

Scientific Advisory Committee Meeting ◦ Richland, Washington ◦ April 11-12, 2019

Radiochemistry Progress Report

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*“Learning from Plutonium and
Uranium Workers”*





Outline

- Analytical methods
- Tissue analysis progress
- New equipment
- Radiochemistry database





Analytical Methods



Tissue Analysis Protocol

Drying
Ashing

Digestion
Dissolution

Actinide
separation

α -source
preparation

Actinide
measurement





Site Specific Performance Evaluation Program

Analytical method testing program

- *Sponsored:* U.S. DOE
- *Administered:* Radiological and Environmental Sciences Laboratory
- *Objective:* Double-blind performance evaluation

Test samples

- *Matrix:* liver and bone (2 samples each)
- *Analyte:* 238 , 239 Pu, 241 Am, 234 , 238 U,
- *Material type:* high-fired Pu oxide; insoluble U
- *Activity range:* 1 – 6 and 5 – 25 dpm

Analysis protocol

- USTUR standard operation procedures



Performance Evaluation Test Results

- $^{238,239}\text{Pu}$: 100% pass
- ^{241}Am : 75% pass
- $^{234,238}\text{U}$: failed

Department of Energy Radiological & Environmental Sciences Laboratory

LabName: USTUR

Matrix: Liver

LogNo	Sample ID	Nuclide	Known Activity	Experimental Activity	Ratio	
					Exp/Known	Agreement
SP-472	Liver-0318-1	Am-241	7.05 +/- 0.15 E-1 pCi	6.7 +/- 0.5 E-1 pCi	0.95 +/- 0.07	YES
SP-472	Liver-0318-1	Pu-238	5.12 +/- 0.11 E-1 pCi	5.9 +/- 0.4 E-1 pCi	1.15 +/- 0.09	YES
SP-472	Liver-0318-1	Pu-239	9.6 +/- 0.2 E-1 pCi	1.00 +/- 0.06 E0 pCi	1.04 +/- 0.07	YES
SP-472	Liver-0318-1	U-234	1.42 +/- 0.03 E0 pCi	1.31 +/- 0.06 E0 pCi	0.92 +/- 0.05	YES
SP-472	Liver-0318-1	U-238	1.48 +/- 0.03 E0 pCi	5.73 +/- 0.19 E0 pCi	3.87 +/- 0.15	NO 18.6 sig, 287%

LabName: USTUR

Matrix: Bone Ash

LogNo	Sample ID	Nuclide	Known Activity	Experimental Activity	Ratio	
					Exp/Known	Agreement
SP-475	BoneAsh-0218-2	Am-241	2.44 +/- 0.05 E0 pCi	1.5 +/- 0.3 E0 pCi	0.63 +/- 0.11	NO 3.5 sig, -37%
SP-475	BoneAsh-0218-2	Pu-238	3.80 +/- 0.09 E0 pCi	3.31 +/- 0.12 E0 pCi	0.87 +/- 0.04	WARNING 3.4 sig
SP-475	BoneAsh-0218-2	Pu-239	2.85 +/- 0.07 E0 pCi	2.39 +/- 0.09 E0 pCi	0.84 +/- 0.04	WARNING 4.4 sig
SP-475	BoneAsh-0218-2	U-234	2.86 +/- 0.07 E0 pCi	1.68 +/- 0.06 E0 pCi	0.59 +/- 0.02	NO 16.6 sig, -41%
SP-475	BoneAsh-0218-2	U-238	9.1 +/- 0.2 E0 pCi	1.76 +/- 0.06 E0 pCi	0.194 +/- 0.008	NO 101.4 sig, -81%

