-Lung	18.13	5.35	8.35E-02	3.90E-03	4.61E-03	1.56E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Tumor, liver	0.65	0.08	1.65E-02	1.30E-03	2.56E-02	2.07E-01
Tumor, R-Lung	12.06	3.79	3.98E-02	2.30E-03	3.30E-03	1.05E-02
Vein, large	2.30	0.02	5.73E-03	8.00E-04	2.49E-03	2.87E-01
Vena Cava	11.43	0.07	1.51E-02	1.50E-03	1.32E-03	2.16E-01
Bones						
Bone tumor & bits	9.77	1.51	4.83E-02	5.20E-03	4.95E-03	3.20E-02
Calcaneus	113.94		1.54E+00	5.11E-02	1.35E-02	
Canine RL3	1.53	1.13	2.10E-02	1.70E-03	1.37E-02	1.86E-02
Canine RU3	1.97	1.45	4.34E-04	2.00E-04	2.20E-04	3.00E-04
Capitate	7.02	2.17	1.66E-01	6.90E-03	2.37E-02	7.67E-02
Clav Acrom	19.24	3.46	2.13E-01	8.80E-03	1.11E-02	6.15E-02
Clav Shaft	24.61	11.82	3.77E-01	1.40E-02	1.53E-02	3.19E-02
Clavicl SE	15.45	4.43	1.13E-03	3.00E-04	7.34E-05	2.56E-04
Coccyx	6.19	0.70	5.22E-02	3.00E-03	8.43E-03	7.44E-02
Costal Cart. L + R combined	196.51	4.40	8.05E-02	4.50E-03	4.10E-04	1.83E-02
Cuboid	22.24	4.44	2.76E-01	1.00E-02	1.24E-02	6.22E-02
Femur DE	285.94	57.22	3.09E+00	1.42E-01	1.08E-02	5.41E-02
Femur DS	130.22	45.36	1.30E+00	4.90E-02	9.99E-03	2.87E-02
Femur MS	104.85	46.73	7.15E+00	4.04E-01	6.82E-02	1.53E-01
Femur PE	229.82	38.17	8.03E+00	6.29E-01	3.49E-02	2.10E-01
Femur PS	111.95	43.99	1.69E-02	1.40E-03	1.51E-04	3.83E-04
Fibula DE	23.64	5.95	3.06E-01	1.20E-02	1.29E-02	5.14E-02
Fibula DS	37.17	18.18	3.58E-01	1.31E-02	9.63E-03	1.97E-02
Fibula PE	22.64	3.31	2.25E-01	8.60E-03	9.96E-03	6.81E-02
Fibula PS	33.91	15.94	3.66E-01	1.27E-02	1.08E-02	2.29E-02
Fingernails-R	0.87	0.01	-2.67E-04	3.00E-04	-3.07E-04	-4.45E-02
Fluid from pelvis	15.73	0.03	1.20E-03	4.00E-04	7.63E-05	3.64E-02
Frontal #1	32.34	18.64	8.70E-01	3.03E-02	2.69E-02	4.66E-02
Frontal #2	42.44	24.43	1.11E+00	4.20E-02	2.61E-02	4.54E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Frontal #3	23.97	11.76	8.06E-01	2.85E-02	3.36E-02	6.85E-02
Ft Phal D1	3.21	0.43	5.52E-02	3.20E-03	1.72E-02	1.28E-01
Ft Phal D2	0.60	0.07	9.46E-03	1.10E-03	1.58E-02	1.46E-01
Ft Phal D3	0.72	0.08	7.43E-03	9.00E-04	1.03E-02	9.29E-02
Ft Phal D4	0.65	0.07	9.28E-03	1.00E-03	1.43E-02	1.33E-01
Ft Phal D5	0.35	0.03	5.37E-03	8.00E-04	1.53E-02	1.63E-01
Ft Phal M2	0.86	0.15	1.38E-02	1.20E-03	1.60E-02	8.96E-02
Ft Phal M3	0.67	0.13	9.53E-03	1.00E-03	1.42E-02	7.33E-02
Ft Phal M4	0.54	0.08	8.53E-03	9.00E-04	1.58E-02	1.04E-01
Ft Phal M5	0.37	0.05	8.40E-03	1.00E-03	2.27E-02	1.68E-01
Ft Phal P1	7.70	1.96	1.43E-01	5.80E-03	1.86E-02	7.32E-02
Ft Phal P2	2.96	0.80	4.76E-02	4.00E-03	1.61E-02	5.98E-02
Ft Phal P3	2.28	0.51	3.62E-02	3.20E-03	1.59E-02	7.07E-02
Ft Phal P4	2.11	0.49	3.54E-02	2.20E-03	1.68E-02	7.17E-02
Ft Phal P5	1.76	0.35	3.16E-02	2.20E-03	1.80E-02	8.95E-02
Hamate	5.11	1.45	1.24E-01	5.80E-03	2.42E-02	8.55E-02
Humerus DE	66.77	23.39	9.74E-01	3.39E-02	1.46E-02	4.17E-02
Humerus DS	63.59	29.86	7.79E-01	2.70E-02	1.22E-02	2.61E-02
Humerus PE	97.90	17.33	2.06E-01	6.10E-03	2.10E-03	1.19E-02
Humerus PS	65.56	25.70	8.50E-01	3.01E-02	1.30E-02	3.31E-02
Hyoid	3.82	0.79	8.04E-02	4.50E-03	2.10E-02	1.01E-01
I cuneiform	7.88	2.02	1.39E-01	6.20E-03	1.76E-02	6.87E-02
Ilium-R	207.92	45.51	3.26E+00	1.14E-01	1.57E-02	7.16E-02
Incisor RL1	0.66	0.51	7.67E-04	3.00E-04	1.16E-03	1.52E-03
Incisor RL2	0.75	0.57	1.52E-02	1.30E-03	2.03E-02	2.68E-02
Incisor RU1	1.49	1.10	1.90E-02	1.60E-03	1.28E-02	1.72E-02
Incisor RU2	0.99	0.75	7.57E-03	1.10E-03	7.64E-03	1.01E-02
Ischium-R	235.21	40.73	3.27E+00	1.15E-01	1.39E-02	8.02E-02
L cuneiform	11.39	2.71	1.51E-01	8.20E-03	1.32E-02	5.56E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
L-Rib #1, tumor	7.29	0.82	4.92E-02	2.90E-03	6.75E-03	6.03E-02
L-Rib #1, VE	10.43	2.45	1.98E-01	8.20E-03	1.90E-02	8.09E-02
L-Rib #2, MS	6.88	0.85	6.54E-02	3.50E-03	9.51E-03	7.70E-02
L-Rib #2, SE	5.28	0.75	7.03E-02	4.70E-03	1.33E-02	9.34E-02
L-Rib #2, VE	11.91	2.16	1.41E-01	6.10E-03	1.19E-02	6.55E-02
L-Rib #3	25.30	4.30	3.58E-01	1.37E-02	1.42E-02	8.33E-02
L-Rib #4, MS	18.21	2.80	1.26E-01	5.30E-03	6.91E-03	4.49E-02
L-Rib #4, SE	19.69	2.75	3.13E-01	1.09E-02	1.59E-02	1.14E-01
L-Rib #4, VE	10.34	1.61	1.36E-01	7.90E-03	1.32E-02	8.45E-02
L-Rib #5, MS	14.95	1.90	1.84E-01	7.20E-03	1.23E-02	9.71E-02
L-Rib #5, SE	13.89	1.87	2.67E-01	9.60E-03	1.92E-02	1.42E-01
L-Rib #5, VE	14.59	2.45	1.72E-01	7.10E-03	1.18E-02	7.03E-02
L-Rib #6, MS	11.83	2.57	3.15E-01	1.45E-02	2.66E-02	1.22E-01
L-Rib #6, SE	15.02	2.12	1.77E-01	8.10E-03	1.18E-02	8.33E-02
L-Rib #6, VE	17.54	3.74	3.56E-01	1.33E-02	2.03E-02	9.52E-02
L-Rib #7, MS	13.27	2.80	3.52E-01	1.29E-02	2.65E-02	1.26E-01
L-Rib #7, SE	11.68	1.77	1.93E-01	7.60E-03	1.65E-02	1.09E-01
L-Rib #7, VE	12.18	2.75	1.78E-01	6.90E-03	1.46E-02	6.47E-02
L-Rib #7, VE tumor	14.81	2.58	2.17E-01	8.40E-03	1.46E-02	8.38E-02
L-Rib #8, MS	12.05	1.66	1.27E-01	5.40E-03	1.06E-02	7.65E-02
L-Rib #8, SE	14.25	2.06	4.75E-02	2.60E-03	3.33E-03	2.31E-02
L-Rib #8, VE	26.94	5.76	6.06E-01	2.20E-02	2.25E-02	1.05E-01
L-Rib #9, MS-1	11.03	2.32	2.08E-01	8.40E-03	1.88E-02	8.96E-02
L-Rib #9, MS-2	9.68	1.57	1.66E-01	6.50E-03	1.71E-02	1.06E-01
L-Rib #9, SE	11.27	1.85	2.16E-01	8.90E-03	1.92E-02	1.17E-01
L-Rib #9, VE	13.61	2.64	1.42E-01	1.44E-02	1.04E-02	5.37E-02
L-Rib #10, MS	12.38	2.92	3.20E-01	1.12E-02	2.59E-02	1.10E-01
L-Rib #10, SE	8.43	1.03	1.27E-01	5.40E-03	1.51E-02	1.23E-01
L-Rib #10, VE	19.22	3.57	3.24E-01	1.24E-02	1.69E-02	9.09E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
L-Rib #11, MS	8.01	2.42	2.55E-01	9.60E-03	3.19E-02	1.06E-01
L-Rib #11, SE	6.06		1.07E-01	5.70E-03	1.76E-02	
L-Rib #11, VE	11.16	1.79	1.47E-01	5.90E-03	1.32E-02	8.22E-02
L-Rib #12, MS	16.74	2.28	7.26E-02	3.50E-03	4.34E-03	3.19E-02
L-Rib #12, SE	5.91	0.63	4.71E-02	2.70E-03	7.97E-03	7.49E-02
L-Rib #12, VE	8.17	1.12	1.37E-01	5.80E-03	1.68E-02	1.23E-01
Lunate	3.75	1.07	8.85E-02	4.30E-03	2.36E-02	8.27E-02
M cuneiform	18.87	4.68	1.04E-01	4.60E-03	5.51E-03	2.22E-02
Mandible	47.74	24.95	5.03E-01	1.75E-02	1.05E-02	2.02E-02
Maxilla	33.31	11.81	6.78E-01	2.60E-02	2.04E-02	5.74E-02
Metacarpal #1	9.51	3.22				
Metacarpal #2	13.77	4.93				
Metacarpal #3	12.22	4.48	2.49E-01	9.20E-03	2.04E-02	5.55E-02
Metacarpal #4	7.29	2.49	1.42E-01	6.10E-03	1.95E-02	5.72E-02
Metacarpal #5	6.66	2.24	1.10E-01	5.70E-03	1.65E-02	4.91E-02
Metatars 1	27.10	6.88	3.19E-01	1.16E-02	1.18E-02	4.64E-02
Metatars 2	14.29	4.25	1.93E-01	8.00E-03	1.35E-02	4.54E-02
Metatars 3	12.58	3.64	1.68E-01	7.10E-03	1.33E-02	4.61E-02
Metatars 4	13.29	3.80	1.26E-01	5.40E-03	9.45E-03	3.30E-02
Metatars 5	13.26	3.83	2.10E-01	8.00E-03	1.58E-02	5.48E-02
Misc bone & tumor fragment	181.10	23.38	7.65E-01	7.28E-02	4.22E-03	3.27E-02
Molar RL6	1.96	1.34	4.01E-02	2.60E-03	2.05E-02	2.99E-02
Molar RL7	1.56	1.04	2.95E-02	3.00E-03	1.89E-02	2.84E-02
Molar RL8	2.54	1.91	4.37E-02	2.60E-03	1.72E-02	2.29E-02
Molar RU6	1.81	1.24	9.33E-04	5.00E-04	5.16E-04	7.50E-04
Molar RU7	1.91	1.39	3.17E-02	2.00E-03	1.66E-02	2.28E-02
Molar RU8	1.94	1.51	1.95E-02	1.70E-03	1.00E-02	1.29E-02
Nasal Cart.	6.91	0.12	1.48E-02	1.80E-03	2.14E-03	1.22E-01
Nasal Septa	3.56	0.29	9.32E-02	4.60E-03	2.62E-02	3.24E-01

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Navicular	24.21	5.89	3.24E-01	1.32E-02	1.34E-02	5.50E-02
Occipital	65.80	37.64	1.97E+00	1.05E-01	3.00E-02	5.24E-02
Parietal #1	58.36	33.08	1.79E+00	1.07E-01	3.07E-02	5.42E-02
Parietal #2	90.83	52.03	2.77E+00	1.30E-01	3.05E-02	5.33E-02
Patella-R	33.41	10.14	5.39E-01	1.86E-02	1.61E-02	5.31E-02
Phalanges D1	2.09	0.50	4.26E-02	2.60E-03	2.04E-02	8.48E-02
Phalanges D2	1.03	0.22	1.55E-02	1.90E-03	1.50E-02	6.95E-02
Phalanges D3	1.17	0.28	1.76E-02	1.50E-03	1.51E-02	6.36E-02
Phalanges D4	1.03	0.19	2.01E-02	2.20E-03	1.95E-02	1.08E-01
Phalanges D5	0.71	0.17	9.86E-03	1.10E-03	1.39E-02	5.94E-02
Phalanges M2	2.32	0.83	4.39E-02	2.60E-03	1.89E-02	5.32E-02
Phalanges M3	3.16	1.18	6.47E-02	3.70E-03	2.05E-02	5.47E-02
Phalanges M4	2.39	0.90	4.48E-02	2.50E-03	1.88E-02	4.97E-02
Phalanges M5	1.34	0.47	2.98E-02	2.10E-03	2.22E-02	6.38E-02
Phalanges P1	5.09	1.76				
Phalanges P2	5.92	2.22	1.09E-01	4.80E-03	1.84E-02	4.93E-02
Phalanges P3	7.22	2.80	1.53E-01	6.50E-03	2.12E-02	5.47E-02
Phalanges P4	5.54	2.10	9.17E-02	4.50E-03	1.66E-02	4.38E-02
Phalanges P5	3.43	1.21	5.57E-02	2.90E-03	1.62E-02	4.60E-02
Pisiform	2.32	0.53				
Premolar RL4	1.34	1.00	2.01E-02	1.50E-03	1.50E-02	2.00E-02
Premolar RL5	1.38	1.03	2.52E-02	2.10E-03	1.83E-02	2.45E-02
Premolar RU4	1.19	0.93	3.00E-02	5.10E-03	2.53E-02	3.22E-02
Premolar RU5	1.07	0.79	2.67E-04	4.00E-04	2.49E-04	3.37E-04
Process, broken	0.14	0.04	4.00E-03	1.50E-03	2.86E-02	1.00E-01
R-Rib #1	24.34	2.92	1.91E-01	7.50E-03	7.83E-03	6.53E-02
R-Rib #2 w/o tumor	13.55	1.90	1.96E-01	1.07E-02	1.45E-02	1.03E-01
R-Rib #3, MS	11.07	0.96	1.16E-01	5.00E-03	1.04E-02	1.20E-01
R-Rib #3, SE	12.27	2.46	1.82E-01	7.70E-03	1.49E-02	7.40E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
R-Rib #3, VE	11.64	2.19	9.98E-02	4.50E-03	8.57E-03	4.56E-02
R-Rib #4, MS	10.38	1.44	1.35E-01	5.60E-03	1.30E-02	9.35E-02
R-Rib #4, SE	10.88	1.64	1.84E-01	7.50E-03	1.69E-02	1.13E-01
R-Rib #4, VE	14.37	3.18	2.60E-01	1.13E-02	1.81E-02	8.17E-02
R-Rib #5, SE	26.69	2.54	9.62E-02	5.90E-03	3.60E-03	3.79E-02
R-Rib #5, VE	23.84	5.07	5.66E-01	2.09E-02	2.38E-02	1.12E-01
R-Rib #6, MS	16.72	2.78	3.82E-01	1.31E-02	2.29E-02	1.38E-01
R-Rib #6, SE	11.41	2.91	2.62E-01	9.70E-03	2.30E-02	9.02E-02
R-Rib #6, VE	13.71	2.36	3.79E-01	1.31E-02	2.76E-02	1.60E-01
R-Rib #7, MS	9.64	2.19	2.31E-01	9.90E-03	2.40E-02	1.06E-01
R-Rib #7, SE	6.13	0.81	7.85E-02	5.70E-03	1.28E-02	9.68E-02
R-Rib #7, SE tumor	7.06	1.38	1.21E-01	5.20E-03	1.72E-02	8.78E-02
R-Rib #7, VE	10.90	2.29	1.50E-01	6.25E+01	1.37E-02	6.55E-02
R-Rib #7, VE tumor	14.73	2.73	4.83E-01	1.75E-02	3.28E-02	1.77E-01
R-Rib #8, MS	12.14	2.17	1.95E-01	1.45E-02	1.60E-02	8.97E-02
R-Rib #8, SE	16.97	1.43	2.58E-01	9.60E-03	1.52E-02	1.80E-01
R-Rib #8, VE + tumor	130.86	33.63	5.62E-01	4.51E-02	4.29E-03	1.67E-02
R-Rib #9,MS	8.85	1.74	1.59E-01	6.60E-03	1.80E-02	9.17E-02
R-Rib #9,SE	8.53	1.93	9.29E-02	4.30E-03	1.09E-02	4.82E-02
R-Rib #9,VE	18.87	3.63	2.87E-01	1.06E-02	1.52E-02	7.90E-02
R-Rib #10, MS	11.11	2.58	2.28E-01	8.70E-03	2.05E-02	8.83E-02
R-Rib #10, SE	6.11	0.27	2.70E-02	1.80E-03	4.42E-03	9.96E-02
R-Rib #10, tumor	15.14	2.34	1.65E-01	7.10E-03	1.09E-02	7.03E-02
R-Rib #10, VE	9.60	1.90	1.53E-01	6.30E-03	1.60E-02	8.06E-02
R-Rib #11, MS	7.12	1.67	1.46E-01	5.90E-03	2.05E-02	8.77E-02
R-Rib #11, SE	4.24	0.63	6.53E-02	7.40E-03	1.54E-02	1.04E-01
R-Rib #11, VE	12.14	1.84	1.35E-01	6.50E-03	1.11E-02	7.33E-02
R-Rib #12, SE	9.26	0.80	7.07E-02	3.50E-03	7.63E-03	8.86E-02
R-Rib #12, VE	68.49	5.89	2.22E-01	9.40E-03	3.24E-03	3.77E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius DE	21.12	5.96	2.84E-01	1.28E-02	1.35E-02	4.77E-02
Radius DS	25.84	14.34	2.76E-01	1.59E-02	1.07E-02	1.93E-02
Radius PE	8.31	2.52	1.50E-01	6.30E-03	1.80E-02	5.95E-02
Radius PS	32.50	16.51	4.04E-01	1.39E-02	1.24E-02	2.45E-02
Rib costal cart	10.58		3.07E-03	6.00E-04	2.90E-04	
Rib end & tumor	6.65	0.62	2.09E-02	1.50E-03	3.14E-03	3.37E-02
Sacrum central "A"	13.15	8.05	1.04E-01	4.60E-03	7.89E-03	1.29E-02
Sacrum central "B"	35.51	21.86	3.22E-01	1.56E-02	9.06E-03	1.47E-02
Sacrum central "C"	44.43	19.85	5.51E-01	1.97E-02	1.24E-02	2.77E-02
Sacrum central anterior piec	35.66	11.52	1.17E-01	1.02E-02	3.29E-03	1.02E-02
Sacrum central lump	28.38	9.18	3.33E-04	5.00E-04	1.17E-05	3.63E-05
Sacrum left "A"	52.33	23.26				
Sacrum left "B"	202.15	99.42	8.17E-01	3.50E-02	4.04E-03	8.22E-03
Sacrum left "C"	37.87	17.21	2.62E-01	4.09E-02	6.91E-03	1.52E-02
Sacrum right "A"	151.13	86.48	1.26E+00	5.29E-02	8.33E-03	1.45E-02
Sacrum right "B"	111.76	55.72	9.03E-01	3.69E-02	8.08E-03	1.62E-02
Sacrum right "C"	22.06	10.35	2.42E-01	1.34E-02	1.10E-02	2.34E-02
Sacrum right lump	84.51	37.84	1.82E-01	9.80E-03	2.15E-03	4.80E-03
Scap spine	56.31	13.11	8.34E-01	2.84E-02	1.48E-02	6.36E-02
Scap spine, tumor	46.91	10.59	4.42E-01	1.69E-02	9.42E-03	4.17E-02
Scaphoid	6.13	1.79				
Scapula DE	40.07	13.29	7.32E-01	2.50E-02	1.83E-02	5.51E-02
Scapula PE	24.13	4.91	3.00E-01	1.18E-02	1.25E-02	6.12E-02
Sesamoids-R	0.86	0.17	1.11E-02	1.10E-03	1.30E-02	6.63E-02
Talus	72.42	80.82	9.77E-01	3.26E-02	1.35E-02	1.21E-02
Temporal #1	18.49	8.10	3.60E-01	1.41E-02	1.95E-02	4.45E-02
Temporal #2	111.62	44.31	2.31E+00	9.98E-02	2.07E-02	5.20E-02
Temporal #3	6.88	3.03	1.04E-01	4.70E-03	1.51E-02	3.43E-02
Tibia DE	79.63	19.46	8.25E-01	7.19E-02	1.04E-02	4.24E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Tibia DS	120.09	56.77	6.29E-01	2.45E-02	5.24E-03	1.11E-02
Tibia PE	192.75	34.78	7.99E-02	2.90E-03	4.15E-04	2.30E-03
Tibia PS	152.69	64.18	9.24E-01	5.35E-02	6.05E-03	1.44E-02
Toenails-Ft-L	0.71	0.01	2.33E-04	2.00E-04	3.29E-04	3.89E-02
Trapezium	4.54	1.21	7.17E-02	4.40E-03	1.58E-02	5.91E-02
Trapezoid	2.77	0.82	5.88E-02	3.50E-03	2.12E-02	7.16E-02
Triangular	2.66	0.75	4.52E-02	3.40E-03	1.70E-02	6.00E-02
Tumor from R-Rib #2	24.31	2.35	9.01E-02	4.20E-03	3.71E-03	3.84E-02
Tumor-Outside L. Orbit	1.06	0.06	2.47E-03	8.00E-04	2.33E-03	3.92E-02
Ulna DE	5.84	1.38	7.76E-02	3.70E-03	1.33E-02	5.62E-02
Ulna DS	21.89	11.15	2.50E-01	9.20E-03	1.14E-02	2.24E-02
Ulna PE	40.35	14.89	7.54E-01	2.55E-02	1.87E-02	5.06E-02
Ulna PS	35.18	19.44	3.95E-01	1.41E-02	1.12E-02	2.03E-02
Vert C-1	33.70	8.28			0.00E+00	0.00E+00
Vert C-2 arch	12.38	3.41				
Vert C-2 body	20.46	3.02	1.23E-02	1.10E-03	6.01E-04	4.07E-03
Vert C-3 arch	12.08	3.35				
Vert C-3 body	9.08	1.59	1.43E-01	5.90E-03	1.57E-02	9.00E-02
Vert C-4 arch	10.67	2.89	1.82E-01	1.26E-02	1.71E-02	6.31E-02
Vert C-4 body	12.33	2.31				
Vert C-5 arch	14.42					
Vert C-5 arch #1	4.44	0.73	7.35E-02	3.80E-03	1.65E-02	1.00E-01
Vert C-5 arch #2	6.46	1.17	7.97E-02	3.90E-03	1.23E-02	6.82E-02
Vert C-5 body	13.39	1.66	1.89E-01	8.20E-03	1.41E-02	1.14E-01
Vert C-5 dorsal arch part	3.19	0.91				
Vert C-6 arch	11.42	2.51	1.95E-01	7.40E-03	1.70E-02	7.77E-02
Vert C-6 body	9.55	1.62				
Vert C-7 arch	16.35	3.83	2.67E-01	9.60E-03	1.63E-02	6.96E-02
Vert C-7 body	15.42	1.98	1.94E-01	7.60E-03	1.26E-02	9.85E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert L-1 arch	35.30	6.62	5.45E-01	4.05E-02	1.54E-02	8.23E-02
Vert L-1 body	78.84	8.47	7.39E-01	2.77E-02	9.37E-03	8.72E-02
Vert L-2 arch	31.84	6.17	5.30E-01	2.05E-02	1.66E-02	8.58E-02
Vert L-2 body	72.49	9.80	1.50E-02	1.90E-03	2.07E-04	1.53E-03
Vert L-2 wedge	6.11	0.73	3.52E-02	2.40E-03	5.76E-03	4.82E-02
Vert L-3 arch	34.53	8.10	5.95E-01	2.19E-02	1.72E-02	7.34E-02
Vert L-3 body	39.47	5.37	3.19E-01	1.12E-02	8.08E-03	5.94E-02
Vert L-3 wedge	9.27	0.84	4.89E-02	2.90E-03	5.27E-03	5.80E-02
Vert L-3,4 or 5 wedge	5.21	0.74	2.29E-02	1.70E-03	4.39E-03	3.10E-02
Vert L-4 arch remnants	89.24	5.54	4.05E-01	2.19E-02	4.54E-03	7.31E-02
Vert L-4 body	67.13	6.96	6.60E-01	3.69E-02	9.84E-03	9.49E-02
Vert L-5 arch	49.92	13.39	8.43E-01	3.34E-02	1.69E-02	6.29E-02
Vert L-5 body	60.93	6.92	5.48E-01	2.10E-02	8.99E-03	7.91E-02
Vert T-1 arch #1	3.85	0.84	7.99E-02	5.80E-03	2.07E-02	9.52E-02
Vert T-1 arch #2	6.00	0.86	8.09E-02	4.00E-03	1.35E-02	9.42E-02
Vert T-1 body	11.95	1.71	1.48E-01	7.20E-03	1.24E-02	8.66E-02
Vert T-1 dorsal arch part	12.68	3.26	2.26E-01	8.40E-03	1.79E-02	6.95E-02
Vert T-2 arch #1	8.54	2.12	1.00E-01	5.20E-03	1.18E-02	4.74E-02
Vert T-2 arch #2	3.05	0.94				
Vert T-2 body	16.93	2.41	1.13E-01	7.00E-03	6.67E-03	4.69E-02
Vert T-2 dorsal arch part	11.45	3.29				
Vert T-3 arch	23.45	4.80	1.37E-02	1.20E-03	5.86E-04	2.86E-03
Vert T-3 body	68.17	16.83	5.60E-01	2.46E-02	8.21E-03	3.33E-02
Vert T-4 arch #1	8.46	1.36	6.90E-03	8.00E-04	8.16E-04	5.06E-03
Vert T-4 body	20.55	1.93	2.03E-01	7.70E-03	9.90E-03	1.06E-01
Vert T-4 dorsal arch part	12.91	2.82	2.73E-03	6.00E-04	2.12E-04	9.69E-04
Vert T-5 arch	24.55	4.81				
Vert T-5 body	32.75	3.27	3.41E-01	2.48E-02	1.04E-02	1.05E-01
Vert T-6 arch a-1	10.71	2.40	1.29E-01	9.20E-03	1.21E-02	5.40E-02