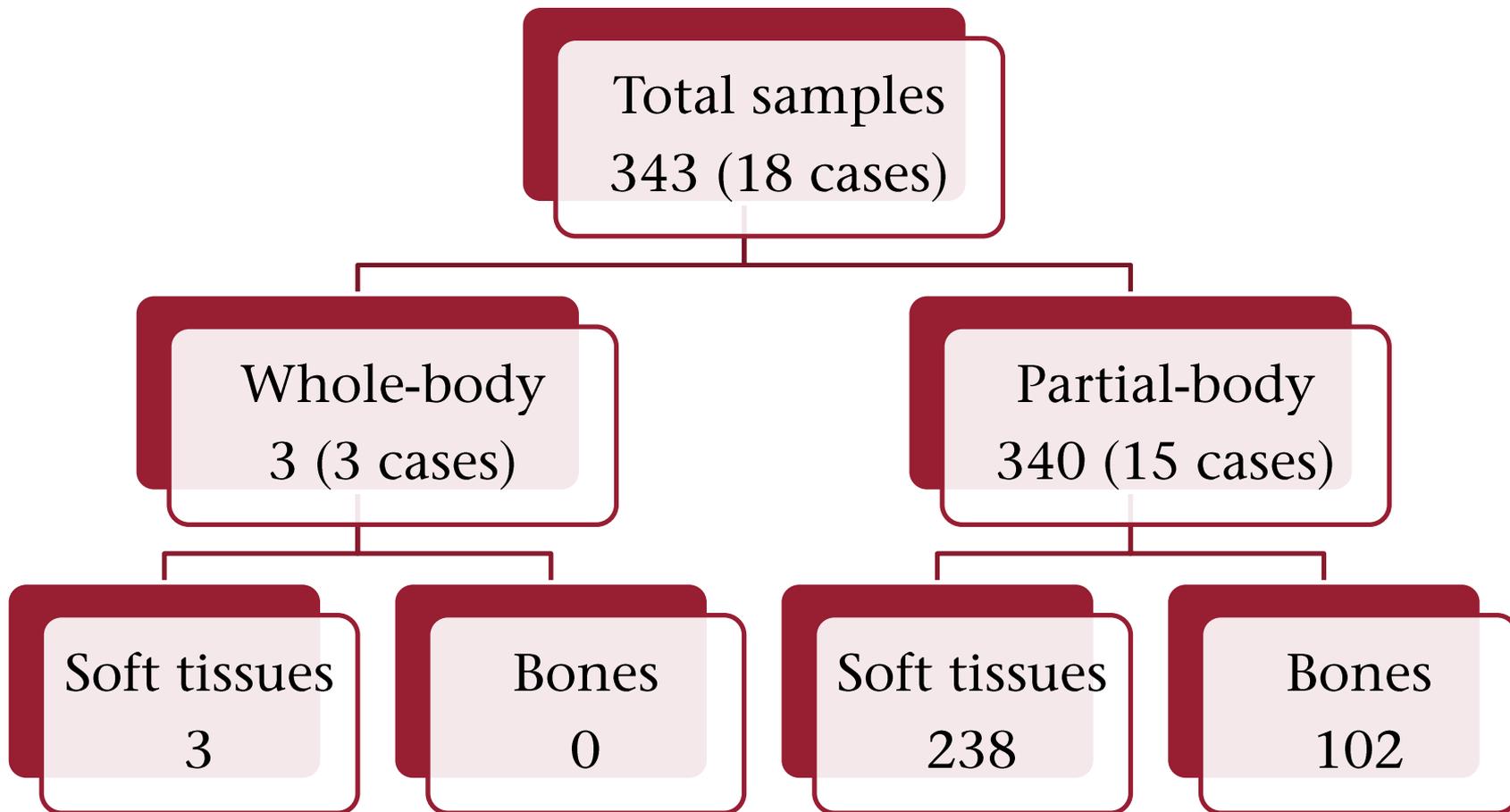




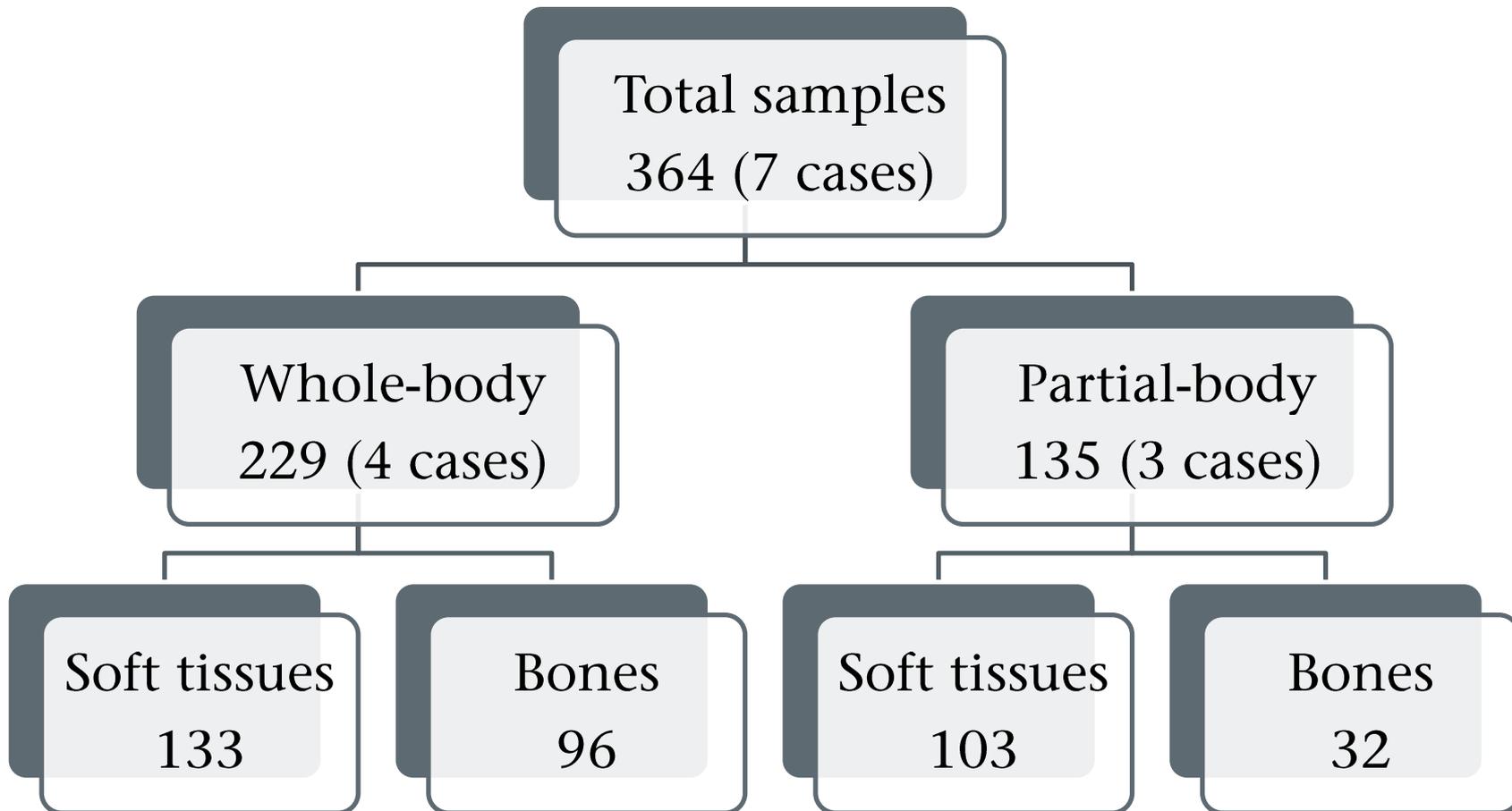
Tissue Analysis Progress



Tissues Analyzed



Tissue Analysis in Progress





Additional Samples Analyzed

- Sample (solution) reanalysis: 34 (7 cases)
- Residual formalin: 39 (1 case)
- Quality control
 - ✓ Method blanks: 32
 - ✓ Reagent blanks: 22
 - ✓ Spike solutions: 22

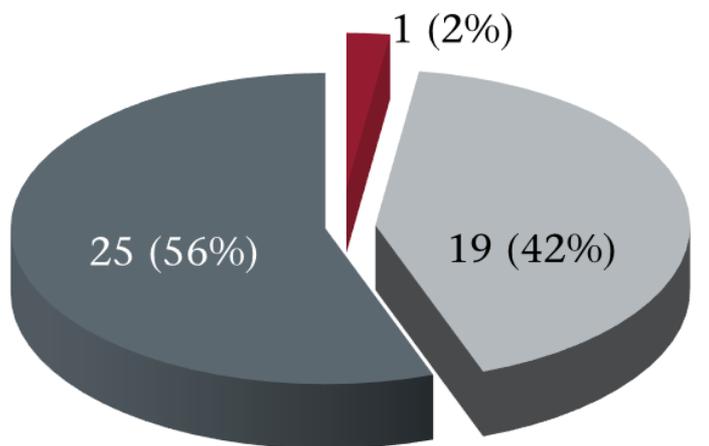




Status Change: *Whole-Body*

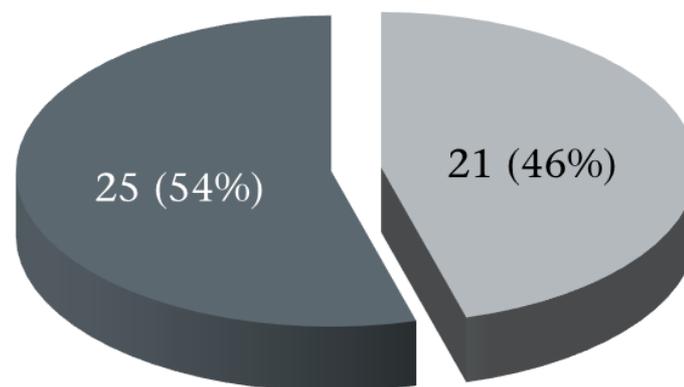
Intact → Incomplete: 2 cases

4/1/2018: 45



■ Intact ■ Incomplete ■ Complete

4/1/2019: 45 + 1



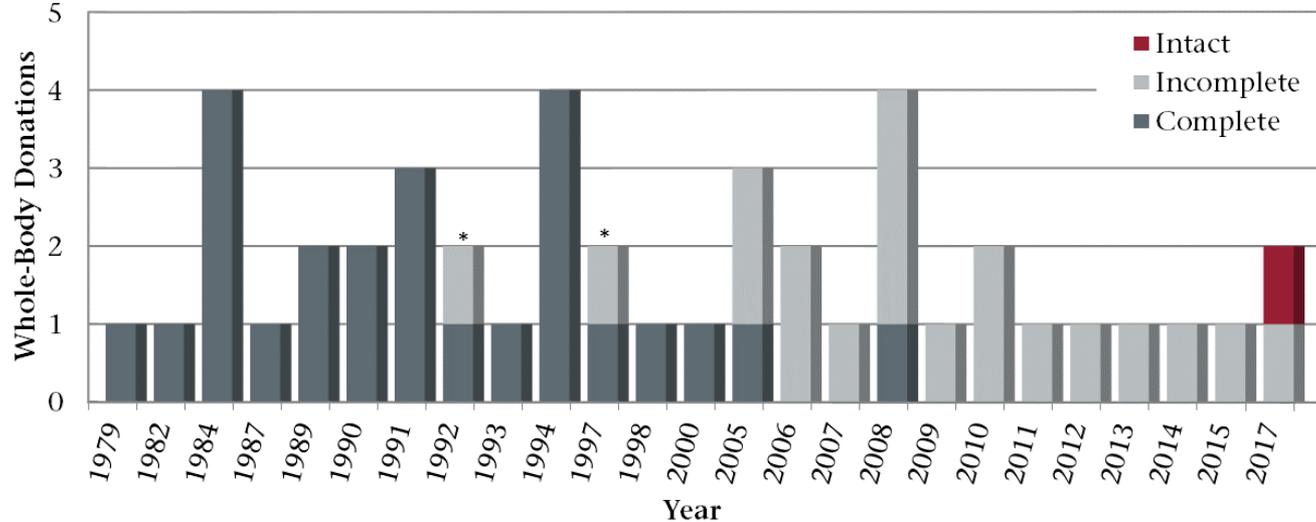