Table 22. ^{239}Pu in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-6 body	12.92	1.78	1.22E-01	5.50E-03	9.44E-03	6.84E-02
Vert T-6 dorsal arch part	18.41	4.26				
Vert T-7 arch	20.45	5.06				
Vert T-7 body	57.67	12.24	4.19E-01	1.89E-02	7.26E-03	3.42E-02
Vert T-8 arch	22.44	5.84	3.96E-01	1.58E-02	1.76E-02	6.78E-02
Vert T-8 body	33.54	7.64				
Vert T-9 arch	28.76	5.81				
Vert T-9 body	82.22	14.18	5.93E-01	3.61E-02	7.22E-03	4.19E-02
Vert T-10 arch	28.51	6.71	4.00E-01	1.61E-02	1.40E-02	5.97E-02
Vert T-10 body	45.14	7.63				
Vert T-11 arch	30.70	5.61				
Vert T-11 body	30.64	5.59				
Vert T-12 arch	32.27	5.56				
Vert T-12 body	27.90	2.32	2.24E-01	8.40E-03	8.02E-03	9.64E-02
Vert T-12 wedge	3.42	0.45	2.68E-02	1.90E-03	7.85E-03	5.92E-02
	42040.88	2430.65	194.47			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Soft Tissues						
Adrenal-L	13.66	0.06				
Adrenal-R	9.26	0.05				
Aorta, decend thoracic	29.62	0.34				
Aortic Arch	46.28	0.44				
Bladder	130.65	0.80				
Cerebellum #1	63.84	0.86				
Cerebellum #2	14.68	0.23	2.07E-03	7.00E-04	1.41E-04	8.99E-03
Cerebrum	1051.72	13.65	3.83E-03	8.00E-04	3.64E-06	2.81E-04
Diaphragm #1	53.36		1.67E-03	7.00E-04	3.12E-05	
Diaphragm #2	33.78	0.23				
Duodenum	25.67	0.15				
Dura	49.73	0.77	4.90E-03	9.00E-04	9.85E-05	6.36E-03
Ear-L	20.91	0.18	6.67E-04	6.00E-04	3.19E-05	3.77E-03
Ear-R	20.56	0.21	1.47E-03	5.00E-04	7.13E-05	7.15E-03
Epiglottis	1.24		1.38E-01	3.18E-02	1.12E-01	
Esophagus	51.32	0.39				
Eyes	8.38	0.06	2.67E-04	3.00E-04	3.18E-05	4.23E-03
Gall Bladder	9.47	0.08				
Gall Bladder scraps	2.53	0.01	1.87E-03	6.00E-04	7.38E-04	1.87E-01
Gland, lacrimal	3.78	0.03	5.01E-04	3.00E-04	1.33E-04	1.47E-02
Hair	16.08	0.15	7.67E-04	5.00E-04	4.77E-05	5.22E-03
Heart	224.65	1.88				
Intestine-large	503.24	1.93				
Intestine-small	481.01	1.06				
Kidney scraps	3.61	0.02	9.33E-04	5.00E-04	2.59E-04	4.67E-02
Kidney-L	115.98	1.07				
Kidney-L, Fascia	115.39	0.50				
Kidney-R	97.29	0.82				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Kidney-R, Fascia	139.49	0.51				
Larynx	49.26	1.79				
Liver	1438.28	17.36				
Liver scrap	4.55	0.05	6.67E-01	1.38E+00	1.47E-01	1.33E+01
LN, Carinal	0.78					
LN, L-Lung	0.52	0.01				
LN, Mediastinal	2.26	0.05				
LN, Mesentery	0.41		1.33E-04	7.00E-04	3.25E-04	
LN, peri-aortic + fat	90.97	0.44				
LN, peri-Duodenal	1.29	0.01				
LN, peri-M.S. ?	5.20	0.03				
LN, peri-Pancreatic#2	10.62	0.06				
LN, R-Lung	1.79	0.02				
Lung scrap w/ metastises	125.64	8.66	-1.87E+00	1.22E+00	-1.49E-02	-2.16E-01
Lung-L	426.97	10.67				
Lung-R	383.76	7.63				
Meninges, part	3.32	0.06	3.33E-04	4.00E-04	1.00E-04	5.56E-03
Mesentary scrap	5.50	0.05	2.00E-04	3.00E-04	3.64E-05	4.00E-03
Mesentery, Gastric	31.03	0.06				
Midbrain, pons	19.31	0.28				
Musc calf-L lower	490.48	3.62	6.67E-04	1.10E-03	1.36E-06	1.84E-04
Musc calf-L upper	327.52	2.38	6.50E-03	3.00E-03	1.98E-05	2.73E-03
Musc calf-R lower	361.39	2.62	1.00E-02	3.40E-03	2.77E-05	3.82E-03
Musc calf-R upper	402.35	3.02	3.17E-03	1.60E-03	7.87E-06	1.05E-03
Musc foot-L	310.77	1.48	7.67E-03	1.10E-03	2.47E-05	5.18E-03
Musc foot-R	310.18	2.04	3.50E-03	2.20E-03	1.13E-05	1.72E-03
Musc forearm-L#1	455.41	4.44	4.00E-03	2.10E-03	8.78E-06	9.01E-04
Musc forearm-R#1	456.58	4.58				
Musc hand-L #1	103.63	0.95	3.62E-03	1.20E-03	3.49E-05	3.80E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Musc hand-L #2	13.05	0.18	4.01E-04	5.00E-04	3.07E-05	2.26E-03
Musc hand-L #3	19.22	0.17	1.50E-03	5.00E-04	7.80E-05	8.98E-03
Musc hand-R	141.88	1.28	3.83E-03	2.60E-03	2.70E-05	2.99E-03
Musc L back#1	645.42	10.30	7.67E-03	6.70E-03	1.19E-05	7.44E-04
Musc L back#2	306.51	2.80	7.83E-03	3.70E-03	2.56E-05	2.80E-03
Musc L back#3	415.91	2.60	5.67E-03	1.20E-03	1.36E-05	2.18E-03
Musc L back#4	536.44	3.23	5.83E-03	1.00E-03	1.09E-05	1.81E-03
Musc L front#1	600.53	4.79	7.50E-03	2.40E-03	1.25E-05	1.57E-03
Musc L front#2	200.11	1.59	7.17E-03	2.40E-03	3.58E-05	4.51E-03
Musc L front#3	458.22	4.11	4.83E-03	1.10E-03	1.05E-05	1.18E-03
Musc L front#4	362.85	2.13	1.33E-03	1.00E-03	3.67E-06	6.26E-04
Musc R back#1	1108.47	11.19	1.17E-02	3.50E-03	1.05E-05	1.04E-03
Musc R back#2	308.58	2.78	2.83E-03	2.00E-03	9.18E-06	1.02E-03
Musc R back#3	408.86	5.86	4.05E-03	2.00E-03	9.90E-06	6.91E-04
Musc R back#4	641.00	3.86	1.03E-02	3.50E-03	1.61E-05	2.68E-03
Musc R front#1	450.24	3.73	1.02E-02	2.50E-03	2.27E-05	2.74E-03
Musc R front#2	116.75	1.01	7.33E-04	7.00E-04	6.28E-06	7.26E-04
Musc R front#3	474.10	3.60	9.50E-03	3.10E-03	2.00E-05	2.64E-03
Musc R front#4	284.86	2.15	7.67E-03	3.40E-03	2.69E-05	3.57E-03
Musc scrap Vert	19.51	0.16				
Musc thigh-L lower	892.90	7.03	1.10E-02	2.90E-03	1.23E-05	1.56E-03
Musc thigh-L upper	1072.96	8.70	1.65E-02	5.50E-03	1.54E-05	1.90E-03
Musc thigh-R lower	671.20	5.94	1.20E-02	4.10E-03	1.79E-05	2.02E-03
Musc thigh-R upper	992.01	8.05	7.33E-03	4.60E-03	7.39E-06	9.11E-04
Musc up arm-L#1	663.35	7.25	4.07E-03	3.60E-03	6.13E-06	5.61E-04
Musc up arm-R#1	689.93	7.00	5.51E-03	2.20E-03	7.99E-06	7.88E-04
Muscle index finger - R	3.76	0.02	3.33E-03	2.30E-03	8.87E-04	1.67E-01
Muscle - tumor	2.99	0.25	1.33E-03	1.10E-03	4.46E-04	5.33E-03
Muscle head	551.11	4.91	1.09E-02	1.80E-03	1.98E-05	2.23E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Muscle scrap,spine & rib	624.96	12.02	7.93E-03	1.90E-03	1.27E-05	6.60E-04
Pancreas	19.28	0.12				
Pancreas, part	8.59	0.14	2.13E-03	1.30E-03	2.48E-04	1.52E-02
Penis	84.49	0.60	1.03E-03	5.00E-04	1.22E-05	1.71E-03
Peri-duodenal tissue	61.48	0.17				
Peri-vert. muscle	25.35	0.16				
Pericardium	44.72	0.14	1.80E-03	5.00E-04	4.03E-05	1.25E-02
Pituitary	0.22	0.00				
Prostate	37.01	0.25				
Salivary gland	30.25	0.23				
Skin calf-L #1	310.07	1.28				
Skin calf-L #2	156.11	0.78	2.47E-03	6.00E-04	1.58E-05	3.15E-03
Skin calf-R #1	384.68	1.34				
Skin calf-R #2	194.61	0.89	4.15E-03	1.10E-03	2.13E-05	4.69E-03
Skin foot-L	292.06	1.79				
Skin foot-R	341.06	1.74	7.07E-03	1.40E-03	2.07E-05	4.06E-03
Skin forearm-L	125.78	0.72				
Skin forearm-R	140.40	0.92				
Skin hand-L	79.50	0.54	1.67E-03	5.00E-04	2.10E-05	3.10E-03
Skin hand-R	93.32	0.63	1.00E-04	2.00E-04	1.07E-06	1.59E-04
Skin head	522.52	3.40				
Skin Index Finger - R	9.02	0.07				
Skin L back#1	273.48	1.43				
Skin L back#2	256.73	1.35				
Skin L back#3	344.16	1.31	3.84E-03	7.00E-04	1.11E-05	2.93E-03
Skin L back#4	346.37	1.41	5.80E-03	1.80E-03	1.67E-05	4.12E-03
Skin L front#1	169.11	0.88				
Skin L front#2	102.48	0.56	1.77E-03	5.00E-04	1.72E-05	3.18E-03
Skin L front#3	113.27	0.59	1.17E-03	8.00E-04	1.03E-05	1.99E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Skin L front#4	103.74	0.63	1.17E-03	4.00E-04	1.12E-05	1.85E-03
Skin R back#1	348.83	1.57	7.67E-03	1.50E-03	2.20E-05	4.88E-03
Skin R back#2	285.31	1.68				
Skin R back#3	355.95	1.37				
Skin R back#4	410.51	1.40				
Skin R front#1	111.59	0.58				
Skin R front#2	138.37	0.71	2.60E-03	6.00E-04	1.88E-05	3.66E-03
Skin R front#3	170.06	0.85	3.33E-03	7.00E-04	1.96E-05	3.94E-03
Skin R front#4	125.17	0.55				
Skin thigh-L #1	899.02	3.68				
Skin thigh-L #2	497.93	1.69				
Skin thigh-R #1	832.37	3.42	1.43E-02	2.10E-02	1.72E-05	4.19E-03
Skin thigh-R #2	554.78	1.25	3.03E-03	9.00E-04	5.47E-06	2.42E-03
Skin up arm-L	268.59	1.25				
Skin up arm-R	281.00	1.40				
Skin, thumb - L	10.62	0.08	8.68E-04	5.00E-04	8.17E-05	1.14E-02
Soft Tissue from bones	170.10	4.95				
Spinal col mus + conn tiss	1077.27	12.56	1.79E-02	4.60E-03	1.66E-05	1.42E-03
Spleen	38.71	0.39				
Stomach	101.97	0.73				
Testis-L	21.18	0.07				
Testis-R	22.71	0.18				
Thoracic metastatic nodules	1.67	0.49	6.01E-04	6.00E-04	3.61E-04	1.22E-03
Thyroid	12.89	0.10				
Tongue	71.08	0.71	7.33E-04	4.00E-04	1.03E-05	1.03E-03
Trachea	19.66	0.33				
Tumor, L-Lung	18.13	5.35				
Tumor, liver	0.65	0.08				
Tumor, R-Lung	12.06	3.79				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vein, large	2.30	0.02	-1.33E-04	5.00E-04	-5.80E-05	-6.67E-03
Vena Cava	11.43	0.07				
Bones						
Bone tumor & bits	9.77	1.51	1.00E-03	1.90E-03	1.02E-04	6.62E-04
Calcaneus	113.94		3.93E-03	6.00E-04	3.45E-05	
Canine RL3	1.53	1.13	2.30E-03	8.00E-04	1.50E-03	2.04E-03
Canine RU3	1.97	1.45	-2.00E-04	5.00E-04	-1.02E-04	-1.38E-04
Capitate	7.02	2.17	5.23E-03	9.00E-04	7.45E-04	2.42E-03
Clav Acrom	19.24	3.46				
Clav Shaft	24.61	11.82	1.39E-02	1.50E-03	5.65E-04	1.18E-03
Clavicl SE	15.45	4.43				
Coccyx	6.19	0.70	1.60E-03	7.00E-04	2.58E-04	2.28E-03
Costal Cart. L + R combined	196.51	4.40	6.80E-03	1.50E-03	3.46E-05	1.55E-03
Cuboid	22.24	4.44	6.97E-03	1.70E-03	3.13E-04	1.57E-03
Femur DE	285.94	57.22				
Femur DS	130.22	45.36	4.05E-02	2.50E-03	3.11E-04	8.94E-04
Femur MS	104.85	46.73	4.44E-02	3.00E-03	4.23E-04	9.50E-04
Femur PE	229.82	38.17	8.69E-02	4.30E-03	3.78E-04	2.28E-03
Femur PS	111.95	43.99				
Fibula DE	23.64	5.95	1.01E-02	1.30E-03	4.26E-04	1.69E-03
Fibula DS	37.17	18.18	1.08E-02	1.10E-03	2.90E-04	5.92E-04
Fibula PE	22.64	3.31	8.54E-03	1.10E-03	3.77E-04	2.58E-03
Fibula PS	33.91	15.94	1.11E-02	1.20E-03	3.27E-04	6.97E-04
Fingernails-R	0.87	0.01	1.27E-03	1.00E-03	1.46E-03	2.12E-01
Fluid from pelvis	15.73	0.03	2.27E-03	6.00E-04	1.44E-04	6.87E-02
Frontal #1	32.34	18.64				
Frontal #2	42.44	24.43	2.63E-02	2.30E-03	6.19E-04	1.08E-03
Frontal #3	23.97	11.76	1.18E-02	1.30E-03	4.92E-04	1.00E-03
Ft Phal D1	3.21	0.43	1.83E-03	6.00E-04	5.71E-04	4.25E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Ft Phal D2	0.60	0.07	1.29E-03	5.00E-04	2.14E-03	1.98E-02
Ft Phal D3	0.72	0.08	1.23E-03	5.00E-04	1.71E-03	1.54E-02
Ft Phal D4	0.65	0.07	1.25E-04	8.00E-04	1.92E-04	1.79E-03
Ft Phal D5	0.35	0.03	5.33E-04	6.00E-04	1.52E-03	1.62E-02
Ft Phal M2	0.86	0.15	1.67E-03	6.00E-04	1.94E-03	1.08E-02
Ft Phal M3	0.67	0.13	1.73E-03	6.00E-04	2.59E-03	1.33E-02
Ft Phal M4	0.54	0.08	1.57E-03	1.00E-03	2.90E-03	1.91E-02
Ft Phal M5	0.37	0.05	2.00E-04	4.00E-04	5.41E-04	4.00E-03
Ft Phal P1	7.70	1.96	4.80E-03	9.00E-04	6.23E-04	2.45E-03
Ft Phal P2	2.96	0.80	1.39E-03	5.00E-04	4.71E-04	1.75E-03
Ft Phal P3	2.28	0.51	1.43E-03	5.00E-04	6.29E-04	2.80E-03
Ft Phal P4	2.11	0.49	1.83E-03	6.00E-04	8.69E-04	3.71E-03
Ft Phal P5	1.76	0.35	1.54E-03	5.00E-04	8.73E-04	4.35E-03
Hamate	5.11	1.45	2.87E-03	8.00E-04	5.61E-04	1.98E-03
Humerus DE	66.77	23.39				
Humerus DS	63.59	29.86				
Humerus PE	97.90	17.33	3.89E-02	2.50E-03	3.97E-04	2.25E-03
Humerus PS	65.56	25.70				
Hyoid	3.82	0.79	1.87E-03	8.00E-04	4.89E-04	2.35E-03
I cuneiform	7.88	2.02	3.37E-03	8.00E-04	4.28E-04	1.67E-03
Ilium-R	207.92	45.51	9.35E-02	7.60E-03	4.50E-04	2.05E-03
Incisor RL1	0.66	0.51	1.50E-03	6.00E-04	2.27E-03	2.96E-03
Incisor RL2	0.75	0.57		6.00E-04		
Incisor RU1	1.49	1.10	1.20E-03	7.00E-04	8.05E-04	1.09E-03
Incisor RU2	0.99	0.75	1.54E-02	1.30E-03	1.56E-02	2.06E-02
Ischium-R	235.21	40.73	9.02E-02	7.30E-03	3.83E-04	2.21E-03
L cuneiform	11.39	2.71	1.59E-02	2.00E-03	1.40E-03	5.87E-03
L-Rib #1, tumor	7.29	0.82	2.13E-03	8.00E-04	2.93E-04	2.61E-03
L-Rib #1, VE	10.43	2.45	5.67E-03	1.60E-03	5.43E-04	2.31E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
L-Rib #2, MS	6.88	0.85	-2.33E-04	9.00E-04	-3.39E-05	-2.75E-04
L-Rib #2, SE	5.28	0.75	1.17E-03	1.50E-03	2.21E-04	1.55E-03
L-Rib #2, VE	11.91	2.16	5.60E-03	1.40E-03	4.70E-04	2.59E-03
L-Rib #3	25.30	4.30				
L-Rib #4, MS	18.21	2.80	4.17E-03	1.20E-03	2.29E-04	1.49E-03
L-Rib #4, SE	19.69	2.75				
L-Rib #4, VE	10.34	1.61				
L-Rib #5, MS	14.95	1.90	4.30E-03	1.20E-03	2.88E-04	2.27E-03
L-Rib #5, SE	13.89	1.87				
L-Rib #5, VE	14.59	2.45	6.03E-03	1.30E-03	4.14E-04	2.46E-03
L-Rib #6, MS	11.83	2.57	1.24E-02	1.80E-03	1.05E-03	4.84E-03
L-Rib #6, SE	15.02	2.12	6.30E-03	2.40E-03	4.20E-04	2.97E-03
L-Rib #6, VE	17.54	3.74				
L-Rib #7, MS	13.27	2.80				
L-Rib #7, SE	11.68	1.77	6.10E-03	1.70E-03	5.22E-04	3.45E-03
L-Rib #7, VE	12.18	2.75				
L-Rib #7, VE tumor	14.81	2.58				
L-Rib #8, MS	12.05	1.66	3.84E-03	1.40E-03	3.18E-04	2.31E-03
L-Rib #8, SE	14.25	2.06				
L-Rib #8, VE	26.94	5.76	1.16E-02	2.80E-03	4.31E-04	2.02E-03
L-Rib #9, MS-1	11.03	2.32	6.60E-03	1.50E-03	5.99E-04	2.85E-03
L-Rib #9, MS-2	9.68	1.57	6.50E-03	1.30E-03	6.72E-04	4.14E-03
L-Rib #9, SE	11.27	1.85				
L-Rib #9, VE	13.61	2.64	5.65E-03	1.30E-03	4.15E-04	2.14E-03
L-Rib #10, MS	12.38	2.92				
L-Rib #10, SE	8.43	1.03				
L-Rib #10, VE	19.22	3.57				
L-Rib #11, MS	8.01	2.42	2.57E-03	1.00E-03	3.20E-04	1.06E-03
L-Rib #11, SE	6.06		5.80E-03	1.70E-03	9.58E-04	