■ Intact ■ Incomplete ■ Complete



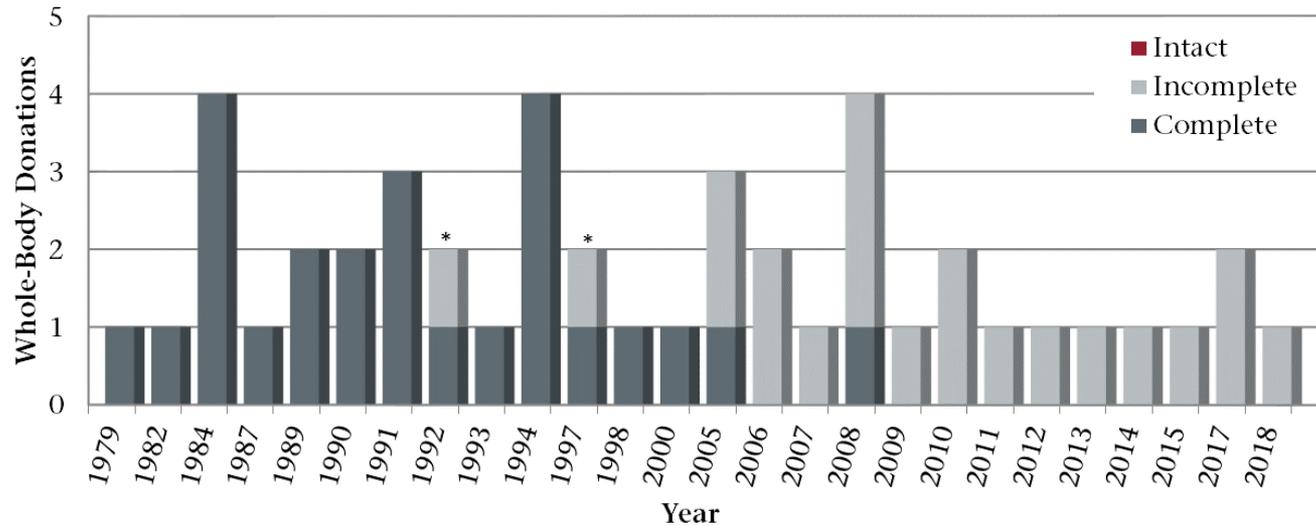


Status Summary by Year: *Whole-Body*

4/1/2018



4/1/2019



* Thorotrast cases

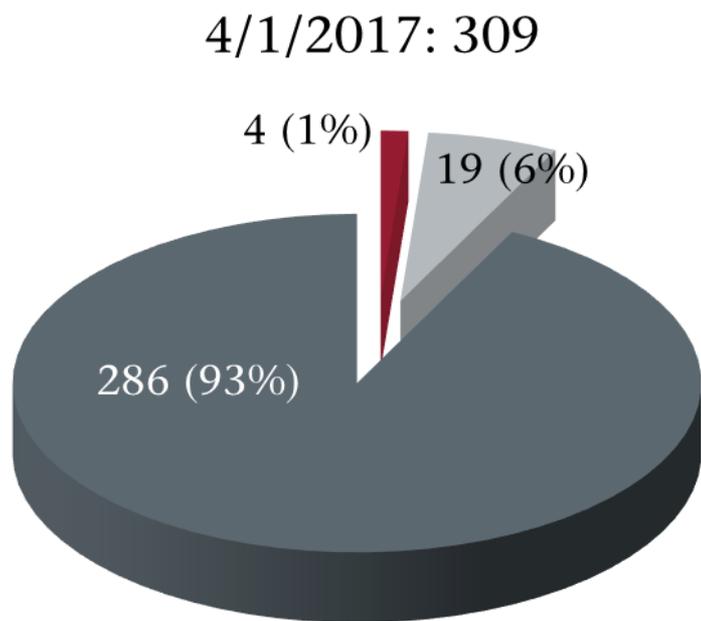