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
L-Rib #11, VE	11.16	1.79	5.03E-03	1.30E-03	4.51E-04	2.81E-03
L-Rib #12, MS	16.74	2.28				
L-Rib #12, SE	5.91	0.63	6.54E-03	1.20E-03	1.11E-03	1.04E-02
L-Rib #12, VE	8.17	1.12				
Lunate	3.75	1.07	1.89E-03	1.00E-03	5.05E-04	1.77E-03
M cuneiform	18.87	4.68	4.23E-03	9.00E-04	2.24E-04	9.05E-04
Mandible	47.74	24.95	1.86E-02	1.70E-03	3.89E-04	7.45E-04
Maxilla	33.31	11.81				
Metacarpal #1	9.51	3.22				
Metacarpal #2	13.77	4.93				
Metacarpal #3	12.22	4.48	6.00E-03	8.00E-04	4.91E-04	1.34E-03
Metacarpal #4	7.29	2.49	2.32E-03	7.00E-04	3.18E-04	9.34E-04
Metacarpal #5	6.66	2.24	4.07E-03	1.10E-03	6.11E-04	1.82E-03
Metatars 1	27.10	6.88	1.18E-02	1.50E-03	4.35E-04	1.72E-03
Metatars 2	14.29	4.25	6.60E-03	1.00E-03	4.62E-04	1.55E-03
Metatars 3	12.58	3.64	5.43E-03	9.00E-04	4.32E-04	1.49E-03
Metatars 4	13.29	3.80	5.17E-03	8.00E-04	3.89E-04	1.36E-03
Metatars 5	13.26	3.83	7.43E-03	1.00E-03	5.61E-04	1.94E-03
Misc bone & tumor fragment	181.10	23.38	1.38E-02	4.10E-03	7.64E-05	5.92E-04
Molar RL6	1.96	1.34	1.07E-03	7.00E-04	5.44E-04	7.96E-04
Molar RL7	1.56	1.04	1.93E-03	6.00E-04	1.24E-03	1.87E-03
Molar RL8	2.54	1.91				
Molar RU6	1.81	1.24				
Molar RU7	1.91	1.39	2.00E-04	3.00E-04	1.05E-04	1.44E-04
Molar RU8	1.94	1.51	8.67E-04	6.00E-04	4.47E-04	5.75E-04
Nasal Cart.	6.91	0.12	-1.34E-03	1.40E-03	-1.94E-04	-1.11E-02
Nasal Septa	3.56	0.29	1.30E-03	6.00E-04	3.65E-04	4.51E-03
Navicular	24.21	5.89	1.03E-02	3.00E-03	4.24E-04	1.74E-03
Occipital	65.80	37.64				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Parietal #1	58.36	33.08				
Parietal #2	90.83	52.03				
Patella-R	33.41	10.14	1.37E-02	1.30E-03	4.11E-04	1.35E-03
Phalanges D1	2.09	0.50	1.04E-03	9.00E-04	4.96E-04	2.06E-03
Phalanges D2	1.03	0.22	1.36E-03	8.00E-04	1.32E-03	6.09E-03
Phalanges D3	1.17	0.28	1.50E-03	6.00E-04	1.28E-03	5.42E-03
Phalanges D4	1.03	0.19	1.00E-03	9.00E-04	9.71E-04	5.38E-03
Phalanges D5	0.71	0.17	-2.50E-04	3.00E-04	-3.52E-04	-1.51E-03
Phalanges M2	2.32	0.83	3.57E-05	2.00E-04	1.54E-05	4.33E-05
Phalanges M3	3.16	1.18	1.61E-03	1.20E-03	5.09E-04	1.36E-03
Phalanges M4	2.39	0.90	1.53E-03	8.00E-04	6.41E-04	1.70E-03
Phalanges M5	1.34	0.47	8.57E-04	5.00E-04	6.40E-04	1.84E-03
Phalanges P1	5.09	1.76				
Phalanges P2	5.92	2.22	1.68E-03	6.00E-04	2.83E-04	7.57E-04
Phalanges P3	7.22	2.80	4.03E-03	9.00E-04	5.59E-04	1.44E-03
Phalanges P4	5.54	2.10	3.27E-03	7.00E-04	5.90E-04	1.56E-03
Phalanges P5	3.43	1.21	1.87E-03	7.00E-04	5.44E-04	1.54E-03
Pisiform	2.32	0.53				
Premolar RL4	1.34	1.00	1.77E-03	5.00E-04	1.32E-03	1.76E-03
Premolar RL5	1.38	1.03	9.67E-04	5.00E-04	7.00E-04	9.39E-04
Premolar RU4	1.19	0.93	9.67E-04	5.00E-04	8.13E-04	1.04E-03
Premolar RU5	1.07	0.79				
Process, broken	0.14	0.04	2.17E-03	1.60E-03	1.55E-02	5.42E-02
R-Rib #1	24.34	2.92				
R-Rib #2 w/o tumor	13.55	1.90	4.80E-03	3.00E-03	3.54E-04	2.53E-03
R-Rib #3, MS	11.07	0.96	2.90E-03	9.00E-04	2.62E-04	3.01E-03
R-Rib #3, SE	12.27	2.46	4.80E-03	1.70E-03	3.91E-04	1.95E-03
R-Rib #3, VE	11.64	2.19	3.57E-03	1.10E-03	3.07E-04	1.63E-03
R-Rib #4, MS	10.38	1.44	4.57E-03	1.30E-03	4.40E-04	3.18E-03

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
R-Rib #4, SE	10.88	1.64	5.20E-03	1.50E-03	4.78E-04	3.18E-03
R-Rib #4, VE	14.37	3.18				
R-Rib #5, SE	26.69	2.54	3.17E-03	1.20E-03	1.19E-04	1.25E-03
R-Rib #5, VE	23.84	5.07				
R-Rib #6, MS	16.72	2.78				
R-Rib #6, SE	11.41	2.91	8.53E-03	1.80E-03	7.48E-04	2.94E-03
R-Rib #6, VE	13.71	2.36				
R-Rib #7, MS	9.64	2.19	6.47E-03	1.40E-03	6.71E-04	2.96E-03
R-Rib #7, SE	6.13	0.81				
R-Rib #7, SE tumor	7.06	1.38				
R-Rib #7, VE	10.90	2.29				
R-Rib #7, VE tumor	14.73	2.73				
R-Rib #8, MS	12.14	2.17	8.47E-03	1.30E-03	6.98E-04	3.90E-03
R-Rib #8, SE	16.97	1.43				
R-Rib #8, VE + tumor	130.86	33.63				
R-Rib #9,MS	8.85	1.74	5.03E-03	1.60E-03	5.69E-04	2.89E-03
R-Rib #9,SE	8.53	1.93	3.30E-03	1.50E-03	3.87E-04	1.71E-03
R-Rib #9,VE	18.87	3.63	6.87E-03	1.20E-03	3.64E-04	1.89E-03
R-Rib #10, MS	11.11	2.58	6.27E-03	1.50E-03	5.64E-04	2.43E-03
R-Rib #10, SE	6.11	0.27				
R-Rib #10, tumor	15.14	2.34	3.04E-03	1.00E-03	2.00E-04	1.30E-03
R-Rib #10, VE	9.60	1.90				
R-Rib #11, MS	7.12	1.67	2.57E-03	1.00E-03	3.61E-04	1.54E-03
R-Rib #11, SE	4.24	0.63				
R-Rib #11, VE	12.14	1.84	9.30E-03	2.00E-03	7.66E-04	5.06E-03
R-Rib #12, SE	9.26	0.80	8.40E-03	2.00E-03	9.07E-04	1.05E-02
R-Rib #12, VE	68.49	5.89	2.67E-03	1.50E-03	3.89E-05	4.53E-04

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Radius DE	21.12	5.96	8.73E-03	1.10E-03	4.14E-04	1.47E-03
Radius DS	25.84	14.34	8.80E-03	1.20E-03	3.41E-04	6.14E-04
Radius PE	8.31	2.52				
Radius PS	32.50	16.51	1.46E-02	1.30E-03	4.50E-04	8.86E-04
Rib costal cart	10.58					
Rib end & tunor	6.65	0.62				
Sacrum central "A"	13.15	8.05	5.65E-03	9.00E-04	4.30E-04	7.02E-04
Sacrum central "B"	35.51	21.86	1.09E-02	2.40E-03	3.08E-04	5.00E-04
Sacrum central "C"	44.43	19.85	7.73E-03	1.70E-03	1.74E-04	3.90E-04
Sacrum central anterior piece	35.66	11.52	3.40E-03	1.50E-03	9.53E-05	2.95E-04
Sacrum central lump	28.38	9.18	2.00E-04	1.30E-03	7.05E-06	2.18E-05
Sacrum left "B"	202.15	99.42	1.83E-02	3.80E-03	9.07E-05	1.84E-04
Sacrum left "A"	52.33	23.26				
Sacrum left "C"	37.87	17.21	7.67E-03	2.50E-03	2.02E-04	4.45E-04
Sacrum right "C"	22.06	10.35	7.87E-03	2.00E-03	3.57E-04	7.60E-04
Sacrum right "A"	151.13	86.48	3.30E-02	6.70E-03	2.18E-04	3.82E-04
Sacrum right "B"	111.76	55.72	2.25E-02	3.70E-03	2.01E-04	4.04E-04
Sacrum right sacrum lump	84.51	37.84	4.70E-03	1.50E-03	5.56E-05	1.24E-04
Scap spine	56.31	13.11	2.41E-02	2.20E-03	4.28E-04	1.84E-03
Scap spine, tumor	46.91	10.59				
Scaphoid	6.13	1.79				
Scapula DE	40.07	13.29	2.28E-02	2.00E-03	5.70E-04	1.72E-03
Scapula PE	24.13	4.91				
Sesamoids-R	0.86	0.17	5.71E-04	3.00E-04	6.64E-04	3.40E-03
Spinal cord	28.48	0.42	2.67E-03	2.00E-03	9.36E-05	6.35E-03
Talus	72.42	80.82	2.86E-02	3.30E-03	3.95E-04	3.54E-04
Temporal #1	18.49	8.10	1.05E-02	1.20E-03	5.66E-04	1.29E-03
Temporal #2	111.62	44.31				
Temporal #3	6.88	3.03				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Tibia DE	79.63	19.46	2.73E-02	2.00E-03	3.42E-04	1.40E-03
Tibia DS	120.09	56.77	3.53E-02	2.30E-03	2.94E-04	6.21E-04
Tibia PE	192.75	34.78	7.10E-02	3.40E-03	3.68E-04	2.04E-03
Tibia PS	152.69	64.18	8.14E-02	4.10E-03	5.33E-04	1.27E-03
Toenails-Ft-L	0.71	0.01	9.00E-04	5.00E-04	1.27E-03	1.50E-01
Trapezium	4.54	1.21	8.47E-03	2.10E-03	1.86E-03	6.99E-03
Trapezoid	2.77	0.82	2.48E-03	7.00E-04	8.95E-04	3.02E-03
Triangular	2.66	0.75	4.72E-03	1.70E-03	1.77E-03	6.26E-03
Tumor from R-Rib #2	24.31	2.35	1.70E-03	7.00E-04	6.99E-05	7.24E-04
Tumor-Outside L. Orbit	1.06	0.06	2.00E-04	6.00E-04	1.89E-04	3.18E-03
Ulna DE	5.84	1.38				
Ulna DS	21.89	11.15	5.17E-03	8.00E-04	2.36E-04	4.63E-04
Ulna PE	40.35	14.89	1.88E-02	1.60E-03	4.65E-04	1.26E-03
Ulna PS	35.18	19.44	1.14E-02	1.40E-03	3.23E-04	5.85E-04
Vert C-1	33.70	8.28	1.58E-02	2.30E-03	4.69E-04	1.91E-03
Vert C-2 arch	12.38	3.41	4.83E-03	1.10E-03	3.90E-04	1.42E-03
Vert C-2 body	20.46	3.02	4.63E-03	9.00E-04	2.27E-04	1.53E-03
Vert C-3 arch	12.08	3.35				
Vert C-3 body	9.08	1.59	4.15E-03	9.00E-04	4.57E-04	2.61E-03
Vert C-4 arch	10.67	2.89	5.47E-03	1.00E-03	5.12E-04	1.89E-03
Vert C-4 body	12.33	2.31				
Vert C-5 arch	14.42					
Vert C-5 arch #1	4.44	0.73	1.93E-03	6.00E-04	4.35E-04	2.64E-03
Vert C-5 arch #2	6.46	1.17	2.37E-03	7.00E-04	3.67E-04	2.03E-03
Vert C-5 body	13.39	1.66	7.50E-03	1.40E-03	5.60E-04	4.52E-03
Vert C-5 dorsal arch part	3.19	0.91				
Vert C-6 arch	11.42	2.51	4.47E-03	9.00E-04	3.91E-04	1.78E-03
Vert C-6 body	9.55	1.62				
Vert C-7 arch	16.35	3.83				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert C-7 body	15.42	1.98	6.57E-03	1.30E-03	4.26E-04	3.33E-03
Vert L-1 arch	.35.30	6.62	1.64E-02	2.80E-03	4.65E-04	2.48E-03
Vert L-1 body	78.84	8.47				
Vert L-2 arch	31.84	6.17	1.31E-02	2.00E-03	4.11E-04	2.12E-03
Vert L-2 body	72.49	9.80	1.54E-02	2.70E-03	2.12E-04	1.57E-03
Vert L-2 wedge	6.11	0.73	2.13E-03	7.00E-04	3.49E-04	2.92E-03
Vert L-3 arch	34.53	8.10	1.33E-02	2.60E-03	3.84E-04	1.64E-03
Vert L-3 body	39.47	5.37	4.90E-03	7.00E-04	1.24E-04	9.14E-04
Vert L-3 wedge	9.27	0.84	1.47E-03	6.00E-04	1.58E-04	1.74E-03
Vert L-3,4 or 5 wedge	5.21	0.74				
Vert L-4 arch remnants	89.24	5.54	6.47E-03	1.80E-03	7.25E-05	1.17E-03
Vert L-4 body	67.13	6.96	1.73E-02	2.30E-03	2.58E-04	2.49E-03
Vert L-5 arch	49.92	13.39				
Vert L-5 body	60.93	6.92	1.55E-02	2.60E-03	2.54E-04	2.23E-03
Vert T-1 arch #1	3.85	0.84				
Vert T-1 arch #2	6.00	0.86	2.04E-03	7.00E-04	3.39E-04	2.37E-03
Vert T-1 body	11.95	1.71	4.60E-03	1.10E-03	3.85E-04	2.70E-03
Vert T-1 dorsal arch part	12.68	3.26				
Vert T-2 arch #1	8.54	2.12	5.73E-03	1.10E-03	6.71E-04	2.71E-03
Vert T-2 arch #2	3.05	0.94				
Vert T-2 body	16.93	2.41	2.80E-03	8.00E-04	1.65E-04	1.16E-03
Vert T-2 dorsal arch part	11.45	3.29				
Vert T-3 arch	23.45	4.80				
Vert T-3 body	68.17	16.83				
Vert T-4 arch #1	8.46	1.36	2.23E-03	7.00E-04	2.64E-04	1.64E-03
Vert T-4 body	20.55	1.93				
Vert T-4 dorsal arch part	12.91	2.82				
Vert T-5 arch	24.55	4.81				
Vert T-5 body	32.75	3.27				

Table 23. ^{241}Am in the Tissues of USTUR Case 0769

Tissue	Wet Wgt (g)	Ash Wgt (g)	Activity (Bq)	SD (Bq)	Conc. Wet (Bq/g)	Conc. Ash (Bq/g)
Vert T-6 arch a-1	10.71	2.40	4.87E-03	1.00E-03	4.55E-04	2.03E-03
Vert T-6 body	12.92	1.78				
Vert T-6 dorsal arch part	18.41	4.26	7.84E-03	1.30E-03	4.26E-04	1.84E-03
Vert T-7 arch	20.45	5.06				
Vert T-7 body	57.67	12.24				
Vert T-8 arch	22.44	5.84	2.33E-02	3.10E-03	1.04E-03	4.00E-03
Vert T-8 body	33.54	7.64	1.00E-01	6.80E-03	2.99E-03	1.31E-02
Vert T-9 arch	28.76	5.81				
Vert T-9 body	82.22	14.18				
Vert T-10 arch	28.51	6.71	6.73E-03	1.60E-03	2.36E-04	1.00E-03
Vert T-10 body	45.14	7.63				
Vert T-11 arch	30.70	5.61	1.19E-02	2.60E-03	3.87E-04	2.12E-03
Vert T-11 body	30.64	5.59				
Vert T-12 arch	32.27	5.56				
Vert T-12 body	27.90	2.32				
Vert T-12 wedge	3.42	0.45				
	42039.66	2430.65	1.04			

Abbreviations

L	Left	DE	Distal end	c	cervical
R	Right	PE	Proximal end	d	distal
LN	Lymph Nodes	DS	Distal shaft	m	medial
TB	Trachcobronchial	PS	Proximal shaft	p	proximal
				t	thoracic
				l	lumbar

PLUTONIUM CONTENT OF HUMAN FETAL AND PLACENTAL TISSUE

John J. Russell, Ronald L. Kathren and Cheryl L. Love

Introduction

Although a number of studies have been made in animals (Sikov and Mahlum 1968; Weiss, Walburg and McDowell 1980; Morgan, Haines and Harrison 1991; Finkel 1947; Weiss and Walburg 1978), data on human placental transfer and accumulation of plutonium and other actinides is sparse.

Weiss et al.1980, have demonstrated in pregnant mice that the transfer of Pu or Am-citrate across the placenta was influenced by mass. Their results indicated that atom for atom, Am was incorporated into fetal tissue in amounts ranging from 1.0 to 2.5 times less than that of Pu when injected in equal atom amounts. Also, tissue analysis disclosed that at low dose levels, the average fraction of the dose retained in the fetus, placenta, and maternal femurs decreased as the dose injected increased. However, at the higher dose levels the fetal-placental retention burdens of actinides, and especially Pu, are clearly not a linear function of dose. The effect of mass on the transmission of Pu across the placenta to the fetus was first demonstrated in laboratory animals several decades ago (Finkel 1947).

Weiner et al. (1985) reported on the environmental levels of Pu, U, Am, and Th in human fetal tissue samples of varying ages post conception: 10-14 weeks, 22-24 weeks, and 26 weeks. Measurements for ^{239}Pu, ^{238}Pu, and ^{241}Am in the first trimester samples were below the detection level at the $P<.01$ level. In the 22-24 week samples, ^{239}Pu values ranged from 1.83 to 35.0 mBq/kg with the highest value for a fetus and umbilical cord being 3.83 mBq/kg and 35.0 mBq/kg respectively. Americium-241 results for the umbilical cord from this same group ranged from 16.67 to 35.0 mBq/kg compared with values in the fetus that ranged from 1.33 to 4.83 mBq/kg. In the fetus, levels of uranium ranged from 1.62 to 5.33 mBq/kg, for placenta the levels were 5.17 to 8.67 mBq/kg. Umbilical cord was highest at 58.33 to 63.33 mBq/kg. Plutonium-239, ^{241}Am and U values for the 26 week samples were comparable to those of the 22-24 weeks group.

Overall, these results demonstrate that actinides do cross the placental barrier and enter the fetus and when compared to a reference female value of, ~1.17 mBq/kg for Pu, suggests a concentration factor of about three relative to the mother. However, in a more recent paper (Prosser et al.1994) using fetal tissues from second trimester terminations, have found placenta and fetus sample concentrations of the same order of magnitude, viz. a few tens of uBq/kg, suggesting the absence of a concentration factor.

Results

The previous studies of Weiner, McInroy and Wegst (1985) and Prosser, McCarthy and Lands (1994), on the cross placental transfer of Pu in human fetal tissue were made with samples obtained from non-nuclear industry workers, and hence contained only background or Environmental levels of plutonium. The Registries have obtained a cord and placenta sample from a woman with a work history involving an accidental Pu intake that occurred several years before her pregnancy. This case is identified as USTUR Case 0777. In addition, the Registries obtained a control cord and placenta sample from a non-industry worker for comparison purposes. The tissue samples were divided and submitted to three collaborating laboratories for ultrasensitive analysis by either fission track analysis (two samples) or mass spectrometry (one sample). A fourth fraction was obtained by the Registries and reserved for possible future study. To date, analytical results have been received from one laboratory (Table 24).

The registrant acquired an intake of actinide from a Pu scrap metal fire even though she was wearing respiratory protection. After the incident, she received an injection of DTPA and extensive skin decontamination cleansing. Lung counts performed shortly after the incident indicated an initial lung burden of 18.5 to 24.0 Bq of ^{239}Pu. She was monitored by urinalysis and fecal analysis for a month after the incident and did excrete measurable amounts of ^{239}Pu and ^{241}Am. Since then, routine urinalyses have been negative or below the detection level of about 0.3 mBq based on a single day excretion.

The concentration of Pu in the placenta tissue in USTUR Case 0777 compared to the concentration in reference female is about 8 times higher whereas the concentration in our control case was less than that of the reference case (table 24). Compared to each other, the placental Pu concentration in USTUR Case 0777 was about 150 times higher than that in the control case. Unfortunately concentration values for the umbilical cord pieces for either case cannot be determined because they were not weighed prior to radiochemical analysis. Likewise, without a matched fetal tissue sample for comparison we cannot determine if a concentration gradient between the mother (placenta) and the fetus exists. However, Weiner, McInroy and Wegst (1985), using aborted fetal tissue samples in comparison to a reference female, reported a fetal concentration increase of more than 3 fold.

Conclusion

Although the actinide levels in these tissue samples typically represent only a few tens of million atoms of Plutonium, it is noteworthy that in a blind test, the ultra sensitive fission track analysis technique was able to identify a marked difference in Plutonium content between the control and accidental Plutonium intake case tissues in this small sample. The results from this single case suggest that plutonium is selectively concentrated in placenta, perhaps as a discrimination mechanism to limit fetal uptake.

Aknowledgments

Radiochemical analysis of the placenta and cord samples from USTUR Case 0777 and the associated control case were performed by ultra low level fission track analysis at Brookhaven National Laboratory (BNL). The collaborative contributions in providing the analysis of these samples of our colleagues at BNL, Edward Kaplan, Anant Murthy and Casper Sun is hereby gratefully acknowledged.

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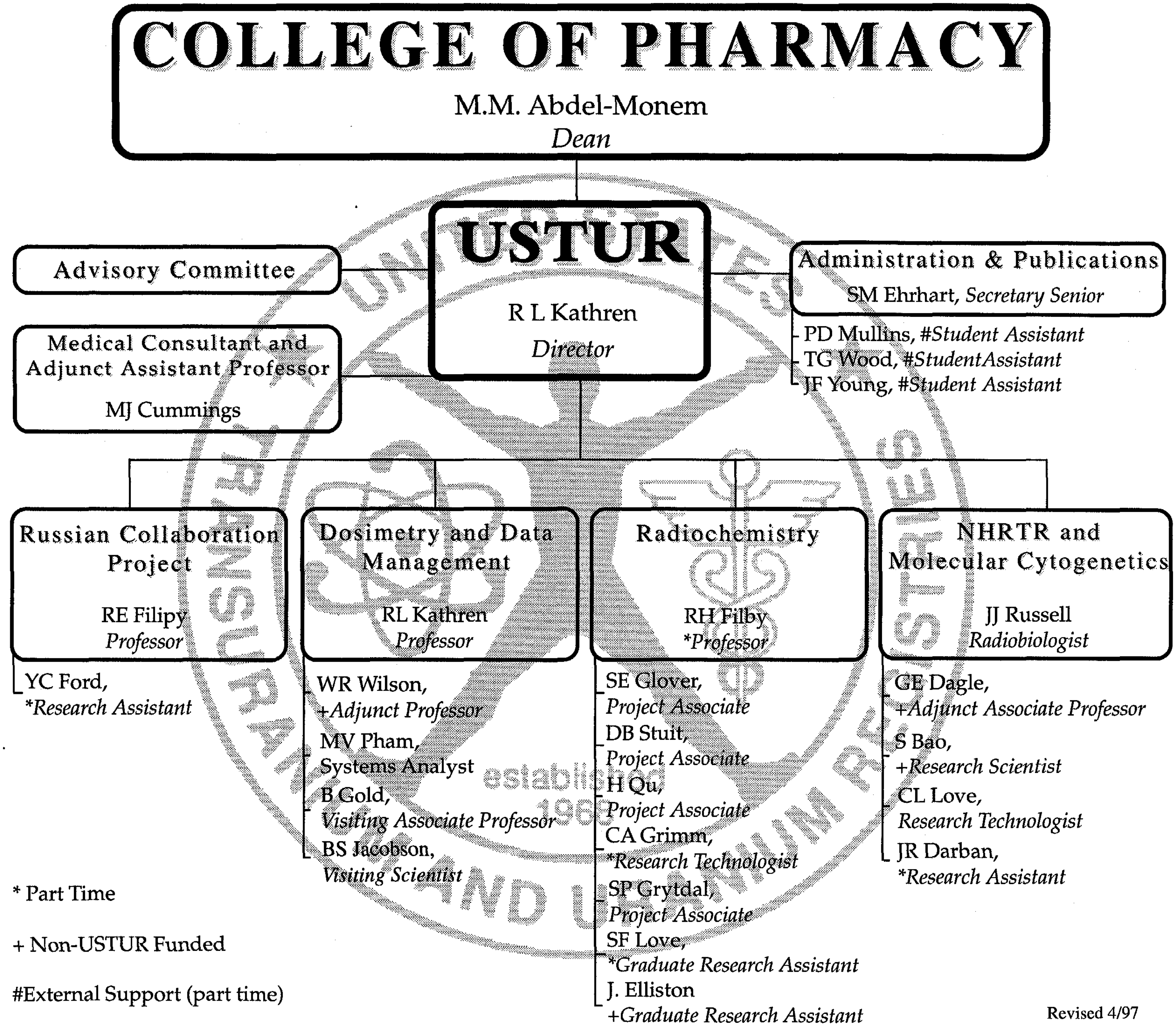
Table 24. Concentration of ^{239}Pu in Human Fetal Tissue

Case No.	Tissue	Weight (g)	uBq per Sample	u Bq . Kg^{-1}
0777	Placenta	66	640	9697
	Umbilical cord	--	1.59	--
	Membrane	--	--	--
0835	Placenta	94	6.07	64.5
	Umbilical cord	--	<MDL	
	Membrane	--	< MDL	

MDL = Minimum Detection Level;
Fission track MDL at BNL is $< 3.7 \times 10^{-7}$ Bq

Appendix A

USTUR Functional Organization Chart


COLLEGE OF PHARMACY
M.M. Abdel-Monem
Dean
USTUR
R L Kathren
Director
Advisory Committee
Medical Consultant and Adjunct Assistant Professor
MJ Cummings
Administration & Publications
SM Ehrhart, Secretary Senior
PD Mullins, #Student Assistant
TG Wood, #StudentAssistant
JF Young, #Student Assistant
Russian Collaboration Project
RE Filipy
Professor
YC Ford,
*Research Assistant
Dosimetry and Data Management
RL Kathren
Professor
WR Wilson,
+Adjunct Professor
MV Pham,
Systems Analyst
B Gold,
Visiting Associate Professor
BS Jacobson,
Visiting Scientist
Radiochemistry
RH Filby
*Professor
SE Glover,
Project Associate
DB Stuit,
Project Associate
H Qu,
Project Associate
CA Grimm,
*Research Technologist
SP Grytdal,
Project Associate
SF Love,
*Graduate Research Assistant
J. Elliston
+Graduate Research Assistant
NHRTR and Molecular Cytogenetics
JJ Russell
Radiobiologist
GE Dagle,
+Adjunct Associate Professor
S Bao,
+Research Scientist
CL Love,
Research Technologist
JR Darban,
*Research Assistant
* Part Time
+ Non-USTUR Funded
#External Support (part time)
Revised 4/97

Appendix B

USTUR Publications and Presentations

PUBLICATIONS

October 1, 1995 - September 30, 1996

Bao, S. Transfection of plasmid DNA into cultured cells by ultrasonic cavitation in vitro. Journal of Ultrasound in Medicine (In press).

Bao, S.; Harwood, P. W.; Wood, B. H.; Chrisler, W. B.; Groch, K. M.; Brooks, A. L. Comparative clastogenic sensitivity of respiratory tract cells to gamma rays. Radiation Research (In press).

Brodsky, A.; **Kathren, R. L.**; Willis, C. A. History of the medical uses of radiation: regulatory and voluntary standards of protection. Health Phys. 69:783-824; 1995.

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Dagle, G. E.; Weller, **R. E.; Filipy**, R.E.; Watson, C. R.; Buschbom, R. L. The distribution and effects of inhaled $^{239}Pu(NO_3)_4$ deposited in the liver of dogs. Health Phys. 71(2):198-205; 1996.

Filipy, R. E. Estimation of actinide element skeletal content in humans on the basis of limited number of samples collected at autopsy. In: Chronic radiation exposure: risk of late effects. First International Symposium Proceedings, Chelyabinsk, Russia. January 9 - 13, 1995.

Filipy, R. E.; Kathren, R. L. Changes in soft tissue concentrations of plutonium and americium with time after human occupational exposure. Health Phys. 70:153-159; 1996.

Filipy, R. E.; Khokhryakov, V. F. Second progress report on project 2.1: Metabolism and dosimetry of plutonium industrial compounds. USTUR-0053-96.

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Gilbert, E. S.; Cross, F. T.; **Dagle, G. E.** Analysis of lung tumor risks in rats exposed to radon. Rad. Research. 145:350-360; 1996.

Gilbert, E. S.; Griffith, W. C.; **Dagle, G. E.**; Park, J. F.; Watson, C. R. Statistical modeling of carcinogenic risks in dogs exposed to inhaled $^{239}PuO_2$. Rad. Research (In press).

Glover, S. E.; Filby, R. H.; Clark, S. Determination of ^{232}Th in human tissues by radiochemical neutron activation analysis with yield determination using ^{227}Th. J. Radioanal. Nucl. Chem. (In press).

Glover, S. E.; Filby, R. H.; Clark, S. Determination of isotopic thorium in biological and environmental samples by combined alpha spectrometry and neutron activation analysis. J. Radioanal. Nucl. Chem. (In press).

Glover, S. E.; Filby, R. H.; Clark, S. Optimization and characterization of a sulfate based electrodeposition method for alpha spectroscopy of actinide elements using chemometric analysis. J. Radioanal. Nucl. Chem. (In press).

Hedaya, M. A.; Birkenfeld, H. P.; **Kathren, R. L.** A sensitive method for the determination of uranium in biological samples utilizing kinetic phosphorescence analysis (KPA). J. Pharm. Sci. (In press).

Kathren, R. L. Primeval X-ray Protection: x-rays and x-ray protection before there were state regulators, the first fifty years of x-ray protection. In: Proceedings of the 1995 Annual Meeting of the Conference of Radiation Control Program Directors, San Antonio, Texas, May, 1995. CRCPD Publication 95-4:6-18; 1995.

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Kathren, R. L.; Hunacek, M. M. Teeth as an indicator of total skeletal actinide content. Health Phys. (Submitted).

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Lamont, S. P.; **Glover, S. E.; Filby, R. H.** Determination of plutonium-239/240 ratios in low activity samples using high resolution alpha-spectroscopy. J. Radioanal. Nucl. Chem. (In press).

Love, S. F.; **Glover, S. E.; Stuit, D. B.; Kathren, R. L.; Filby, R. H.** Use of combined alpha sectrometry and fission track analysis for the determination of $^{239}Pu/^{240}Pu$ atom ratios in human tissue. J. Radioanal. Nucl. Chem (In press).

Moody, C. A.; **Filby, R. H.; Glover, S. E.; Stuit, D. B.** Pre-concentration and separation of thorium, uranium, plutonium and americium in human soft tissues by extraction chromatography. J. Radioanal. Nucl. Chem. (In press).

Park, J. F.; Buschbom, R. L.; **Dagle, G. E.**; James, A. C.; Watson, C. R.; Weller, R. E. Biological effects of inhaled $^{238}PuO_2$ in beagles. Rad. Research (In press).

Qu, H.; Filby R. H. Preconcentration of actinides using the actinide-Cu resin for human tissue analysis. J. Radioanal. Nucl. Chem. (In press).

Russell, J. J.; Kathren, R. L.; Dietert, S. E. A histological kidney study of uranium and nonuranium workers. Health Phys. 70:466-472; 1996.

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Suslova, K. G.; **Filipy, R. E.**; Khokhryakov, V. F.; Romanov, S. A.; **Kathren, R. L.** Comparison of the Dosimetry Registry of the Mayak Industrial Association and the United States Transuranium and Uranium Registries: A preliminary report. Rad. Prot. Dos. 67:13-22; 1996.

PRESENTATIONS

October 1, 1995 - September 30, 1996

October

- S. E. Glover presented a seminar on the USTUR to the Analytical Chemistry faculty and graduate students at WSU in Pullman, Washington.

- H. Qu presented his research with the EICHROM resins to the Analytical Chemistry faculty and graduate students at WSU in Pullman, Washington.

November

- R. E. Filipy presented a seminar on the USTUR radiochemistry program to the Environmental Sciences and Regional Planning faculty and graduate students at WSU in Pullman, Washington.

December

- J. Norton presented a seminar on radioanalytical methods development to the Analytical Chemistry faculty and graduate students at WSU in Pullman, Washington.

January

- R. L. Kathren, at the invitation of Hong Kong Hospital Authority, served as course director and presented several lectures and a training course for radiation protection supervisors in Hong Kong.

February

- R. L. Kathren presented a lecture-laboratory activity "Radiation in Everyday Life," at the Ninth Annual Mathematics, Engineering, and Science Achievement (MESA) program in Sunnyside, Washington.

- R. L. Kathren presented "The U. S. Transuranium and Uranium Registries Tissue Research Program," at the DOE-Health Physics Society workshop on the Health Physics of Plutonium in Albuquerque, New Mexico.

March

- R. E. Filipy presented "The United States Transuranium and Uranium Registries - Russian Connection," to Washington State University Radiation Safety Office and to the Nuclear Technology Class at Columbia Basin College in Pasco, Washington.

- R. H. Filby gave invited seminars on the USTUR Radiochemistry Project to the Kentucky Local Section of the American Chemical Society and to the Department of Chemistry, University of Kentucky in Kentucky.

- R. L. Kathren presented an invited seminar on the activities of the USTUR at Texas A & M in College Station, Texas.

- R. L. Kathren presented "Ethics of Human Radiation Experimentation," to the student chapter of the Health Physics Society in College Station, Texas.

- R. L. Kathren presented testimony on NCRP Report 121 on Collective Dose before a joint Subcommittee of the Advisory Committee on Reactor Safeguard and the Advisory Committee on Nuclear Waste in Washington, D. C.

April

- S. Bao presented the "Induction of Micronuclei as a Model for Radiation Sensitivity of Respiratory Tract Cells Exposed to ^{60}Co Rays," and "Distribution of Radon Induced Micronuclei in Respiratory Tract Cells," at the 44th Annual Meeting of the Radiation Research Society in Chicago, Illinois.

- R. L. Kathren presented "Human Radiation Experimentation: A Health Physics Perspective", at the International Radiation Protection Association meeting in Vienna, Austria.

- J. J. Russell presented a seminar at the University of Washington entitled "The United States Transuranium and Uranium Registries Old and New: Health Physics, Molecular Biology and Biomarkers" in Seattle, Washington.

May

- ***None***

June

- S. Bao presented "Biodosimetry in Respiratory Tract Following Exposure to Radon," at the 1996 Conference on Radiation and Health, American Statistical Association in Vail, Colorado.

- R. L. Kathren presented "Risk and Health Effects from Incorporation of Actinides: Lessons Learned from the Human Tissue Studies of the USTUR", at the Annual Meeting of the Canadian Radiation Protection Association in Trois Riveres, Canada.

July

- R. E. Filipy presented "Comparison of Biokinetics Models for Actinide Elements with Observed Tissue Analysis Data From Occupationally Exposed Humans of Two Countries," at the Health Physics Society 1996 Annual Meeting in Seattle, Washington.

- S. E. Glover presented "The Status and Current Research Projects of the Radiochemical Division of the Health Physics Society 1996 Annual Meeting in Seattle, Washington.

- R. L. Kathren presented "The Historical Development of the Linear Nonthreshold Hypothesis," at the Annual Meeting of the Health Physics Society in Seattle, Washington.

August

- None

September

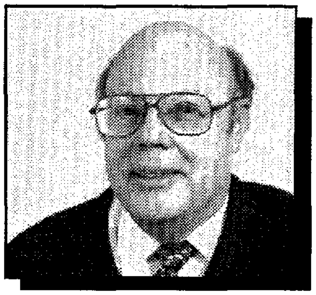
- R. L. Kathren was the banquet speaker at the Workshop on X-ray Spectroscopies of Environmental Interfaces sponsored by the Pacific Northwest National Laboratory presenting a lecture and demonstration on the history of X-rays, Richland, Washington.

- J. J. Russell was an invited participant presenter at a meeting sponsored by the Inter-Tribal Council on Hanford Health Effects, in Spokane, Washington.

Appendix C

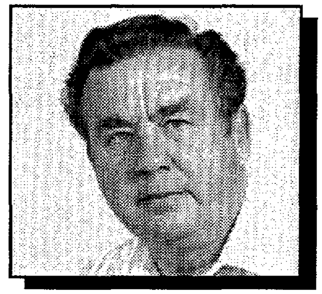
USTUR Staff Photographs

FACULTY AND STAFF PHOTOGRAPHS

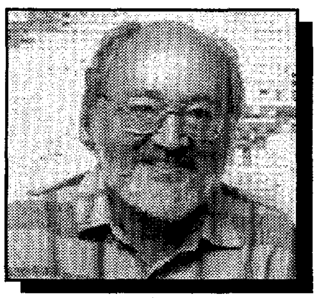


Ronald L. Kathren
Professor and Director

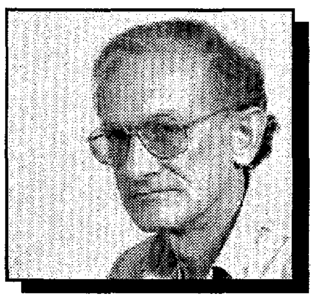
John J. Russell
NHRTR Curator and Radiobiologist



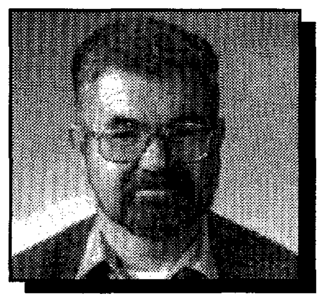
Ronald E. Filipy
Professor



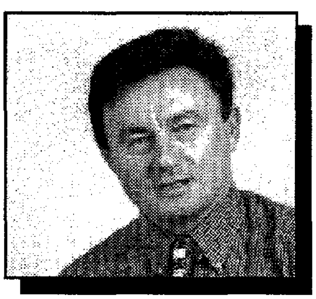
Royston H. Filby
Professor



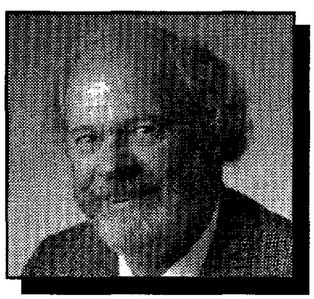
Walter R. Wilson
Adjunct Professor



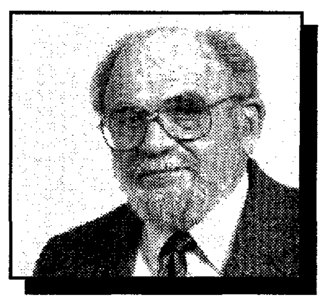
Gerald E. Dagle
Adjunct Associate Professor



Baruch Gold
Visiting Associate Professor

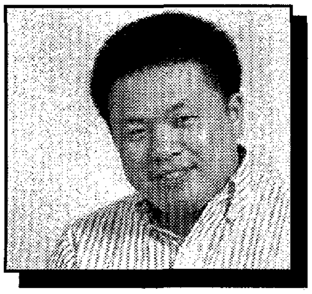


Michael J. Cummings
Adjunct Assistant Professor



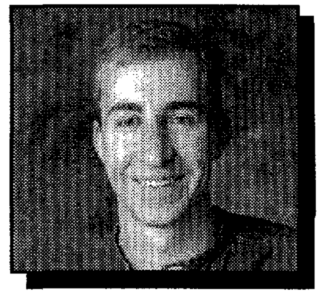
Baruch S. Jacobson
Visiting Scientist

FACULTY AND STAFF PHOTOGRAPHS

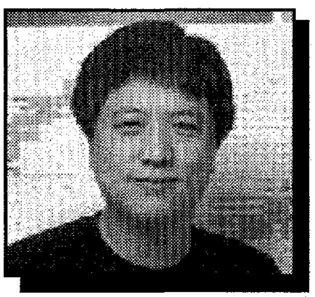


Shiping Bao
Research Scientist

Samuel E. Glover
Project Associate

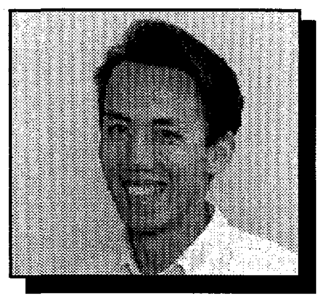


Scott P. Grytdal
Project Associate



Hongguo Qu
Project Associate

Dorothy B. Stuit
Project Associate



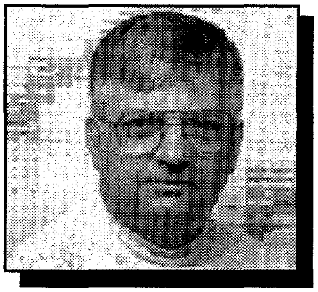
Minh V. Pham
Systems Analyst

Susan M. Ehrhart
Secretary Senior

Cheryl L. Love
Research Technologist

Cathy A. Grimm
Research Technologist

FACULTY AND STAFF PHOTOGRAPHS



James Elliston
Graduate Research Assistant

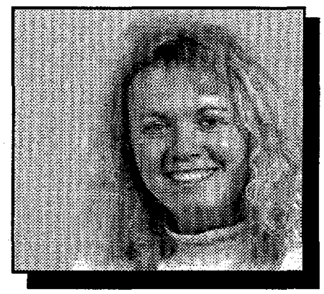
Suzanne F. Love
Graduate Research Assistant

Picture not Available

Jill R. Darban
Research Assistant

Yong C. Ford
Research Assistant

Patricia D. Mullins
Student Assistant



Tanya G. Wood
Student Assistant

Jennifer F. Young
Student Assistant

Appendix D

USTUR Radiochemical Intercomparisons

USTUR RADIOCHEMISTRY REPORT

QA/QC

Presented at the USTUR Advisory Committee Meeting

October 18-19, 1997

Introduction

Responsibility for the determination of actinides in human tissue samples for the United States Transuranium and Uranium Registries was transferred to Washington State University February 1, 1994. Since these early beginning, the progress of the USTUR program has been documented with each annual report of the USTUR. The 1994 Annual Report included the first of several intercomparisons which were conducted by the USTUR to validate transfer of the program. This represented the start of the QA/QC program to assure the production of high quality data as the programs changes from a period of validation to 'routine' sample analysis.

The recommendations of 1995 Advisory Committee included several suggestions for the QA/QC program of the USTUR. These included:

- Establishment of a measurement quality assessment program
- Tracer quality verification
- Participation in external QA/QC programs
- Analyze 5 or more SRM's for method validation

In keeping with these recommendations and with recommendations of ANSI N13.30, a program for routine data quality assessment has been developed. The following report summarizes the data presented at the 1996 USTUR Advisory Committee Meeting held October 18-19, 1997 in Richland, Washington.

USTUR QA/QC Program at a Glance

The Radiochemistry Project of the USTUR has adopted the QA/QC criteria established in ANSI N13.30 as a guide of minimum performance. These recommendations were used when developing the USTUR procedures which are documented in the "USTUR Analytical Procedures Manual" and are typically updated on an annual basis. Key elements of the routine analysis program include:

- All tracers are obtained from NIST if possible
- New tracers are evaluated against internal standards to insure accuracy
- Instrument calibration

- QC spike and blank are run with each sample set (typically 10 samples in a set, including the spike and blank)
- Continual evaluation of NIST Standard Reference Materials (SRM) for human tissues (lung and liver)
- Participate in intercomparison of samples with appropriate matrices
- Analysis of blind samples prepared by third party laboratory (to be implemented in 1997)
- Participate in DOELAP for bioassay in actinides (next round of DOELAP testing)
- Monthly QA/QC report

The monthly QA/QC report provides a tool insure the evaluation of data collected for QA/QC and to communicate the results among the staff and with the USTUR staff located in Richland. While an attachment of a typical QA/QC report was too lengthy to include (~25 pages), the components include:

- Analysis of NIST SRM samples to date
- Results of intercomparison studies
- Statistical analysis of QA/QC data for each element (currently Th, U, Pu, and Am) analyzed by the USTUR (paired t-test, scatter plot, CuSum plot, recovery plot, s-chart)
- Statistical analysis of the blank data for each isotope analyzed by the USTUR (average, standard deviation, standard deviation of the mean, scatter plots of isotopic blank values with upper and lower critical values, and scatter plot of blank recovery)
- Analysis of blind QA/QC sample data (to be implemented in 1997)
- USTUR-Russian laboratory intercomparison (to be implemented in 1997)

Analysis of NIST Human Tissue Standard Reference Materials

In keeping with the recommendations of the Advisory Committee, the USTUR analyzed several additional NIST Standard Reference Materials (SRM) including SRM 4351 (Human

Lung) and SRM 4352 (Human Liver). In addition, the USTUR participated in the certification of a new NIST Human Tissue SRM, bone.

The certified values established by NIST for SRM 4351 and SRM 4352 are presented in Table 1. Both of these SRM's were prepared from tissues from USTUR cases which were diluted with tissue from non-exposed individuals. These processes resulted a sampling error for analysis of the lung SRM because of hot particles which is recognized by NIST in the SRM limitations on the certificate.

The results for the analysis of SRM 4351 (Human Lung) are presented in Table 2. The results for QA/QC sample X011 indicate that very high results for plutonium and americium for this sample was the result of a hot particle which is supported by the correct ratio of $^{238}Pu/^{239+240}Pu$ for that sample. These results are displayed graphically in Figures 1-5.The results for this SRM show good agreement between the NIST certified value and the value obtained by the USTUR if sample X011 is excluded from the analysis of the data.

The results for the analysis of SRM 4352 (Human Liver) are presented in Table 3. There is excellent agreement between the activities obtained by the USTUR and the certified values from NIST for both ^{238}Pu and $^{239+240}Pu$ data (-2% and 1% difference from certified, respectively). The results for the plutonium data are presented graphically in Figures 6 and 7. The data for the determination of ^{241}Am, however, did not agree with the NIST certified value as is evident in Figure 8. This difference may be attributable to the ingrowth of ^{241}Am from ^{241}Pu, which was not determined during the certification process for this SRM. Figure 9 presents a graphical representation of this buildup and the assumptions. These assumptions are being actively investigated collaboratively by the USTUR and Dr. Sue Clark of Washington State University.

Analysis of NIST Human Bone

In addition to the two certified NIST SRM's, the USTUR also participated in the development of a new human tissue SRM, bone. This SRM was prepared by NIST by diluting bone samples obtained from the USTUR with bovine bone. The results of the analysis of these samples as of October 1996 is contained in Table 4 and Figures 10-12. The agreements for Pu and Am based on these initial data seems fairly good. A more complete analysis of 5 bottles of this material measuring 3 aliquots from each bottle is currently in progress.

USTUR-Russian Intercomparison

Beginning in 1997, the USTUR and the Russian Registries program will collaborate to perform a series of blind sample intercomparisons. These will include the analysis of planchets, aliquots of previously analyzed tissues, and NIST SRM's. These intercomparisons follow a extended site visits by scientist from both Russia and the USTUR over the past two years.

Blind Sample QA/QC

A program for the preparation of blind QA/QC samples by a third party laboratory will be implemented during 1997 following the suggestion of the USTUR Advisory Committee. Dr. Sue B. Clark of Washington State University has agreed to participate in this monthly program.

QA/QC Samples

A QA/QC spiked sample is analyzed with each batch of samples to insure data quality from batch to batch. As previously discussed, these results are analyzed each month in the USTUR QA/QC report. An example of this analysis is described below for plutonium and in Table 5 and Figure 13.

Pu Analysis

The results to date are contained in Table 5 and Figure 13. A new QA/QC solution was prepared and accounts for the slight upward rise in the CuSum Plot since QA/QC sample X043.

Concerns

- None

Good Points

- The average ratio of determined to expected activity and standard deviation of the mean of determined to expected activity is 0.984±0.016, which is within 2 standard deviations of the mean of the expected value. No statistical difference exists between the mean and the expected value.
- Recoveries continue to be excellent.
- All values are within 3 standard deviations of the expected value, with the exception of X068 which was 3.05 standard deviations from expected but is well within 3 standard deviations of the average measured values.

Blanks

A blank (reagent) sample is analyzed with each batch of samples to insure data quality from batch to batch. As previously discussed, these results are analyzed each month in the USTUR QA/QC report. An example of this analysis is described below for plutonium and in Figure 14.