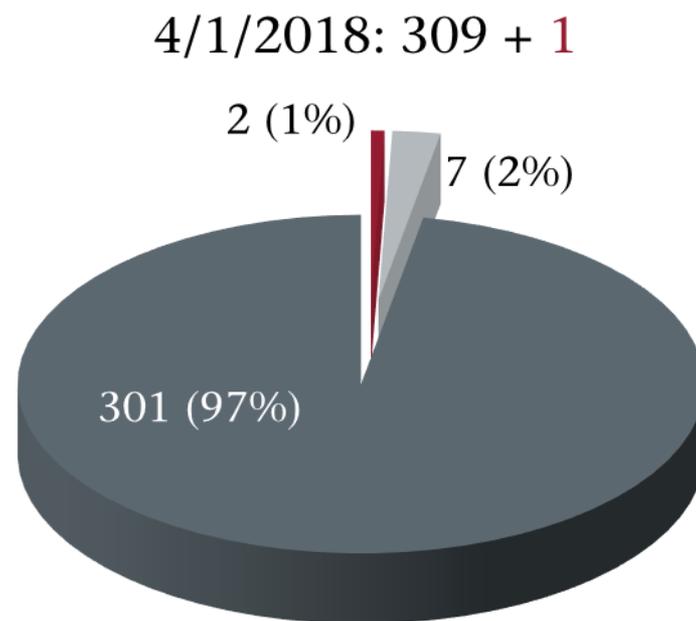
Status Change: *Partial-Body*

Incomplete → **Complete**: 15 cases

Intact → Incomplete: 3 cases



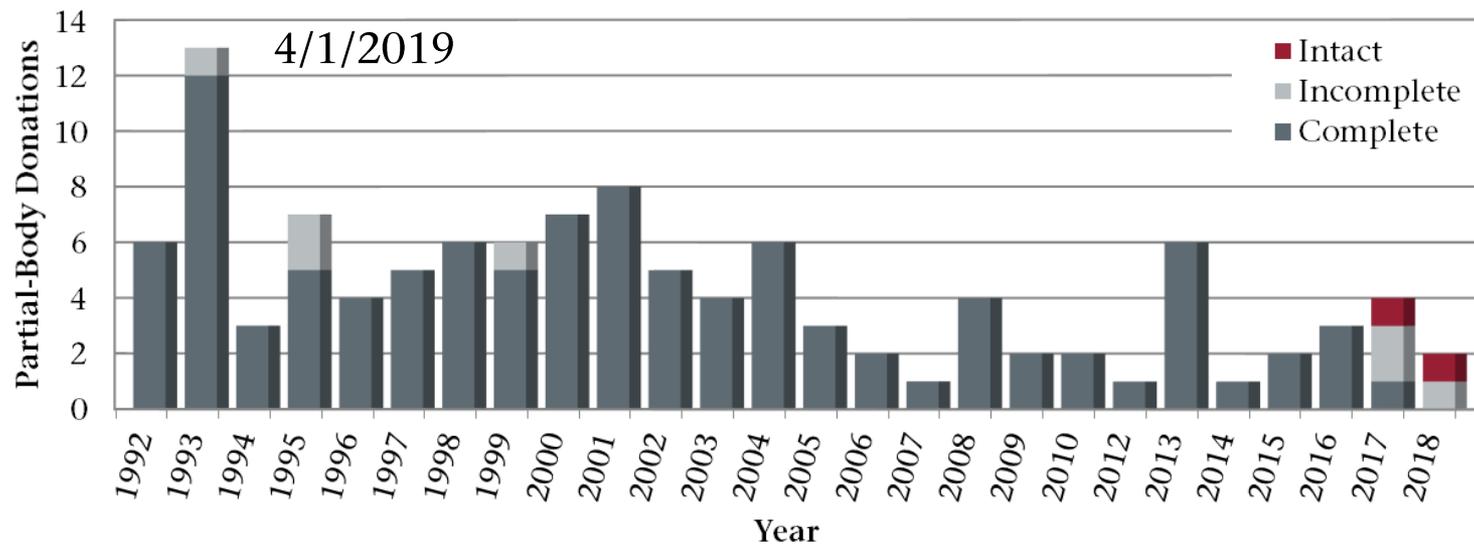
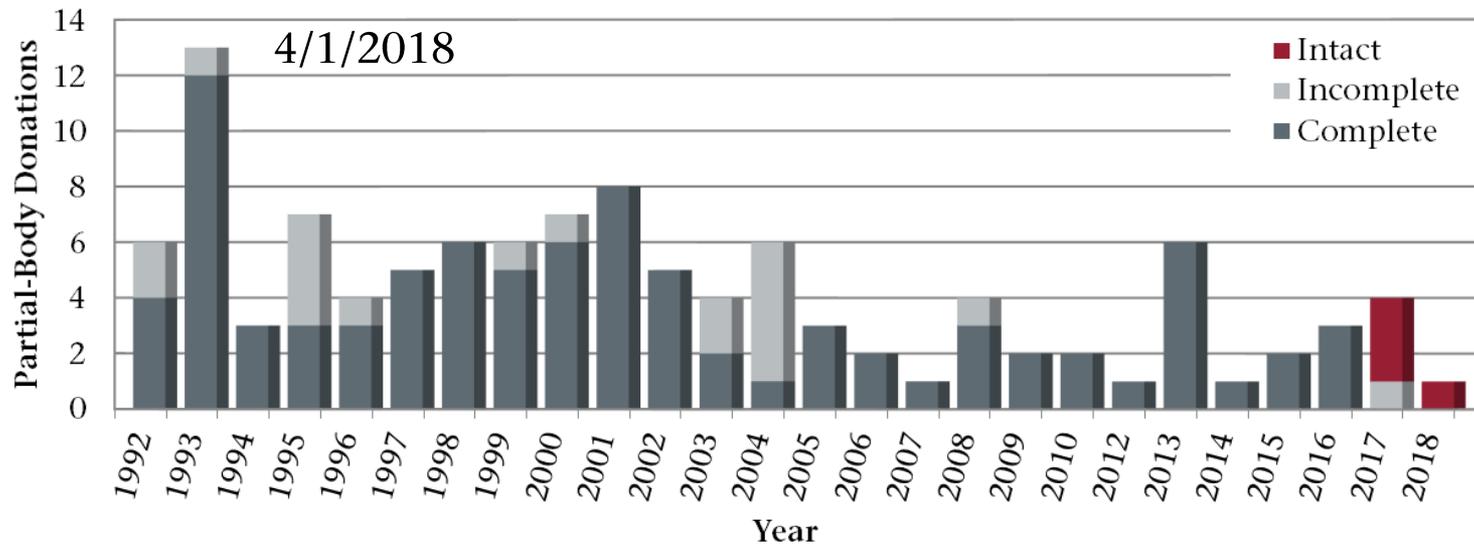
■ Intact ■ Incomplete ■ Complete