Pu Blanks

The results of the Pu blanks to date are shown graphically in Figure 5. No trending problems are noted. The current mean and standard deviation of the mean for the blank values are (L001-L146):

- Pu-238: (2.01± 1.01)E-3 dpm
- Pu-239: (5.67± 1.02)E-3 dpm

Table 1: NIST Human Tissue Certified Values

	Human Lung SRM 4351		**Human Liver** SRM 4352	
	Certified Value (Bq/g)	Uncertainty (%) 2 sigma	Certified Value (Bq/g)	Uncertainty (%) 2 sigma
^{228}Th	2.2E-4	uncertified	5.1E-4	uncertified
^{230}Th	2.0E-4	uncertified	2.0E-4	uncertified
^{232}Th	2.1E-4	13	5.8E-5	uncertified
^{234}U	1.00E-4	25	1.0E-4	uncertified
^{235}U	-	-	9E-6	uncertified
^{238}U	1.01E-4	11	8.8E-5	uncertified
^{238}Pu/$^{239+240}$Pu	1.5E-2	18%	-	-
^{238}Pu	(1.65E-5)	-	5.5E-5	44 %
$^{239+240}$Pu	1.1E-3	+110%, -50%	2.06E-3	19 %
^{241}Am	1.1E-4	uncertified	1.5E-4	37 %
Certificate Date	June 1, 1982		October 1, 1982	

Table 2: Results of NIST Lung SRM Sample Analyses

Sample	^{238}Pu (Bq/g)	±^{238}Pu (Bq/g)	$^{239+240}$Pu Bq/g	±$^{239+240}$Pu Bq/g	^{238}Pu/$^{239+240}$Pu	±^{238}Pu/$^{239+240}$Pu	^{241}Am Bq/g	±^{241}Am Bq/g
X008	-	-	1.07E-3	0.08E-3	-	-	-	-
X009	-	-	1.88E-3	0.15E-3	-	-	-	-
X011*	9.7E-5	1.7E-5	7.8E-3	0.2E-3	1.2E-2	0.2E-2	4.7E-4	0.3E-4
X033	1.6E-5	0.7E-5	1.09E-3	0.04E-3	1.5E-2	0.7E-2	1.2E-4	0.3E-4
X034	9E-6	7E-6	1.05E-3	0.04E-3	9E-3	5E-3	7.7E-5	1.4E-5
Average	1.3E-5	0.5E-5	1.3E-3	0.2E-3	1.2E-2	0.2E-2	9.9E-5	0.2E-5
% Diff from. Cert	-24%		18%		-20%		-10%	
Certified	(1.65E-5)	-	1.1E-3	+110%, -50%	1.5E-2	±18%	(1.1E-4)	-

All activity values are decay corrected to June 1, 1982

All uncertainties for USTUR are 1 sigma

*proposed outlier for Pu and Am (not included in the calculation of these averages except for ratio)

Figure 1

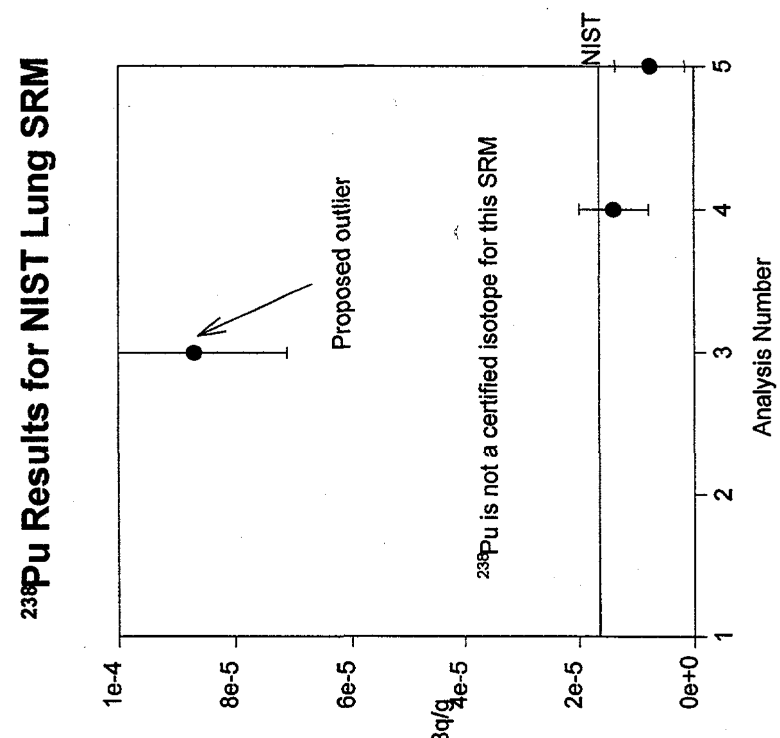


Figure 2

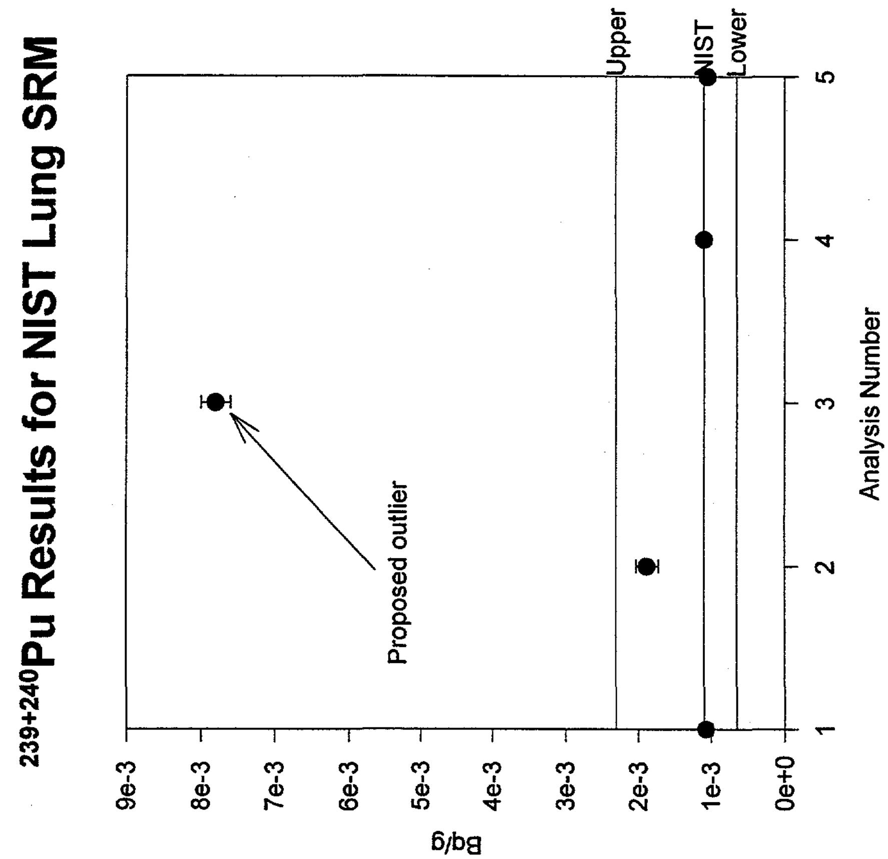


Figure 3

^{234}U Results for NIST Lung SRM

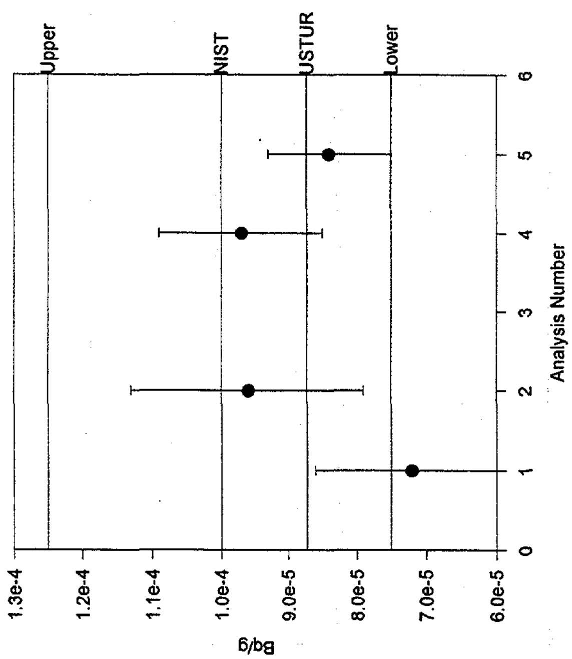


Figure 4

^{238}U Results for NIST Lung SRM

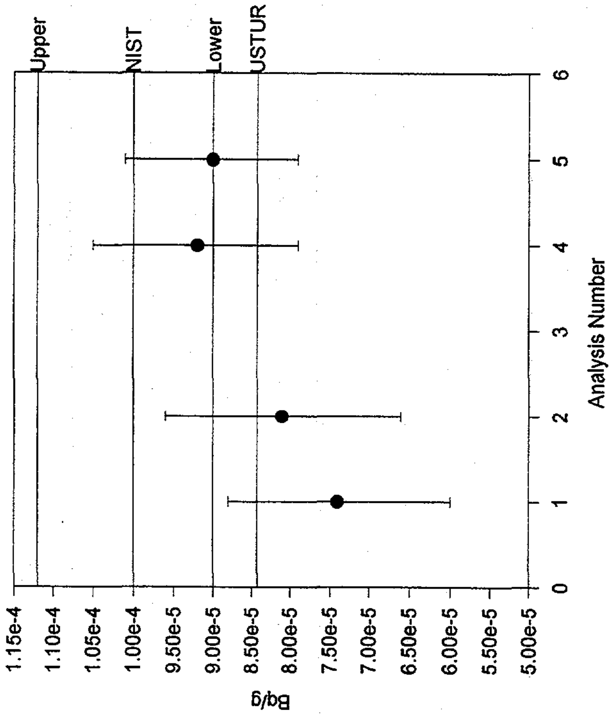


Table 3: Results of NIST Liver QA/QC Sample Analysis

Sample	^{238}Pu (Bq/g)	$\pm^{238}Pu$ (Bq/g)	$^{239+240}Pu$ Bq/g	$\pm^{239+240}Pu$ Bq/g	^{241}Am Bq/g	$\pm^{241}Am$ Bq/g
X006	5.0E-5	1.3E-5	2.14E-3	0.08E-3	2.3E-4	0.3E-4
X007	7.0E-5	1.3E-5	2.00E-3	0.06E-3	2.6E-4	0.3E-4
X010	7.5E-5	1.1E-5	2.05E-3	0.06E-3	2.0E-4	0.2E-4
X035	5.0E-5	0.9E-5	2.21E-3	0.06E-3	2.0E-4	0.2E-4
X036	5.5E-5	0.9E-5	2.03E-3	0.05E-3	2.2E-4	0.2E-4
Average Value	6.0E-5	0.5E-5	2.09E-3	0.04E-3	2.2E-4	0.1E-4
Deviation from Certified (%)	9%		1.5%		48%	
Certified (±2 sigma)	5.5E-5	±44%	2.06E-3	±19%	1.5E-4	±37%

All USTUR uncertainties are 1 sigma

Decay corrected to October 1, 1982

Figure 5

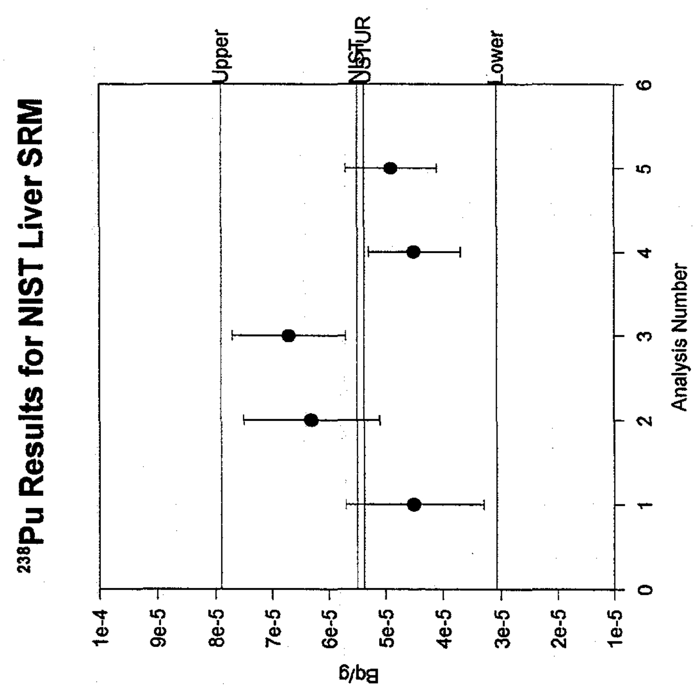


Figure 6

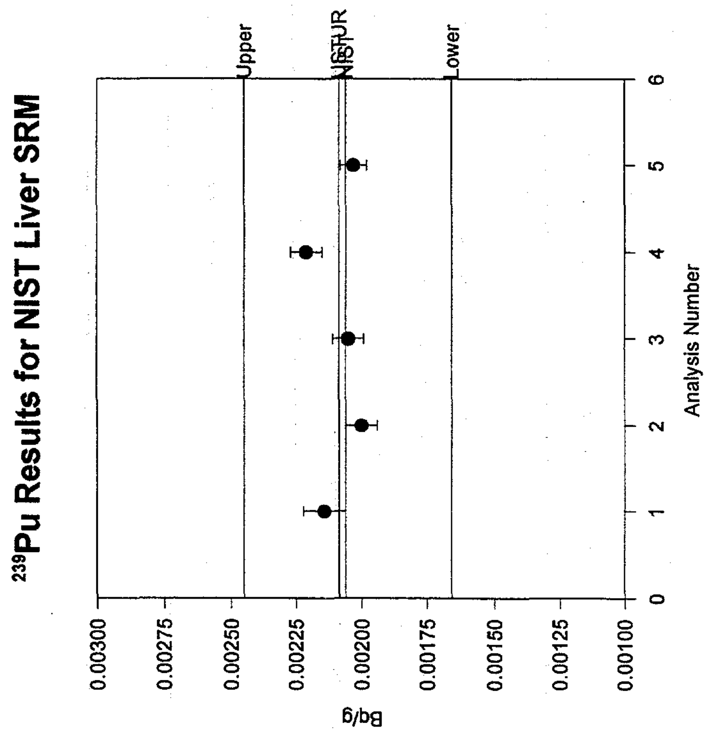
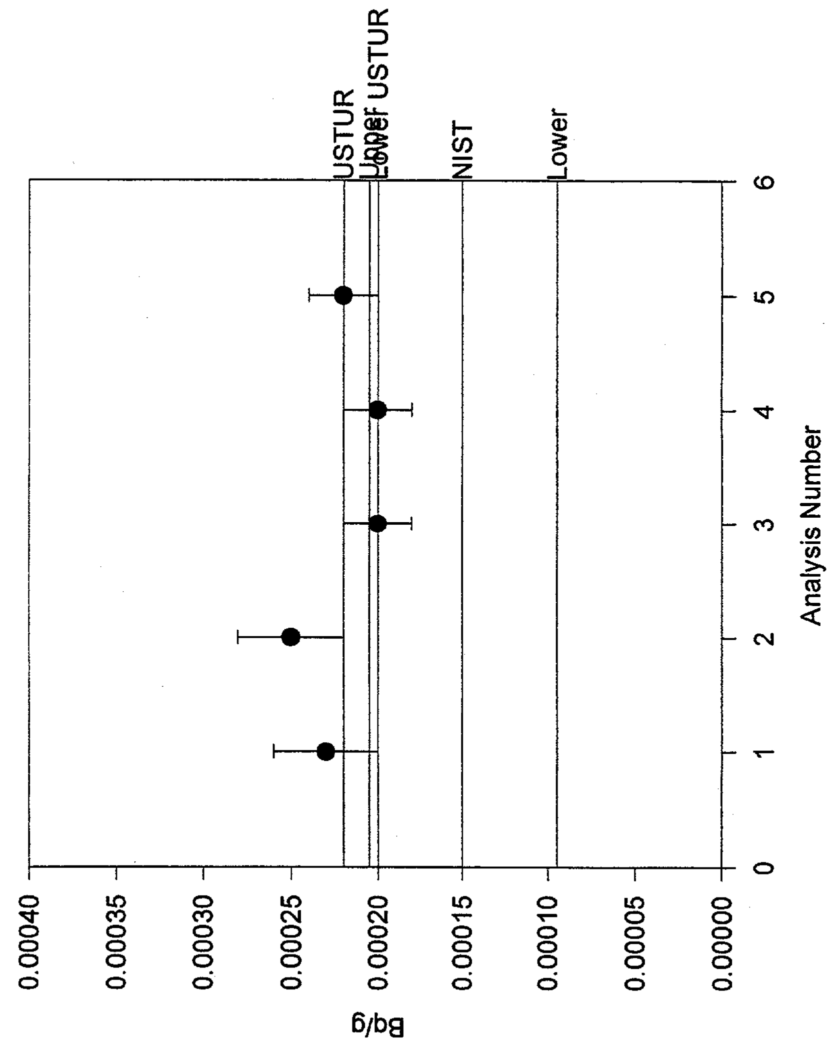


Figure 7

^{241}Am Results for NIST Liver SRM



Assumptions for Ingrowth

- Certified ^{241}Am: $1.5x10^{-4}$ Bq g^{-1}
- USTUR Value: $2.2x10^{-4}$ Bq g^{-1}
- USTUR Value is **~50% higher** 14 years after certification
- $^{239+240}Pu$: $2.06x10^{-3}$ Bq g^{-1}
- ^{238}Pu: 5.5x10-5 Bq g^{-1}
- Total Pu-α : $2.13x10^{-3}$ Bq g^{-1}
- Assume: ^{241}Am ingrowth at 14 yrs $=2.2x10^{-4}-1.5x10^{-4}$ Bq $g^{-1}=7.3x10^{-5}$ Bq g^{-1}
- At 14 yrs, 0.0159 Bq ^{241}Am/Bq ^{241}Pu originally in sample

$\therefore$ $^{241}Pu=4.6x10^{-3}$ Bq g^{-1} at t=0

$\therefore\beta/\alpha$ Activity Ratio=2.16 at t=0

Range of $^{241}Pu/\alpha$-Pu in weapons grade material: 8-2 (WSRC-IM-90-139)

Figure 8

Ingrowth of ^{241}Am in NIST Liver SRM

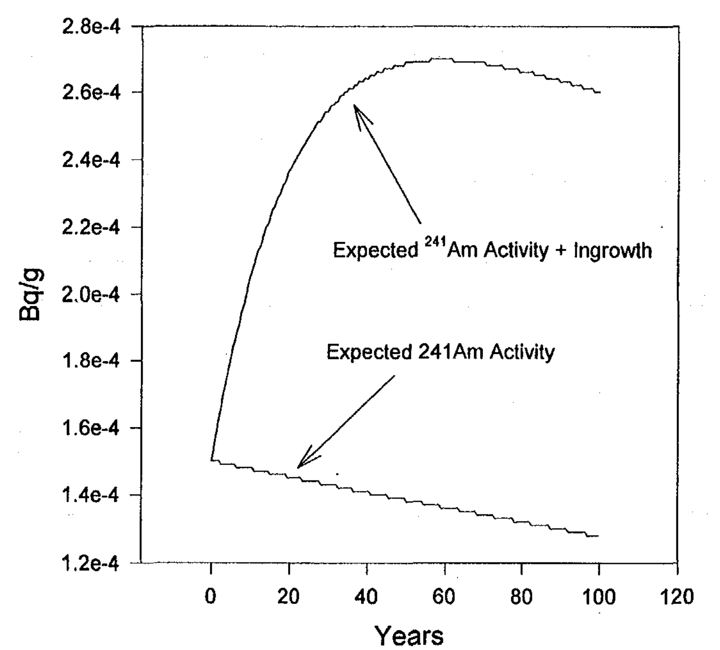


Table 4: Results of NIST Bone Ash SRM
Analysis Results for Pu and Am

Sample	^{238}Pu (mBq/g)	$\pm^{238}Pu$ (mBq/g)	$^{239+240}Pu$ mBq/g	$\pm^{239+240}Pu$ mBq/g	^{241}Am mBq/g	$\pm^{241}Am$ mBq/g
X039	9.8E-1	0.8E-1	1.25	0.09	11.4	0.4
X102	8.8E-1	0.8E-1	1.08	0.08	8.76	0.25
X103	8.1E-1	0.8E-1	1.15	0.09	10.0	0.3
X104	*		*		9.95	0.32
Average Value	8.9E-1	0.5E-1	1.16	0.05	10.0	0.5
Dev.Exp.	9%		-4%		0.4%	
NIST Expected (±2 sigma)	9.7E-1	±0.3E-1	1.21	±0.03	9.96E-3	±0.22E-3

*No recovery for Pu for this sample (repeated twice)

This is NOT a certified sample

NIST data for Pu is one measurement of entire contents of one bottle

NIST data for Am represents 8 measurements from 4 bottles

Figure 9

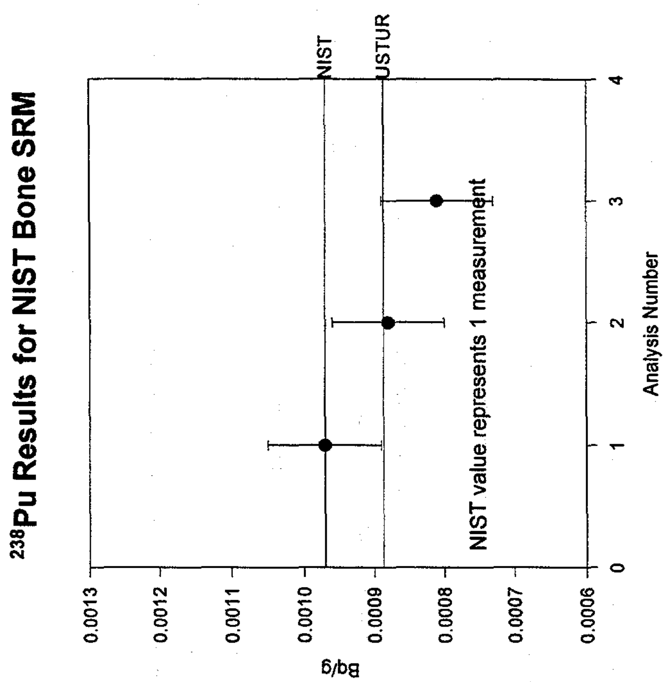


Figure 10

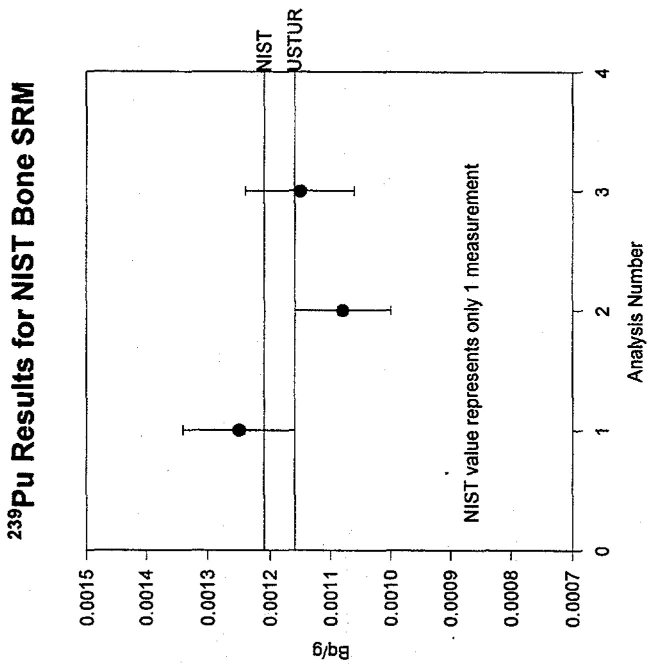


Figure 11

^{241}Am Results for NIST Bone SRM

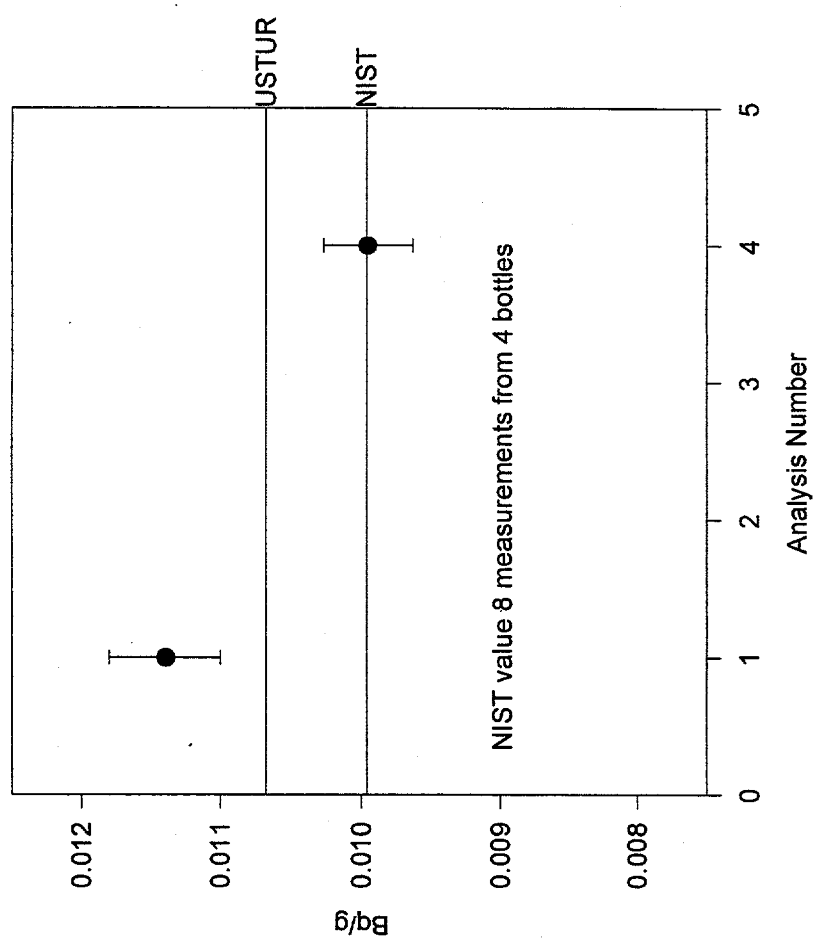


Table5

	Plutonium QA/QC Values								
QA/QC Sample	Pu Recovery (%)	Pu-238 QA/QC Spike Value (Bq/sample)	Pu-238 QA/QC Sample Value (Bq/Smple)	1 sigma Error (Bq/sample)	Relative Value	Relative Value Uncert.	Differ (Bq)	# Standard Deviations from Expected	Cum Sum (Bq)
19	100.0	0.3230	0.3109	0.0199	9.6254E-01	6.1715E-02	-1.21E-02	-6.07E-01	-1.21E-02
21	93.2	0.3230	0.3174	0.0202	9.8251E-01	6.2396E-02	-5.65E-03	-2.80E-01	-1.78E-02
22	87.6	0.3230	0.2804	0.0198	8.6824E-01	6.1269E-02	-4.26E-02	-2.15E+00	-6.03E-02
26	99.9	0.3229	0.3201	0.0202	9.9118E-01	6.2553E-02	-2.85E-03	-1.41E-01	-6.32E-02
27	96.1	0.3228	0.3121	0.0198	9.6685E-01	6.1338E-02	-1.07E-02	-5.40E-01	-7.39E-02
30	88.1	0.3225	0.3517	0.0222	1.0907E+00	6.8729E-02	2.92E-02	1.32E+00	-4.46E-02
31	100.8	0.3225	0.2957	0.0187	9.1702E-01	5.8074E-02	-2.68E-02	-1.43E+00	-7.14E-02
32	97.4	0.3223	0.2944	0.0192	9.1328E-01	5.9572E-02	-2.80E-02	-1.46E+00	-9.93E-02
37	96.2	0.3222	0.3008	0.0181	9.3349E-01	5.6232E-02	-2.14E-02	-1.18E+00	-1.21E-01
40	101.9	0.3221	0.3432	0.0201	1.0655E+00	6.2301E-02	2.11E-02	1.05E+00	-9.97E-02
41	89.8	0.3220	0.2999	0.0196	9.3124E-01	6.0913E-02	-2.21E-02	-1.13E+00	-1.22E-01
42	93.4	0.3220	0.2953	0.0150	9.1708E-01	4.6615E-02	-2.67E-02	-1.78E+00	-1.49E-01
43	96.5	0.3220	0.3428	0.0203	1.0646E+00	6.3043E-02	2.08E-02	1.02E+00	-1.28E-01
45	101.2	0.3217	0.2849	0.0171	8.8573E-01	5.3031E-02	-3.68E-02	-2.15E+00	-1.64E-01
46	100.5	0.3217	0.3227	0.0202	1.0031E+00	6.2698E-02	1.00E-03	4.96E-02	-1.63E-01
68	81.3	0.3213	0.3609	0.0130	1.1232E+00	4.0423E-02	3.96E-02	3.05E+00	-1.24E-01
107	81.5	0.3207	0.3442	0.0228	1.0733E+00	7.1094E-02	2.35E-02	1.03E+00	-1.00E-01
108	84.3	0.3204	0.3370	0.0198	1.0518E+00	6.1798E-02	1.66E-02	8.38E-01	-8.38E-02
109	87.5	0.3204	0.3057	0.0204	9.5412E-01	6.3670E-02	-1.47E-02	-7.21E-01	-9.85E-02
110	82.9	0.3204	0.3064	0.0211	9.5630E-01	6.5855E-02	-1.40E-02	-6.64E-01	-1.12E-01
111	89.4	0.3203	0.3266	0.0148	1.0197E+00	4.6207E-02	6.30E-03	4.26E-01	-1.06E-01

Figure 12

QA/QC Data for Plutonium Analysis

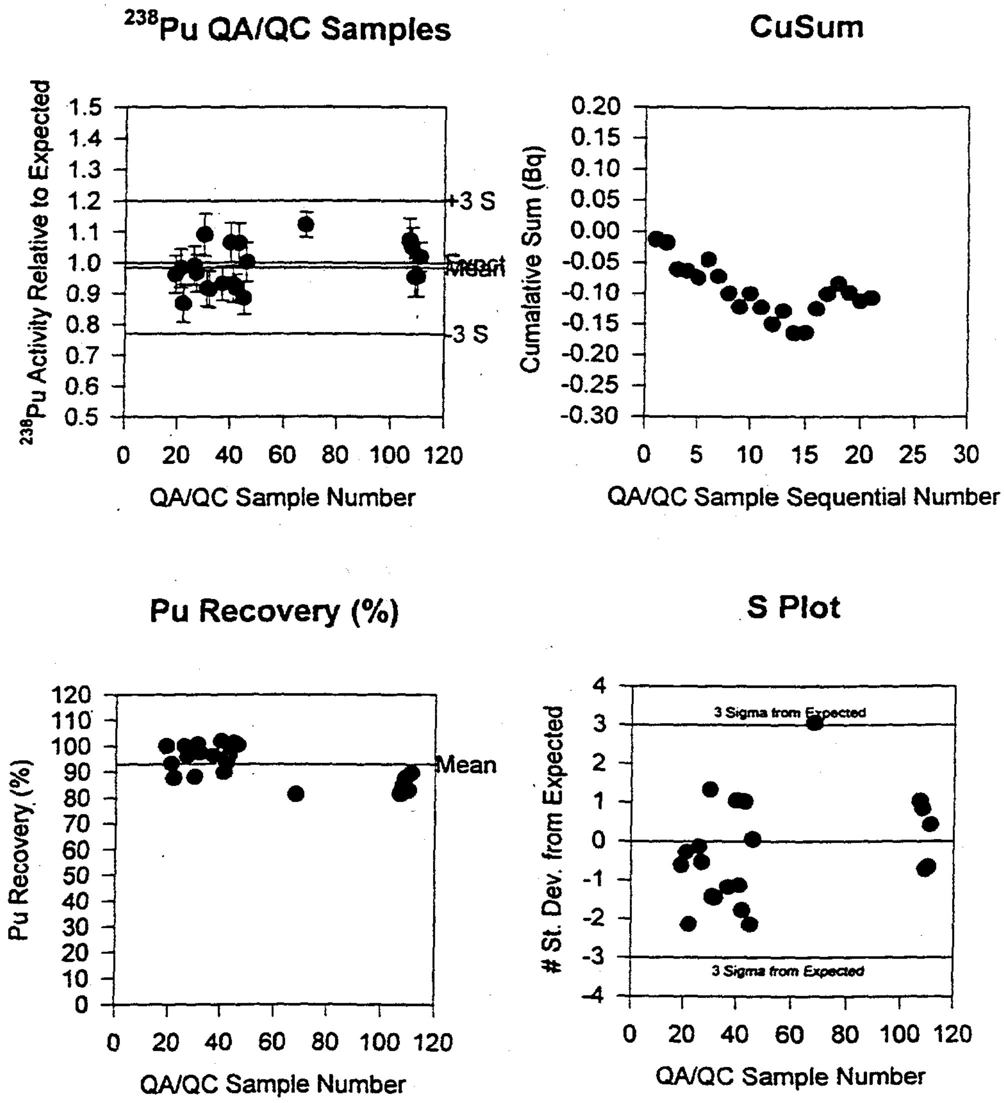
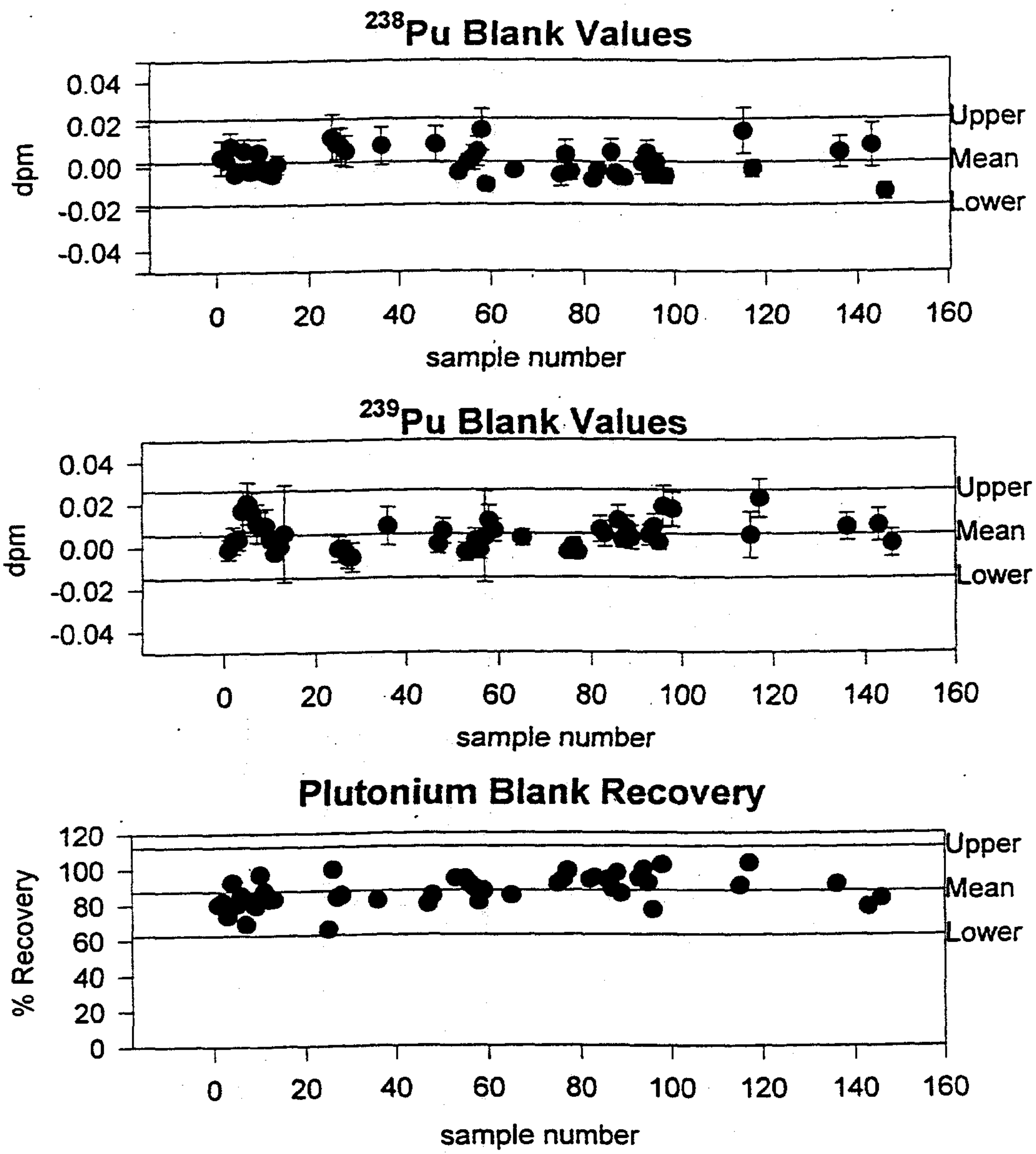


Figure 13

USTUR Plutonium Blanks



Appendix E

USTUR Advisory Committee Report

USTUR 1996 Advisory Committee Report

Date of Meeting: 18-19 October 1996

Location: WSU - Richland Campus

Participants:

Advisory Committee: Kenneth G.W. Inn, Gary R. Johnson, Bruce D. Lawson, Robert Thomas, MaryBelle Thompson

Absent: Frank B. Costello, Frank D. Gilliland, Borje K. Gustaffson, Keith J. Schiager, George L. Voelz

USTUR Staff: Minh V. Pham, Ron L. Kathren, Baruch Gold, Gerald E. Dagle, Shiping Bao, Ron Filby, Sam Glover, Ron Filipy, John Russell, Dot Stuit

Absent: Mahmoud M. Abdel-Monem

Observers: Eugene H. Carbaugh (PNNL), Barbara G. Brooks (DOE/EH)

Review and Status of 1995 Advisory Committee Recommendations: The USTUR continues to make significant progress towards adopting the Advisory Committee's recommendations.

'95 ISSUE	STATUS	COMMENTS
Radiochemistry Accuracy and Precision DQOs	Done	ANSI N13.30 Adopted as Quality Criteria; Higher Accuracy and Precision Criteria should be Established on Case by Case Basis
Radiochemistry Method Review	Done	New & Modified Procedures to be validated
Internal Radiochemistry Quality Assessments	In Process	Internal QC Established; Control Limits on Quality Indicators to be Established
External MAP Participation	In Process	Enrolling in Radiobioassay DOELAP; Participating in NIST Ashed Bone Intercomparison; External Blind Traceability Testing Needs to be Implemented

≥ 5 Replicate Radiochemistry Analyses for Methods Validation	In Process	5 Replicate Samples of SRMs 4351 and 4352 were Analyzed-Some Data Sets Incomplete; Accuracy and Precision Results to be Compared to USTUR DQO's; Cost of SRM Precludes Frequent Exercises
Development of Robust Radiochemical Reference Method	In Process	Sodium Bisulfate Fusion Procedure Added to Procedures Manual; This Method will be Validated and Compared to Existing Procedures
Develop Liaison with DOE Sites to Recruit Registrants	Done	Limited Response from DOE Sites; Sufficient Registrants and Tissue Samples; Further Investment in this Effort is not Appropriate with Changing Direction of WSU Program
Integrate USTUR Work with DRMIA (Russia)	In Process	Proposal Submitted
Advisory Committee Meeting Agenda Developed by USTUR Director and Chair	Done	-
Clarify Terms of Advisory Committee Members	Done	-
Long-Range Plan Includes Priorities, Tasks and Cost	Evolving	The USTUR Long Range Plan has made Considerable Progress towards Specificity of Thrusts, Priorities, Tasks and Timelines; Financial Planning to Meet the Specific Goals are to be Added
2 Day Advisory Committee Meetings	Done	-

DOE Report (Ms. Barbara Brooks):

USTUR funding is in place for '97 and '98's funds are planned to be continued at the same level. USTUR's funding sources must go beyond

DOE. There is an urgent need to prioritize work load to get the most scientific information from the limited amount of funds available. Focus should be place on cases that have been identified as being unique valuable for filling scientific knowledge gaps. The deliverables will be evaluated for its short-term impact. Of particular importance is to start following registrants while they are still alive by collaborating with their employer's HP to obtain in-vivo and in-vitro information. Recall (early evaluations of occupational workers) programs will be started at most DOE sites, USTUR should seek to provide posthumous collaborative followup.

Scientific Projects:

Mission: Pu and U effects on Workers Health
Access adequacy of Controls
Computerization of Data Base and Disseminate Information
Biokinetics, Modeling and Health Physics
Biomarkers, Histopathology and Causes of Death

Status: Biokinetics Program is progressing, and Health Effects Program is starting

Future: Refine Biokinetic Parameters, models and Dose Evaluations
NHRTR/NRA Research
Cause of Death and Morbidity Studies
Risk Coefficients for Radiation Protection
Dosimetry and Biomarkers for Radiological and Chemical Health Impacts

The WSU program is poised for expansion and refocusing of direction and effort. As an early effort to define its reformulated direction, a new name is being sought.

PROJECT	NEED	COLLABORATORS	STATUS
Russian Dosimetry	Significantly Higher Range of Exposure Scenarios	Mayak Industrial Association	$0.1M DOE/EH support for '96; requested $0.275M for '97; obtaining clearance for transport of samples out of Russia is very difficult
Pu in Human Placenta	No data Exists on Transfer of Pu to Placenta	Brookhaven Nat Lab University of Utah AEA Harwell Lab	Split Samples sent to 3 Labs; Data Reported by BNL; Pu very low in Membrane and Cord but much Higher in the Placenta
Beagle and Human Biokinetics	Inter-species Comparison: Pu in Liver/Skeleton	?	Evaluation in Progress; Confounding factor is Beagle Liver Retention Changes with Exposure Level
Respiratory Tract Biodosimetry	Epithelial Chromosome Aberration Dosimeter	PNNL	Concept has been Conceived; Experimental Plan to be Developed; Funding should be Pursued
U Biokinetic Studies	?	?	?

Am Exposure Case Followup	Corroborate USTUR Biokinetic Model with *In-Vivo* Measurements	PNNL LA Health Dept	PNNL Conducting Tomographic In-Vivo Measurements to follow Redistribution of Am from Lung to Liver and Skeleton
Radiochemistry Operations	Radionuclide Measurements of USTUR Tissues	WSU Neutron Activation Analyses	Basic Radiochemical Facilities and Equipment are Operational; Extending Analytical Capabilities to Extraction Chromatography, KPA U, PERALS, NAA, FTA, ICP-AES; Backlog of Wholebody Cases has Highest Priority, Particularly those linked to Accident and Collaborative NHRTR and Biomarker Cases

NHRTR/NRA	National Resource of Tissues for Research Genetic Markers to Monitor Radiation and Chemical Exposure	Human Monitoring Lab (RPB, Canada; Ra Skeleton) AEA Harwell (Thorotrast) U Utah (Pu in Colorado General Population) Rocky Flats Plant (Plasma Cell Granuloma in former Pu/Be Workers)	4 Requests for Tissue Samples; USTUR Registrants are Outliving the Actuary Probabilities; Freezer Repair is an Issue; NHRTR Biomarker Studies Focusing on Cancer Death Cases; 233 ft^3 U Utah/PNNL Dog Tissues being Transferred to USTUR, Storage Space is becoming an Issue ; Tissue Documentation Received from UC Davis, PNNL, LBL, Dr. Finkel, CSU, Dr. Stannard, CIRRPC, ITRI; U Rochester, NRA; Submitted Radiation/Chemical Biomarker Monitor Pre-Proposal for ER/EM-EMSP-96

Administrative Issues:

ISSUE	CONCERN	STATUS
Case Statistics	Sufficient Breath of Cases to Meaningfully Evaluate Radiobiokinetic Models	About 900 Registrants; Analytical Backlog of 8 Wholebodies & 41 Routine Samples; Determination of Cause of Deaths is being Studied
Budget and Staffing -DOE	Diminishing Support and Staff necessitates program expansion to new sources of funds	$1.55 M ('96) $1.2M ('97) $1.05M ('98)
Communications and WWW Data Base/Security -Information Request	Dissemination of USTUR Databases as a National and World-wide Resource; Promotion of WSU Program	Database is Making Excellent Progress; WWW Address is Being Accessed
DOE Site Collaboration	Coordinated DOE Bioeffects Program	Limited Response from DOE Sites; Sufficient Registrants and Tissue Samples; Further Investment in this Effort is not Appropriate with Changing Direction of WSU Program

Mission and Name Change	WSU's Program is Evolving; a New Name and Mission Statement is Necessary to Uniquely Define their Position	In Process
Policies and Procedures	Documentation of Operational Protocols	USTUR Policies and Procedures Manual is Complete, Approved and Operational; Document is Broadbased and includes NHRTR Protocols for Upcoming Changes in WSU Program
Equipment	NHRTR/NRA Tissue Bank are in Aging Deep Freezers	In Process of Locating Reliable Service Contractor

RECOMMENDATIONS:

General Comments

Much progress was seen in this year. The Radiochemistry laboratory has made notable progress in clearing much of the backlog of work. Significant progress is demonstrated in completion of procedures for testing and quality control. Progress has been made in computerization of data. Addition of the Web page should increase visibility of the Registries. Budget reductions appear to have been made without a diminution of service level. The Registries maintains a component and knowledgeable staff.

Because of the prospects of significant decreases in its funding by DOE, the WSU program faces a period of redefinition. Over the past several years, however, WSU has acquired the NHRTR/NRA and Mr. Russell and will be poised to launch an aggressive program in the area of radiological and chemical biomarkers for occupational monitoring, health and safety. Furthermore, WSU has developed radiochemical capabilities that will continue to serve the USTUR, but will also be prepared to expand into additional areas of analytical services. These is a healthy appreciation for continued analytical R&D that will help WSU establish it's place at the cutting-edge of ultra-sensitive radionuclide metrology.

WSU must carefully consider its future role in radionuclide and chemical occupational and environmental protection.. Although the DOE USTUR funding will be decreased, funding will likely continue at some level in out years. WSU's challenge will be to successfully compete for significant amounts of additional sources of funds. To do this, WSU will be shifting its emphasis to include additional activities in addition to the USTUR work. A redefinition of program name and mission is in order. It is of momentous importance that the program name, mission, commitment and expertise be focused to fill a unique nitch. It is the Advisory Committee's desire that the USTUR work continues to be one of WSU's primary focuses. It is only to this extent that the Advisory Committee will comment on the direction of WSU's new name, mission, policies and procedures until they are better defined.

Advisory Committee

RECOMMENDATION: The Registry should review the current constituency of the USTUR Advisory committee and determine if it meets the current and future needs of the Registry.

RATIONAL: The current committee is diverse in its membership relative to its expertise in the field of radionuclides and radiochemistry. With the upcoming change in name and mission of the WSU program, would WSU be better served by an Advisory Committee of individuals with expertise, in areas of dosimetry and health? A committee with such expertise would be better at advising and directing the USTUR into the next century.

Long-Term Plan

RECOMMENDATION: Develop programmatic roadmaps (like organizational charts) that clearly shows the relationship of large components of the program, relationship sub-components to the larger components, timelines, resource investments, collaborations, etc.

RATIONAL: Program roadmap will be a useful tool to communicate a well thought-out plan, and market the new WSU program.

Funding

RECOMMENDATION: Learn of DOE/ER, DOE/EH, DOE/EM, NIOSH, NCI, NRC, EPA programmatic needs in the area of occupational radionuclide and chemical protection R/D, then develop appropriate funding proposals.

RATIONAL: The decrease in DOE/EH funding of the USTUR requires WSU to seek additional funding sources to support it expanding commitment to occupational radionuclide and chemical protection R/D. Opportunities are not limited to national issues. Additional funding sources that reach internationally (e.g., DOE's FSU program) must also be pursued aggressively.

Registrants

RECOMMENDATION: Forms for *Release of Medical Information* and *Request to Send Medical Files to the USTUR* should be included with the Personal/Medical history form that is given to Registrants.

RATIONAL: It has been an awkward process for the USTUR to access Registrant's medical and dosimetric histories from their doctors and employers. This problem can easily be circumvented by including dosimetry and medical release forms in the medical history packet that the registrant gets when he/she formally signs on to the program. He/she can then give them to the HP and doctor to directly release and forward the history files directly to the Registries. The need for more Registrants with high depositions of U was recognized although it was recommended that general recruiting be limited to only the cases of highest interest. Bruce Lawson informed the Advisory Committee and Staff that the Oil, Chemical, and Atomic Workers International Union will soon be interviewing former gaseous diffusion plant workers, as a part of a study of former nuclear workers. He has agreed to attempt to make the people doing the interviews aware of the USTUR's need for high U exposed individuals as possible Registrant candidates and to facilitate getting this information to the USTUR.