■ Intact ■ Incomplete ■ Complete

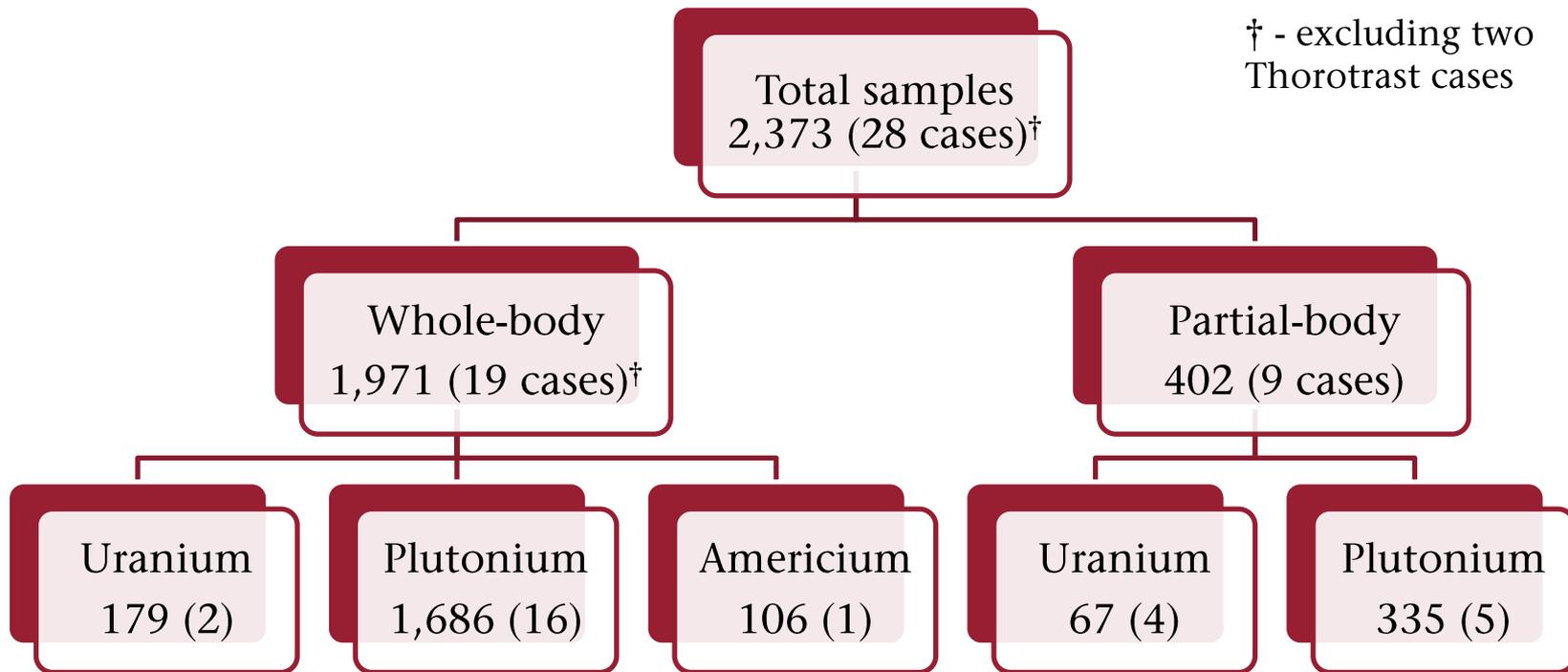


Status Summary by Year: *Partial-Body*



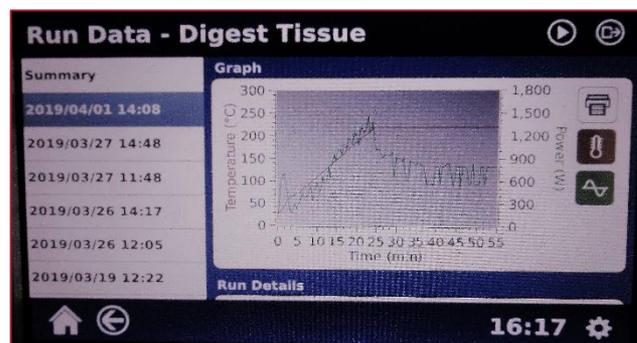


Tissue Sample Backlog: 4/1/2019



MARS6: New Microwave Digestion System

- 12-position rotor with EasyPrep[®] vessels
- Ability to save sample run data
- No need for temperature probe and control cap
 - ✓ Reduced chance of cross-contamination
 - ✓ No cleaning cycle – saves time and equipment wear and tear





Radiochemistry Database



Radiochemistry Database

Case File Navigation

Case []

Donation Type: WB Radiochemistry Status: INCOMPLETE

Collection Date: Date Complete: Most Recent Count Date: 12/2/2015 Report Date:

Reports: Ashing and Dissolution Sheets, Radiochemical Separation, Electrodeposition, Batch Entry, Results for Health Physics DB

External Files and Attachments: Rotor Load Matrix, Sample Analysis Sheets, RadChem Summary, Attached Files

Working Forms: Tissue Backlog, Add Autopsy Masses, Select Samples For Analysis, Analyzed Sample Information

Case File Navigation

Sample Processing: Select Samples For Analysis, Separate Samples, Dry/Ash Samples, Electrodeposit Run, Digest Samples, AlphaVision Information, Dissolve Samples, Batch Entry, Aliquot Samples

AV Database: Update AV Results in DB, Choose AV Spectra

Data Export: Export Rotor Load Info, Export for Analysis, Quarterly Reports

Book Keeping/Maintenance: Alpha Background Login, Add New Tissue Samples, Alpha Calibration Login, Move Sample List, Alpha Background QC, Add Previously Digested Acid Samples, Alpha Calibration QC, Add Aliquots To Themis, Detector History, Change Sample Number and/or Barcode, Alpha Detector Availability, Add QC Soln, Detector MDA Map, Add Tracer, Fill Coinholder

Drying
Ashing

Digestion
Dissolution

Actinide
Separation

α -source
preparation

Actinide
measurement





Radiochemistry Database: *New Functionality*

- Selection of samples for analysis
- Full integration (data exchange) with AlphaVision[®] database
- Summary of the results (Health Physics database)
- Backlog analysis progress
- Tracking chemical recoveries
- Laboratory swipe survey results





Radiochemistry Database: *Samples for Analysis*

- Filtering samples: consistency of sample selection

The screenshot displays the LIMS database interface for filtering samples. The window title is "LIMS_FE : Database- C:\Users\george.USTUR\Desktop\LIMS_FE.accdb (Access 2007 - 2013 file format) - Access". The interface includes a menu bar (FILE, HOME, CREATE, EXTERNAL DATA, DATABASE TOOLS) and a user profile (George). The main area features a "CaseFileSelectSamples" tab with two filter panels: "Sample Type Filter" and "Tissue Filter".