RECOMMENDATION: WSU should suspend further efforts to solicit liaison with H&S mangers and developing rapport with health physics personnel at registrants' employer sites to facilitate identification of prospective new registrants.

RATIONAL: During this time of reformulation of the WSU program, WSU should expend its efforts in evaluating the scientific completeness of the cases already provided by the current registrants. The efforts to establish strong working relationships with H&S managers was dramatically unsuccessful. WSU should determine if there is any additional scientific need to attract new registrants, particularly in the light of the refocusing of WSU programmatic efforts.

Collaborations

RECOMMENDATION: Continue to develop collaborative relationships with WSU's pharmacy department, "In kind" assistance, CEDR, tissue donations, and DOE/FSU Program. Furthermore, WSU should seek collaborative opportunities through inquiries from its Web page.

RATIONAL: WSU's program will derive many benefits from increased collaborative work, including: 1) justification of the database as a national/international resource; 2) increased scientific throughput; 3) more publications; 4) increased scientific/public programmatic exposure; 5) increased scientific return on available funds; 6) access to the Russian data and specimens that could provide the Registries with valuable scientific opportunities; and 7) additional avenues for external funding besides the DOE. With the current climate of ever shrinking budgets, the USTUR would be compromised in its' ability to fulfill its' mission if funding by the DOE were reduced or eliminated. Cooperative and/or collaborative efforts with other investigators within WSU with external funding might serve as a source of funding for the USTUR. In addition, potential external sources of funding might include the pharmaceutical industry.

RECOMMENDATION: USTUR attempt to coordinate the RFP findings with those being produced by their own program at WSU.

RATIONAL: It is a critical time to coordinate efforts for bringing together all possible sources of information on persons who have been exposed to long-lived radionuclides, particularly the transuranic elements. One program that continues to gather data from such exposures is being carried out at the Rocky Flats Plant (RFP) and is in possession of mutually beneficial clinical data on Registrants that would be valuable to augment/enhance the Registry data. Attempts in the past to initiate such a cooperative venture have not succeeded and it is the Committee's idea that such an effort directed through the Department of Energy (DOE) Headquarters may be successful.

Paul Wambach (EH-42/DOE) is the program manager for the project at RFP; Barbara Brooks fulfills this position for the USTUR. It was recommended that these two program managers communicate seriously regarding establishment of a coordinated relationship between the two programs. Brooks indicated that a meeting of the RFP personnel and management was to take place in mid-November and that an attempt should be made between her and Wambach to have USTUR participation, or at least attendance, at this meeting. It turns out that this meeting was canceled so such an effort was not in order. However, a recent quarterly progress report for the RFP program was sent by Barbara Brooks to Ron Kathren, Director of the USTUR, and to Robert Thomas of the Advisory Committee, to serve as a basis for any further approach. It was clear from the report that the RFP program was soundly based and that they were obtaining valuable data on living persons who had some history of having been exposed to plutonium. The report made it clear, however, that there was no arrangement for autopsy material to be procured following the death of one of their subjects. Thus, it is this facet of the USTUR that seemed like a logical point for coordination with the RFP program and it was decided to pursue this aspect.

Shortly following the Advisory Committee meeting a three-way telephone conversation between Brooks, Kathren, and Thomas discussed the above information and recommended that Kathren write a letter to Wambach clearly stating the desires of the USTUR for a dialogue with those in the RFP program. Such a letter dated November 16, 1996, was sent to Paul Wambach from Ron Kathren.

RECOMMENDATION: Ron Filipy should contact Carol Kessler at the Department of State (DOS) and ask her to apply the necessary pressure to

enable movement of samples to the USTUR for radioanalysis and subsequent comparison of results with the existing data.

RATIONAL: There appears to be a barrier to transporting tissue samples for radionuclide analysis from the Russian (Formerly Soviet Union) contaminated sites to those US laboratories which would like very much to perform duplicate analysis for quality assurance and other purposes. Dr. Ron Filipy is the primary USTUR scientist coordinating with the Russian scientists in this aspect. He will pursue this avenue, contacting the DOS to see if this political route will not ease the transportation of samples and data between the two scientific groups.

Radiochemistry

RECOMMENDATION: Screen wholebody donations for scientific usefulness with single measurements on selected sections of benchmark samples, including: bone, liver, and lung.

RATIONAL: The amount of time and cost expended on a complete wholebody case is very large. By doing a limited number of preliminary analyses on benchmark tissue samples, reliable scientific value and priority can be assigned to the donation. Withe the current knowledge of actinide localization within the body, the USTUR should focus on the primary sites of localization based on prior experience and not compromise the mission or the USTUR, resulting in a cost savings to the Registry. Should the preliminary assays indicate an extraordinary scientific opportunity, a high priority can be assigned to the case. On the other hand, if the assays indicate that the case would reveal little new scientific information, the case can be assigned a low priority and only selected numbers of assays would be performed - thereby saving considerable time and conserving valuable resources, as a cost savings strategy.

RECOMMENDATION: WSU Radiochemistry Laboratory must verify and validate the analytical protocols and characterize the bias and precision of the methods.

RATIONAL: The Radiochemistry Laboratory has made an amazing amount of progress by establishing the laboratory, equipment, developing competency in radiochemical separations and measurements, documenting the protocols, and establishing the QA/QC program. The quality of the Laboratory's capabilities in improving dramatically, and is encouraged to continue. The Laboratory has also taken incredible strides to expand its analytical capabilities to include FTA, NAA, and ICP-AES. The Laboratory, must carefully verify and validate their protocols and characterize the bias and precision of their methods. Preliminary results from analysis of NIST SRM 4351 (Lung) and 4352 (Liver) indicate reasonable agreement with the certified values. There appears to be an occasional loss of sample. Initial results of bone analysis reported by WSU have shown the following deficiencies in their radiochemical methods:

A. Inconsistent chemical recovery of Pu and Am;

B. Results indicate difficulties in measuring U and Th in bone; and

C. Precision of multiple measurement are poor, and interpretation of measurement accuracy is compromised.

Facilities

RECOMMENDATION: WSU should make a concerted effort to acquire the use of Port of Benton's Building 747 to consolidate the USTUR programs currently located in Richland, Spokane and Pullman.

RATIONAL: A solidifying action is desirous which would bring together the USTUR work efforts that are currently being conducted at remote sites, in Spokane and Pullman. A building near the hospital in Richland has been identified which would supply the capability for such a unification, and further efforts need to be expended to bring about acquisition of this building for the USTUR.

Benton County is the home of the City of Richland and the Port of Benton is the organization which seemingly has the power and control of the future of this building. It was not clear if the GSA could free-up this facility to become part of the USTUR complex in Richland, and the recommendation of the Committee was for an organized and focused effort be made by Mr. Kathren to bring down the barriers that exist as stumbling blocks in the procurement of the building for the USTUR. Procurement of this facility would allow a much more centralized and hence, economical, operation by having all facets of the program located in Richland near the WSU branch campus.

RECOMMENDATION: Prepare a budgetary plan to ensure that -70°C freezers for storage of tissue specimens are replaced on a regular rotational basis.

RATIONAL: Service availability on the ultra-cold freezers is limited and the majority of the freezers are approaching the limit of their life expectancy.

Since the freezers are critical to preservation of tissue samples, the Registries cannot be without sufficient freezer space.

Appendix F

USTUR Registrant Newsletter

USTUR Newsletter

United States Transuranium and Uranium Registries

Issue 3 *December 1996*

Letter From the Director

Last year we celebrated the 100th anniversary of the discovery of x-rays, and this year marks the centennial of the discovery of radioactivity. It was Henri Becquerel, a French physicist, who discovered the radioactive properties of uranium ore in March of 1896. Since that epochal discovery, a number of new and potentially highly radiotoxic elements, including plutonium and americium, have been created. Since 1968, thanks to the generosity and foresight of our Registrants, the USTUR has been studying the distribution, dose and possible biological effects of these new radioelements in humans.

And, what have we found? We have learned a great deal about how and where plutonium and americium are deposited in the human body, and how the dose is distributed among the various tissues and organs. We have verified and validated some of the basic information used to establish safety standards, and suggested changes to other parameters on which the safety standards are based. But, there is still much more to be done in this area. Accordingly, we are studying the transfer of plutonium across the placenta, from mother to child. This study was made possible by the donation of a placenta from a young woman who had incurred a small intake of plutonium as a result of her job.

The Registries continue to collaborate with the Russians, and have expanded their studies in this area. The Russian cohort or group of study subjects is about twice as large as the American group, and as a group the Russians incurred significantly higher intakes and doses of plutonium than did their American counterparts. Our collaborative studies with the Russians will hopefully expedite and enhance our search for possible biological effects.

We have found that our Registrants are, by and large, a very healthy and long lived population who seem to show no ill effects as a result of their work with the actinide elements. But we have begun a new study to evaluate the causes of death among our Registrants, and one which we hope will lead to a better understanding of the role, if any, that their exposure played.

Once again, I note that the Registries work is made possible by the generous postmortem contributions of our registrants, who unselfishly have contributed to ensuring the safety of the workplace. We at the Registries salute you all, and extend to you our very best wishes for a happy holiday season, and a most happy and healthy 1997.

Ronald L. Kathren, Director

World Wide Web

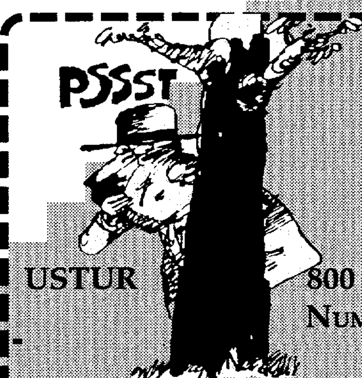
Computer buffs will be pleased to know the USTUR has a homepage on the World Wide Web! The address is:

/WWW.tricity.wsu.edu/htmls/ustur/page1.html

The home page includes useful information about the Registries. Information such as the history and genealogy of the Registries as well as current annual reports and publications and much, much more!

USTUR Database

The health physics, radiochemical, clinical and medical database have been completed and are now part of the database system. Such information continues to be updated as new data from registrants become available. This information (without personal identifiers) is also available through the Comprehenisve Epidemiologic Data Resource (CEDR).



USTUR 800 NUMBER

The USTUR has an 800 number so that you can place toll free calls to the Registries from anywhere in the United States.
(800)375-9317.

ADMINISTRATIVE ACTIVIIES

Policy and Procedure Manual (PPM)

The PPM provides a documented basis for Registries operation. It stresses compliance with university, state, and federal regulations as well as bioethical considerations. The PPM contains three types of information: policies, procedures, and forms. Policies are statements describing the conduct of operations. Procedures are detailed statements which detail the accomplishement of a particular task. Forms, used for collection or distribution of specific information, are included in this manual.

The PPM is reviewed each year and revised as needed. This past year, the PPM was given a complete overhaul and the revisions were sent out to all holders of the manual.

Publications

The Registries are registered with the Office of Scientific and Technical Information (OSTI) and are thus included as a part of the Federal Technical Information Network. Any one interested in receiving a USTUR publication registered with OSTI can request a copy from:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 38831

Registrants may obtain single copies of Registries' publications and a complete publications list directly from the USTUR at:

United States Transuranium and Uranium Registries
Washington State University
100 Sprout Road
Richland, WA 99352

Registrant Renewal

Currently, registrants are renewed at five year intervals depending on their renewal date, which is the day on which their authorizations are signed and returned to the Registries. This not only gives registrants the opportunity to reconsider their participation, but provides a means of updating information at a reasonable interval. All registrants will be renewed simultaneously every five years. At the time of renewal, the Registries are requesting medical and health physics records from past or present employers. Getting records from employees is not always easily done, and the Registries hope to work with the registrants to ensure that this vital information is obtained in a timely manner, and included in each registrant's file.

Advisory Committee

The annual USTUR Advisory Committee Meeting was held October 18th and 19th in the Max E. Benitz Memorial Library conference room on the WSU Tri-Cities campus. The meeting was attended by the Advisory Committee and USTUR faculty and staff as well as other guests associated with the program. In addition, site representatives from each DOE site with employess or former employees in the pool of USTUR Registrants were invited to attend. The Registries wish to facilitate communications with, and to better serve the needs of, radiation protection and medical personnel at the various DOE sites where uranium and the transuranic elements have significant usage and thus may pose significant potential hazards to personnel. Due to significant DOE budget reductions, only the Hanford site, represented by Gene Carbaugh, attended.

Scientific Progress

Americium Biokinetics

Biokinetics refers to how a substance -- in this case americium -- distributes itself throughout the various tissues and organs of the body. Study of biokinetics includes consideration of how long the material remains in a particular tissue, where it gets translocated to, and how quickly it is excreted. Knowledge of these parameters is essential to determining doses and establishing sound safety standards.

A unique opportunity presented itself in early 1996 when a young man accidentally inhaled a quantity of americium at his work facility. This young man agreed to participate in the Registries program andprovided a very special living subject that enabled the Registries to verify certain biokinetic parameters that had been developed from postmortem data. This Registrant, who lives in California, has been flown to Richland each month for the past six months for in-vivo counting. In-vivo counting enables the Registries to determine how much americium remains in the skeleton, respiratory tract and liver at various times after the intake, and to correlate this information with what has been established from the postmortem studies.

The new biokinetic data for americium suggest that when compared with plutonium, a greater fraction of what is taken into the body deposits in the bone. The data also show that americium is cleared from the liver much more rapidly than previously thought. The USTUR data show that the clearance half-time for americium is 2.5 years instead of 20 years. This means that for a given intake of americium, the dose to the liver is less than previously thought.

Uranium Study

Uranium is everywhere in our environment, and sometimes this naturally occurring element can be cause for concern. Among the more interesting and perhaps somewhat out of the ordinary activities of the Registries during 1996 was its role in assisting the Los Angeles County Health Department (LACHD) and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) in resolving a potential public health problem related to high levels of natural uranium in the drinking water of a small mobile home park.

The LACHD had determined that the levels of natural uranium in the drinking water were well above permissible standards and, in conjuction with the ATSDR and Registries, a program to monitor exposures to the current and former residents of the mobile home park was devised.

The Registries served as the scientific resource for the two public health agencies, providing information on uranium toxicity and biokinetics, and also performing uranium measurements in the urine of potentially exposed persons. As a result of this study, it was determined that the elevated levels of radium also were present in the drinking water, and that the radium was likely a greater potential health problem than the uranium. Prompt action was taken to ensure that the water that exceeded permissible standards for uranium and radium was no longer consumed, and that the residents are advised of the situation.

It is unlikely that this situation will result in any measurable ill effects to those who may have drank the water. As for the Registries, we are pleased to have provided this special service and to have shared our expertise with others.

Causes of Death in USTUR Registrants

An examination of the causes of death among the 260 deceased Registrants revealed some interesting but not particularly startling results. Indeed, the registrants appear to be a surprisingly normal population. For 244 deceased Registrants, it was possible to determine with certainty the actual cause of death.

Perhaps somewhat surprising was the high degree of agreement between autopsy diagnosis and the stated cause of death on the death certificate. Agreement was 89%, somewhat greater than is typically found, which may reflect a higher and more detailed level of medical care that the Registrants receive. As expected, the leading causes of death were heart disease and cancer. About a third of the cancer deaths were from lung cancer which was almost exclusively confined to smokers.

There was nothing to suggest that the number of heart disease or cancer deaths were excessive, or were related to radiation exposure. Eleven of the deaths were attributable to accidents (7 from auto mobile or road accidents) and seven more from suicide. As yet, no specific conclusions can be drawn from this study, but additional analysis of the causes of death among the Registrants to date, is under way.

Russian Collaboration

The First Branch of the Russian Institute of Biophysics in Ozersk, Russian Federation maintains the Dosimetry Registry of the Mayak Industrial Association (DRMIA) (DRMIA) which is the Russian counterpart of the USTUR. Professor Ron Filipy, USTUR, visited scientists of the DRMIA in Ozersk in December, 1995. During that visit, the final progress report for the initial year of the joint USTUR-Russian research program was prepared along with a proposal for extension of the collaborative work. That proposal was approved in the summer of 1996 and work on the three-year project began in October, 1996.

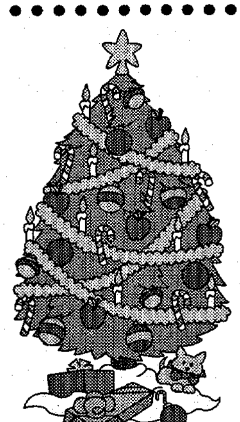
One of the major tasks to be accomplished as part of this program is an intercomparison of the radiochemical analytical methods used by the USTUR and the DRMIA. The Russians have been using methods that are quite different from those used by the USTUR. Although the first look at our combined data indicated good agreement, the results obtained by each of our methods on split samples must be compared to assure compatibility.

There are a number of advantages to a collaborative effort by the two Registries. The Russian Registry contains many more subjects than the USTUR (approximately three times as many) and the Russians used many more female workers in their plutonium production plants than did the United States (this is very important as there are very few women in the USTUR). Also, the Russian workers were exposed to much higher levels of plutonium than were the U.S. workers (an average of 250 times higher) and biological effects, such as cancer, resulting from those exposures have been demonstrated in Russian workers while virtually none have been conclusively demonstrated from exposures of U.S. workers.

Combining data from the USTUR and the Russian registry is expected to result in much better estimates of organ doses from actinide intakes and provides an opportunity for relating actinide intakes with biological effects and for determining the doses necessary for those effects to occur.

Registries Visiting Faculty

Dr. Baruch Gold of the Ben-Gurion University of Negev, Bersheva, Israel, has joined the Registries faculty as a Visiting Associate Professor for the 1996-97 academic year. Dr. Gold is a physician with expertise in nuclear medicine and radiation effects. He is working with other member of the Registries faculty to study the causes of death among the Registrants, and to evaluate possible links between exposure and cause of death.



Seasons Greeting's

From All of Us
At The

United States
Transuranium and
Uranium Registries

Washington State University
U.S. Transuranium and Uranium Registries
100 Sprout Road
Richland, WA 99352

Appendix G

USTUR Policies & Procedures Manual Table of Contents

USTUR Policies and Procedures Manual

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Appendix H

USTUR Analytical Procedures Manual Table of Contents

UNITED STATES TRANSURANIUM AND URANIUM REGISTRIES ANALYTICAL PROCEDURE MANUAL

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Appendix I

Distribution List

DISTRIBUTION LIST

Dr. Mahmoud M. Abdel-Monem, Dean
College of Pharmacy, Wegner 105E
Washington State University
Pullman, WA 99164-6510

Dr. S. Abrahamson
2012 Waunona Way
Madison, WI 53713

Captain David Adams
A.F. Radiation Assessment Team
USAF OEHL/RZA
Brooks AFB, TX 78235-5501

Mr. Steven Adams
IT Corporation
4330 S. Valley View, Suite 114
Las Vegas, NV 89103-4047

Mr. Andor Andrasi
H-1525 Budapest P.O. Box 49
KFKI Atomic Energy Research Institute
HUNGARY

Director
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439

Atomic Energy of Canada Limited
Scientific Doc. Dist. Office
Sta. 14, Chalk River Nuclear Labs
Chalk River, KOJ 1JO Ontario,
CANADA

Director
Agency for Toxic Substances and
Disease Registry
1600 Clifton Rd. MS E-56
Atlanta, GA 30333

Dr. Irina A. Avonova
Department of Radiology
RSFSR Ministry of Public Health
8, Mira, St.
197101, St. Petersburg
RUSSIA

Mr. P. Bannasch
Department of Cell Pathology
German Caner Research Center
Im Neuenheimer Feld 280
62120 Heildelburg,
GERMANY

Mr. Don C. Barg
Radiological Engineer
P.O. Box 1625
Idaho Falls, ID 83415

Mr. Mark C. Becker
Public Affairs Manager
EG&G Mound Applied Technologies
P.O. Box 3000
Miamisburg, OH 45343-3000

Dr. Luiz Bertelli
Rua Geminiano Gois
170 BL-I Apt. 202
Rio De Janeiro - RJ
22743-670
BRAZIL

Dr. R. W. Bistline
DOE/RFFO, HP Group
P.O. Box928
Golden, CO 80402-3408

Dr. B.B. Boecker, Director
Inhalation Toxicology Research Institute
P.O. Box 5890
Albuquerque, NM 87185

Dr. John Boice
REB/NCI EPN 408
Bethesda, MD 20892

Dr. Thomas Borak
Dept. of Radiation Health Science
Colorado State University
Ft. Collins, CO 80523

Library,
Branch #1 Biophysics Institute
Ozyorsk Road 19

Ozyersk, Chelyabinsk Region
RUSSIA

Dr. B.D. Breitenstein, Jr.
Brookhaven National Lab, BLDG. 490
P.O. Box 83
Upton, NY 11973

Dr. Allen Brodsky
Allen B. Consultants
2765 Ocean Pines
Berlin, MD 21811-9127

Director
Brookhaven National Laboratory
Associated Universities, Inc.
Building 490
Upton, NY 11973

Dr. Antone L. Brooks
Dept. of Environmental Science
Washington State University
Richland, WA 99352

Ms. Barbara Brooks
U.S. Dept. of Energy
Office of Health, EH-42, GTN
Washington, DC 20585

Dr. L.A Buldakov
Deputy Director
Institute of Biophysics
Zhivopisnaya 4
Moscow
RUSSIA

Dr. A. R. Britcher
British Nuclear Fuels, Hinton House
Risley, Warrington WA3 6AS
UNITED KINGDOM

Dr. William Burr
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, TN 37830

Dr. E.H. Carbaugh
Pacific Northwest National Laboratory
P.O. Box 999
Richland, WA 99352

Dr. Herman Cember
Technological Institute
Northwestern University
Evanston, IL 60208

Dr. Sue B. Clark
Dept. of Chemistry
Washington State University
305 Fulmer Hall
Pullman, WA 99164-4630

Dr. Larry P. Clevenger
Sandia Laboratories - 3300
P.O. Box 5800
Albuquerque, NM 87123

Dr. Norman Cohen
60 Still Road
Monroe, NY 10950

Ms. Gail Cole
EG&G Mound Applied Technologies
P.O. Box 3000
Miamisburg, OH 45343

Dr. Daniel E. Conrad
Martin Marietta Energy Systems, Inc.
P.O. Box 2009
Oak Ridge, TN 37831

Mr. J.P. Corley
2213 Torbett Street
Richland, WA 99352

Dr. David Coulston
BNFL
1002607 England Regd. Office
Risley Warrington
Cheshire WA3/6AS
ENGLAND

Father Frank B. Costello, S. J.
Jesuit House
Gonzaga University
Spokane, WA 99258

Dr. W. W. Crosbie
Authority Chief Medical Officer
Building 147, Harwell Lab
Oxfordshire, OX11 ORA
ENGLAND

Dr. Frederick T. Cross
1905 Meadows Drive North
Richland, WA 99352

Mr. Jean Pierre Culot
Boeretang 200
B-2400 MOL
BELGIUM

Dr. Robert T. Cutting
Medical Dept.
Savannah River Site
Aiken, SC 29808

Dr. Marina O. Degteva
Ural Research Center
Medgorodok Chelyabinsk
454076
RUSSIA

Dr. Paul M. Deluca
Dept. of Medical Physics
University of Wisconsin
Room 1530 MSC
1300 University Ave.
Madison, WI 53706

Ms. Martha DeMarre
REECO
P.O. Box 98521
Las Vegas, NV 89193-8521

Dr. Gordon DePuey
St. Lukeís Hospital
Amersterdam Ave. at 114th St.
New York, NY 10025

Dr. Marc F. Desrosiers
U.S. Department of Commerce
National Institute of Standards and Tech.
Building 245, Room C229
Gaithersburg, MD 20899

Mr. Bruce B. Dicey
U.S. Environmental Protection Agency
Environmental Monitoring Systems Lab
Radiation Sciences division
P.O. Box 93478
Las Vegas, NV 89193-2929

Ms. Greta J. Dicus
922 Beacon Square Ct., #225
Gaithersburg, MD 20878-5428

Dr. Hans Doerfel
HS/D
Kerforschumgszentrum Karlsruhe
Postfach 3640
D-76021 Karlsruhe 1
GERMANY

Dr. Mildred A. Donlon
Armed Forces Radiobiology Research Institute
Bethesda, MA 20814-5145

Mr. Doug Draper
EG&G MOUND
P.O. Box 3000
Miamisburgh, OH 45343

Dr. Patricia W. Durbin
1150-70A Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, CA 94720

Dr. Keith Eckermann
Medical Sciences Division
Oak Ridge Institue of Science and Ed.
P.O. Box 117
Oak Ridge, TN 37831-0117

Dr. Merrill Eisenbud
340 Carolina Meadows Villa
Chapel Hill, NC 27514

Larry J. Elliott
Robert A. Taft Lab (R44)
4676 Columbia Parkway
Cincinnati, OH 45226

Dr. Robley D. Evans
4621 E. Crystal Lane
Scottsdale, AZ 85253

Ms. Jill Fitch, Director
Radiation Protection Branch
61 Hindmarsh Square
P.O. Box 6, Rundle Mall 5000
Adelaide, South Australia
AUSTRALIA

Dr. Paul W. Frame
Oak Ridge Associated University
TMSD/PT, P.O. Box 117
Oak Ridge, TN 37830

Dr. John R. Frazier
412 Executive Tower Dr., Suite 402
Knoxville, TN 37923

Dr. Thomas Fritz
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439

Miss F. A. Fry
Secretary, NRPB
Chilton Didcot
OXON OXO11 QRQ
ENGLAND

Dr. Shirley Fry
ORISE
P.O. Box 117
Oak Ridge, TN 37831

Dr. F. J. Furman, Director
Medical Department, Bldg. 122
Rocky Flats Plant
P.O. Box 464
Golden, CO 80402

Ms. Marcie Gallagher
ATSDR
1600 Clifton Rd. MS E-56
Atlanta, GA 30333

Dr. A. Seaton Garrett
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37831

Dr. J.A. B. Gibson
Wayside, Wellshead
Harwell, Didcot
OXON OXII OHD
UNITED KINGDOM

Dr. Ethel Gilbert
Division of Cancer Epidemiology
National Cancer Institute
Bethesda, MD 20892

Dr. Frank D. Gilliland
Epidemiology and Cancer Control
Department of Internal Medicine
Univ. of NM School of Medicine
Albuquerque, NM 87131

Dr. Michael E. Ginevan
307 Hamilton Ave.
Silver Springs, MD 20901

Professor Marvin Goldman
Department of Radiological Sciences
University of California Davis
Davis, CA 95616-8742

Dr. Robert Goldsmith
902 Beacon Square Port #405
Gaithersburg, MD 20878

Dr. Abel J. Gonzales, Deputy Director
Division of Nuclear Safety, IAEA
Wagramerstrasse 5, P.O. Box 100
A 1400 Vienna
AUSTRIA

Mr. Daniel A. Gonzalez
Nevada Test Site
P.O. Box 98521
MS NTS 270
Las Vegas, NV 89193-8521

Dr. W. Gossner
Institute for Strahlenbiologie
GSF-Forschungszentrum
D-85764 Oberschileimbheim
GERMANY

Max E. Benitz Library
Washington State University
100 Sprout Road
Richland, WA 99352

Mr. Richard Griffith
IAEA
Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna
AUSTRIA

Dr. W.C. Griffith
Inhalation Toxicology Research institute

P.O. Box 5890
Albuquerque, NM 87185

Dr. David H. Groth
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, OH 45226

Mr. Arnaldo Guerrero
145 Jewell Street Apt. 3
San Rafael, CA 94901

Dr. R.A. Guilmette
Inhalation Toxicology Research Inst.
P.O. Box 5890
Albuquerque, NM 87185

Dr. Borje K. Gustafsson, Dean
College of Veterinary Medicine
Bustad 110
Washington State University
Pullman, WA 99164-7010

Mr. G. J. Ham
Radiological Protectional Board
Chilton, Didcot
Oxfordshire OX 11 ORA
ENGLAND

Dr. Naomi H. Harley
Dept. of Environmental Medicine
New York University
550 First Ave.
New York, NY 10016

Mr. Fred Harrison
128 Russel Dr.
Selma, AL 36701

Dr. William R. Hendee
Research Medical College of Wisconsin
8701 Watertown Plank Road
Milwaukee, WI 53226

Dr. David P. Hickman
Lawrence Livermoore National Lab.
MS L3-78, P.O. Box 808
Livermore, CA 94550

Dr. J.O. Hightower
Westinghouse Savannah River Co.
Bldg. 719-A
Aiken, SC 29808

Dr. Leo J. Hoge
P.O. Box 563
Saratoga Springs, NY 12866

Holland Library
Washington State University
Holland 1st. Fl
Pullman, WA 99164-5610

Mr. Mark D. Hoover
ITRI
P.O. Box 5890
Albuquerque, NM 87185

Dr. E. Huberman
Argonne National Laboratory
9700 South Cass Ave.
Argonne, IL 60439

Mr. J. Humphreys
Biomedical Research Dept.
AEA Environment & Energy
Harwell Lab, B-551
OXON OX11 ORA
ENGLAND

Mr. Jerry B. Hunt
P.O. Box 2008, ORNL
Bldg. 4500-5, MS-6099
Oak Ridge, TN 37831-6099

Dr. J. Inaba
National Inst. of Radiological Science
Anagawa,4-9-1
Chib-shi, 263
JAPAN

Dr. William C. Inkret
Los Alamos National Laboratory
MS ES-46
Los Alamos, NM 87545

Dr. Kenneth G.W. Inn
Center for Radiation Research
U.S. Dept. of Commerce
National Institute of Standards and Tech.
Bldg. 245, Rm C-229
Gaithersburg, MD 20899

Dr. Yuichi Ishikawa
Dept. Pathol. Cancer Inst.
1-37-1 Kami-ikebukuro
Toshima-ku, Tokyo 170
JAPAN

Dr. Seymour Jablon
6813 Persimmon Tree Rd.
Bethesda, MD 20817

Dr. O.W. Jones
Martin Marietta Energy Systems, Inc.
P.O. Box 2009, MS 8103
Oak Ridge, TN 37831-8103

Mr. Stan Jones
Martin Marietta Energy Systems
P.O. Box 628, MS 5020
Piketon, OH 45661

Ms. Amy E. Johnson
Rocky Flats Workers Studies
4300 Cherry Creek Dr. S.
Denver, CO 80222-1530

LCol J. Christopher Johnson
HQAMC; AMCSG-R
5001 Eisenhower Ave.
Alexandria, VA 22333-0001

Dr. John R. Johnson
2629 Harris Ave.
Richland, WA 99352

Dr. Edward Kaplan
Division of Rad. Science
Brookhaven National Laboratory
Bldg. 703 M
Upton, NY 11973

Dr. A. Karaoglou
Comm. of the European Communities
DG XII.F.6
200, rue de la Loi
B-1049 Brussels
BELGIUM

Professor Alexander Kaul
Bundesamt fur Strahlenschutz
Albert-Schweitzer-Str. 18
D-3320 Salzgitter 1
GERMANY

Mr. Hisao Kawamura
Division of Radioecology
Natl. Institute of Rad. Sciences
3609 Isazaki, Hitachinaka,
Ibaraki 311-12
JAPAN

Dr. Al Keane
Argonne National Laboratory
Bldg. 200
9700 Cass Ave.
Argonne, IL 60439-4831

Dr. Charles Kelsey
11513 Kimbark Ct.
N. Potomac, MD 20878

Mr. Robert W. Keys
P.O. Box 1663
MS M888
Los Alamos, NM 87545

Ms. Esther Kim
456 Crossroads Dr.
N. Augusta, SC 29841

Dr. Valentin FY. Khokhryakov
Branch #1 Biophysics Institute
Ozyorsk Road 19
Ozyorsk, Chelyabinsk Region
RUSSIA 456780

Dr. Nina A. Koshurnikova
Clinic, Branch #1 Biophysics Institute
Vostochnaya 3
Ozyorsk, Chelyabinsk Region
RUSSIA 456780

Mr. Ramney Koul
P.O. Box 637
Public Health
Dover, DE 19803

Dr. Gary Kramer
Human Monitoring Laboratory
Radiation Protection Bureau
Postal Locator: 6320D1
775 Brookfield Road
Ottawa, Ontario, K1A 1C1
CANADA

Dr. Arnold Kramish
2065 Weathersfield Court
Reston, VA 22901

Mr. P.W. Kruger
U.S. Department of Energy
P.O. Box 550-A5-90
Richland, WA 99352

Dr. Tom Labone
Westinghouse Savannah River
Bldg. 735-A
Aiken, SC 29802

Ms. Emelie S. Lamothe
AECL Research
Chalk River Laboratories
Chalk River, Ontario KOJ 1JO
CANADA

Director
Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, CA 94720

Director
Lawrence Livermore National Lab
P.O. Box 808
Livermore, CA 94550

Dr. Adam Lawson
British Nuclear Fuels Ltd.
2 Sellafield Cumbria CA20 1 PG
ENGLAND

Dr. Dorothy Legarretta
National Association of Rad. Survivors
78 El Camino Real
Berkeley, CA 94705

Dr. Walter Leggett
Oak Ridge National Laboratory
1060 COM MS 6480
Oak Ridge, TN 37831-6480

Dr. Joyce Lipsztein
Rua Itajuru 132
Rio De Janeiro - RJ
22641-190
BRAZIL

Dr. Ray D. Lloyd
Radiobiology Laboratory, Bldg. 586
University of Utah
Salt Lake City, UT 84112

Mr. Robert Loesch
U.S. Dept. of Energy
EH-52, GTN, 270CC
19901 Germantown Rd.
Washington, DC 20874-1290

Director
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, NM 87545

Dr. Timothy Lynch
Pacific Northwest National Laboratory
P.O. Box 999 MS B1-60
Richland, WA 99352

Dr. Eduard R. Lyubchansky
Branch #1 Biophysics Institute
Ozyorsk Road 19
Ozyorsk, Chelyabinsk Region
RUSSIA 456780

Dr. Joe Maderly, Director
Inhalation Tocicology Research Institute
P.O. Box 5890
Albuquerque, NM 87115

Dr. David Marsden
St. Lukeís-Roosevelt Hospital
428 W. 59th. Street, NW
New York, NY 10019

Mr. Jerome B. Martin, CHP
Battelle-Pantex
P.O. Box 30020
Amarillo, TX 79177

Dr. Osamu Matsuoka
Abiko Laboratory
Central Research Institute of Electric
Power Industry
Abiko 1646, Abiko-city,
Chiba 270-11
JAPAN

Dr. J.F. McInroy
580 E. Lake Drive
Rio Rancho, NM 87124

Dr. Roger O. McClellan
President, CIIT
P.O. Box 12137
Research Triangle Park, NC 27709

Mr. Dave McLaughlin
P.O. Box 2008, MS 6041
Oak Ridge, TN 37831-6041

Mr. Charles B. Meinhold, President
National Council on Radiation
Protection and Measurements
7910 Woodmont Ave, Suite 800
Bethesda, MD 20814

Dr. Mortimer L. Mendelsohn
Radiation Effects Research Foundation
5-2 Hijiyama Park
Minami-ku, Hiroshima 732
JAPAN

Mr. Richard A. Meserve
P.O. Box 7566
Washington, D.C. 20044

Dr. Fred Mettler
Dept. of Radiology
University of New Mexico
University Hospital 1 West
2211 Lomas Blvd. NE
Albuquerque, NM 87106

Mr. Sheldon Meyers
USEPA
3506 Dundee Dr.
Chevy Chase, MD 20815

Dr. William Mills
Risk Assessment
2915 Ascott Lane
Olney, MD 20832

Ms. Hollie Mooers
Richland Field Office
US Dept. of Energy, MS A5-55
P.O. Box 550
Richland, WA 99352

Mr. David S. Meyers
Lawrence Livermore Laboratory
Hazards Control Deparment, L-383
P.O. Box 5508
Livermore, CA 94550

Mr. Sheldon Meyers
3506 Dundee Drive
Chevy Chase, MD 20815

Dr. Charles W. Miller
Center for Disease Control
Radiation Studies Branch
Mail Stop F-35
4770 Buford Highway
Atlanta, GA 30341-3724

Mr. Mark Miller
NRL Code 1244
4555 Overlook Avenue SW
Washington, D.C. 20375-5320

Dr. Scott Miller
Division of Radiobiology, Bldg. 588
University of Utah
Salt Lake City, UT 84112

Dr. Bruce A. Muggenburg
Inhalation Toxicology Research Institute
P.O. Box 5890
Albuquerque, NM 87115

Dr. Anant Murthy
Brookhaven National Laboratory
Division of Rad. Science
Bldg. 703 M
Upton, NY 11973

National Inst. of Radiation Science
Division of Rad. Hazards
9-1, 4-Chrome Anagawa, Chiba
JAPAN

Dr. Neal S. Nelson
U.S. Environmental Protection Agency (6602J)
Washington, D.C. 20460

Mr. James Neton
FERNALD, Fermco
MS-31, P.O. Box 538704
Cincinnati, OH 45252-8704

Dr. Ruth Neta
Office of International Health Programs
EH-63, 270CC
U.S. Dept. of Energy
19901 Germantown Rd.
Germantown, MD 20585

Dr. Lee S. Newman
Pulmonary Division
National Jewish Center for Immunology
and Respiratory Medicine
1400 Jackson St., D-104
Denver, CO 80206

Dr. W.R. Ney
National Council on Radiation
Protection & Measurement
7910 Woodmont Ave #800
Washington, DC 20014

Director
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831

Occupational Health Researcher
Public Citizen Health Research Group
2000 P Street N.W.
Washington, DC 20036

Office of Scientific and Technical Info.
Oak Ridge Operations Office
P.O. Box 62
Oak Ridge, TN 37831

Dr. Nedezhda Okladnikova
Clinic, Branch #1 Biophysics Institue
Vostochnaya 3
Ozyorsk, Chelyabinsk Region
RUSSIA 456780

Mr. Peter Olsen
5201 Blue Jay Lane
W. Richland, WA 99352

Dr. Gilbert Omenn
School of Public Health
University of Washington
Seattle, WA 98145

Dr. Donald Paine
Nuclear Fuels Services, Inc.
P.O. Box 218
Erwin, TX 37650

Ms. Marji Parker
Richland Field Office
US. Dept of Energy
P.O. Box 550, A7-80
Richland, WA 99352

Dr. Norris J. Parks
Civil Engineering Department
University of Texas
El Paso, TX 79969

Dr. John Peeters
Deputy Director
Occupational Medicine Programs Div.
U.S. DOE
EH-431/270CC/GTN
Washington, DC 20585

Dr. Gerald Peterson
U.S. Dept. of Energy
Office of Health, EH-42, GTN
Washington, DC 20585

Dr. Harry Pettingill
U.S. Dept. of Energy
19901 Germantown Road
Germantown, MD 20874

Dr. J.E. Phillips
Martin Marietta Energy Systems, Inc.
Paduca Gaseous Diffusion Plant
P.O. Box 1410
Paducah, KY 42001

Mr. S. Wynne Porter, CHP
Porter Consultants
125 Argyle Road
Ardmore, PA 19003

Dr. John Poston, Sr.
Department of Nuclear Engineering
Texas A&M University
College Station, TX 77843

Mr. Gene Potter
Rocky Flats Environmental
Technology Site
State Hwy 93, Cactus Ave.
Golden, CO 80402-0464

Mr. Howard M. Prichard
Auxier& Associates, Inc.
412 Executive Tower Dr., Suite 402
Knoxville, TN 37923

Dr. Nicholas D. Priest
Environmental Sciences
Middlesex University
Bound Green Rd.
London, N112NQ
UNITED KINGDOM

Dr. Jerry Puskin,
USEPA
11103 Old Coach Rd.
Potomac, MD 20854

Mr. Robert M. Quillin
Radiation Control Division
Colorado Dept. of Health
4300 Cherry Creek Drive South
Denver, CO 80222-1530

Dr. Otto G. Raabe
Lab for Energy-Related Health Research
University of California
Davis, CA 95616

Dr. I. Riaboukhine
Radiation Scientist
World Health Organization
Geneva 2F
SWITZERLAND

Dr. Chester R. Richmond
Science Education Programs & Ext. Relations
P.O. Box 2008-MS 6250
Oak Ridge National Laboratory
Oak Ridge, TN 37831-6250

Dr. S.A. Roberts
Martin Marietta Energy Systems, Inc.
P.O. Box 2003
Oak Ridge, TN 37831-7422

Dr. G.R. Roessler
Health Physics Newsletter
Rt. 1, Box 139H
Elysian, MN 56028

Mr. Harold Rogers
860 Folsom Court
Carson City, NV 89705

Sergey A. Romanov
Clinic, Branch #1 Biophysics Institute
Vostochnaya 3
Ozyorsk, Chelyabinsk Region
RUSSIA 456780

Dr. R.E. Rowland
700 W. Fabyan Pkwy, Apt. 8C
Batavia, IL 60510

Mr. Paul Ruhter
INEL
P.O. Box 1625
Idaho Falls, ID 83415-4147

Dr. Jonathon M. Samat
Epidemiology, School of Hygiene
The Johns Hopkins University
Room 6039
Baltimore, MD 21205

Mr. Sheldon Samuels, Director
Health, Safety and Environment
AFL-C10
815 16th. Street NW
Washington, DC 20006

Mr. D. Michael Schaeffer
Defense Nuclear Agency
Radiation Policy Division
6801 Telegraph Rd.
Alexandria, VA 22310-3398

Dr. Keith J. Schiager
690 E. 4149 South
Salt Lake City, UT 84107-2934

Dr. Robert Schlenker
Argonne National Laboratory
9700 South Cass Ave.
Argonne, IL 60439

Dr. Bobby Scott
Inhalation Toxicology Research Institute
P.O. Box 5890
Albuquerque, NM 87185

Dr. Glenn T. Seaborg
Lawrence Berkeley laboratory
1 Cyclotron Road, Bldg. 70A Room 3307
Berkeley, CA 94720

Dr. Fritz A. Seiler
4101 Lara Drive N.E.
Albuquerque, NM 87111

Mr. Hugo Simenson
Sunhedsstryrelsen
Statens Institut for Stralehygiene
Frederikssundsvej 378
2700 Bronshoj
DENMARK

Dr. Warren K. Sinclair
National Council on Radiation Protection
7910 Woodmont Ave., Suite 1016
Bethesda, MD 20814

Dr. N.P. Singh
University of Utah
4412 Fortuna Way
Salt Lake City, UT 85117

Dr. Kenneth W. Skrable
Department of Physics
University of Lowell
Lowell, MA 01854

Dr. A.J.M. Slovak
British Nuclear Fuels Ltd.
2 Sellafield Cumbria
CA20 1 PG
ENGLAND

Dr. James M. Smith
Centers For Disease Control
MS F-35
4770 Buford Hwy N.E.
Atlanta, GA 30341-3724

Mr. Grover Smithwick
Oak Ridge Operations
DOE Federal Building
Oak Ridge, TN 37830

Mr. Michael Soldano
FERMCO
P.O. Box 538704, MS-31
Cincinnati, OH 45253-8704

Dr. A. Spiethoff
Department of Cell Pathology
German Cancer Research Center
Im Neuenheimer Feld 280
69120 Heidelburg
GERMANY

Prof. Henry B. Spitz
University of Cincinnati
8802 Castleford
Cincinnati, OH 45242

Dr. J. Newell Stannard
17446 Plaza Delores
San Diego, CA 92128

Dr. John Stather
National Radiologial Protection Board
Chilton, Didcot
OXON OX11 ORA
ENGLAND

Dr. Andrew F. Steheny
1132 Curtiss Street Apt. 2D
Downers Grove, IL 60515

Ms. Lynn Stembridge
HEAL
1408 W. Broadway
Spokane, WA 99201

Dr. E.T. Still
Kerr-McGee Corporation
P.O. Box 25861
Oklahoma City, OK 73125

Dr. Heather G. Stockwell, Director
Epidemiological Studies Div., EH-421, GTN
U.S. Department of Energy
Washington, DC 20585

Dr. Tore Straume
Biomedical Sciences Division/L452

Lawrence Livermore National Laboratory
P.O. Box 5507
Livermore, CA 94550

Dr. Daniel J.Strom
Battelle Northwest
P.O. Box 999, MS K3-56
Richland, WA 99352

Dr. Casper Sun
Brookhaven National Laboratory
Division of Rad. Science
Bldg. 703 M
Upton, NY 11973

Dr. Margery Swint
2426 Alexander Avenue
Richland, WA 99352

Dr. William G. Tankersley
Center for Epidemiologic Research
ORISE
P.O. Box 117
Oak Ridge, TN 37831-0117

Professor David Taylor
5, Branwen Close
Cardiff CF5 4NE
UNITED KINGDOM

Mr. Myint Thein
ORNL, 4500S, MS 6105
P.O. Box 2008
Oak Ridge, TN 37831-6105

Dr. James J. Thompson
University of Utah
Dept. of Radiological Health
100 Orson Spencer Hall
Salt Lake City, UT 84112

Ms. Lisa J. Thompson
Westinghouse Savannah River Co.
Medical Department - 719A
Aiken, SC 29808

Dr. MaryBelle Thompson
3313 West Fairway Drive
Couer d'Alene, ID 83814

Dr. Robert G. Thomas
P.O. Box 279
Bigfork, MT 5991

Dr. R. E. Toohey
Medical Sciences Division
ORISE
P.O. Box 117
Oak Ridge, TN 37831-0117

Dr. Lois Travis
Natl. Cancer Inst. Radiation Branch
Executive Plaza North #408
Bethesda, MD 20892

Dr. Normal M. Trieff
Division of Env. Toxicology
University of Texas Medical Branch
2104C Ewing Hall
Galveston, TX 77555-1110

Mr. Clinton Tuck
Health Effects Group
Rocky Flats Plant - Bldg. 122
Golden, CO 80402

Dr. I. Turai, Scientific Secretary
Division of Nuclear Safety, IAEA
Wagramerstrasse 5, P.O. Box 100
A 1400 Vienna
AUSTRIA

United Steel Workers Union, LU 8031
4510 Indiana St.
Golden, CO 80403

Dr. G. Van Kaick
German Cancer Research Center
Im Neuenheimer Feld 280
D-69120 Heidelberg
GERMANY

Veterinary Medical/Pharmacy Library
Washington State University
170B Wegner
Pullman, WA 99164-6512

Dr. George L. Voelz
Los Alamos National Laboratory
MS K404
Los Alamos, NM 87545

Dr. Niel Wald
University of Pittsburgh
Graduate School of Public Health
Room A-744
Pittsburgh, PA 15261

Dr. Ronald A. Walters
Battelle
ROB-3000 MS K1-50
Richland, WA 99352

Dr. Charles Watson
Pacific Northwest National Laboratories
P.O. Box 999, MS P7-58
Richland, WA 99352

Mr. Christian Wernli, Dipl. Phys.
Paul Scherrer Institute
Wurenlingem and Villigen
CH - 5232 Villigen PSI
GERMANY

Mr. Robert A. Wessman
TMA/NORCAL
2030 Wright Ave.
Richmond, CA 94804

Mr. C.M. "Hap" West
Oak Ridge Associated Universities
P.O. Box 117-CER
Oak Ridge, TN 37381-0117

Dr. Gregg Wilkinson
Division of Epidem. & Bio.
University of Texas Medical Branch
1.134 Ewing Hall
Galveston, TX 77555-1147

Miss J. A. Woodhouse
British Nuclear Fuels, Hinton House
Risley, Warrington WA3 6AS
UNITED KINGDOM

World Health Organization
Environment Health Criteria & Stds.
1211 Geneva 29
SWITZERLAND

Prof. McDonald E. Wrenn
Environ. Radiation Department
School of Medicine
The University of Utah
1771 South 900 West #10
Salt Lake City, UT 84104

Dr. S.S. Yaniv
Office of Nuclear Ragulatory Research
Nuclear Regulatory Commission
Washington, DC 20555

Dr. Alvin L. Young
Radiation Research and Policy Coordination
1019 Nineteenth St., NW
Suite 700
Washington, DC 20036

Dr. Maria Limson-Zamora
Bureau of Radiation and Medical Divices
Dept. of National Health and Welfare
775 Brookfield Road
Ottawa, Ontario KIA ICI
CANADA

Dr. Paul L. Ziemer
School of Health Sciences
Purdue University
Lafayette, IN 47907

Dr. John D. Zimbrick
Purdue University
School of Health Sciences
1338 Civil Engineering Bldg.
West Lafayette, IN 47907-1338