Sample Type Filter:

- Show All Samples
- Show Samples Selected
- Show Samples NOT Selected
- Show Only Radiochemistry Samples

Tissue Filter:

- All Tissue Groups
- Bone Samples
- Respiratory
- Fat, Muscle, and Skin Samples
- Other Samples
- Hand Samples

Additional controls include "Samples Selected And Not Yet Ashed" (0) and an "Analysis List" button.

Case	Sample	Tissue Type	Tissue	Initial Mass (g)	Prepared Mass (g)	Analyzed?	Aliquot Fraction	Nom. Spike (dpm)	Select
	002	Lymphatic - LNTH	Paratracheal LN	9.62	9.62	True	20%	2	<input type="checkbox"/>
	003	Lymphatic - LNTH	Hilar (R) LN	1.98	1.98	True	20%	2	<input type="checkbox"/>
	004	Lymphatic - LNTH	Parabronchial (R) LN	9.48	9.48	True	20%	2	<input type="checkbox"/>
	005	Lymphatic - LNTH	Mediastinal LN	18.26	7.91	False	20%	2	<input type="checkbox"/>
	005A	Lymphatic - LNTH	Mediastinal LN	18.26	10.35	True	20%	2	<input type="checkbox"/>
	006	Lymphatic - LNTH	Pulmonary (R) LN	11.59	11.59	True	20%	2	<input type="checkbox"/>
	008	Tracheobronchial	Larynx	57.49	57.49	True	45%	2	<input type="checkbox"/>
	009	Tracheobronchial	Trachea	19.55	19.55	True	70%	2	<input type="checkbox"/>
	010	Tracheobronchial	Bronchial Tree (R)	71.70	71.70	True	57%	2	<input type="checkbox"/>
	011	Tracheobronchial	Bronchus (R)	4.14	4.14	True	70%	2	<input type="checkbox"/>
	301	Respiratory	Lung (L)	699.70	699.70	False	70%	2	<input type="checkbox"/>
	304	Lymphatic - LNTH	Parabronchial (L) LN	9.79	9.79	False	20%	2	<input type="checkbox"/>
	311	Tracheobronchial	Bronchus (L)	6.52	6.52	False	70%	2	<input type="checkbox"/>
	610	Respiratory	Lung: Superior (R)	352.73	352.73	True	5%	2	<input type="checkbox"/>
	620	Respiratory	Lung: Middle (R)	67.78	67.78	True	5%	2	<input type="checkbox"/>

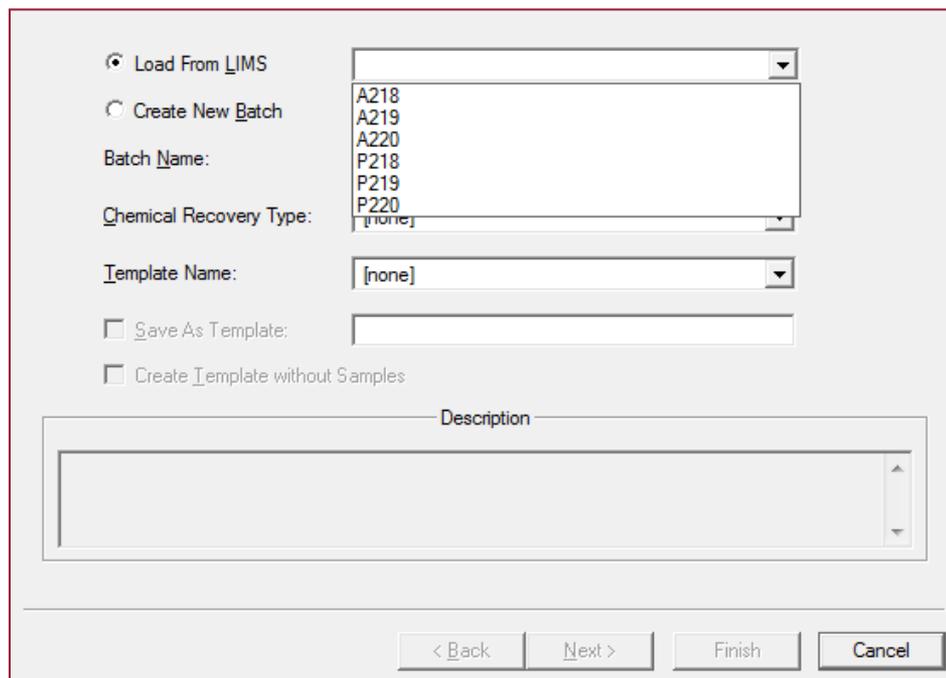
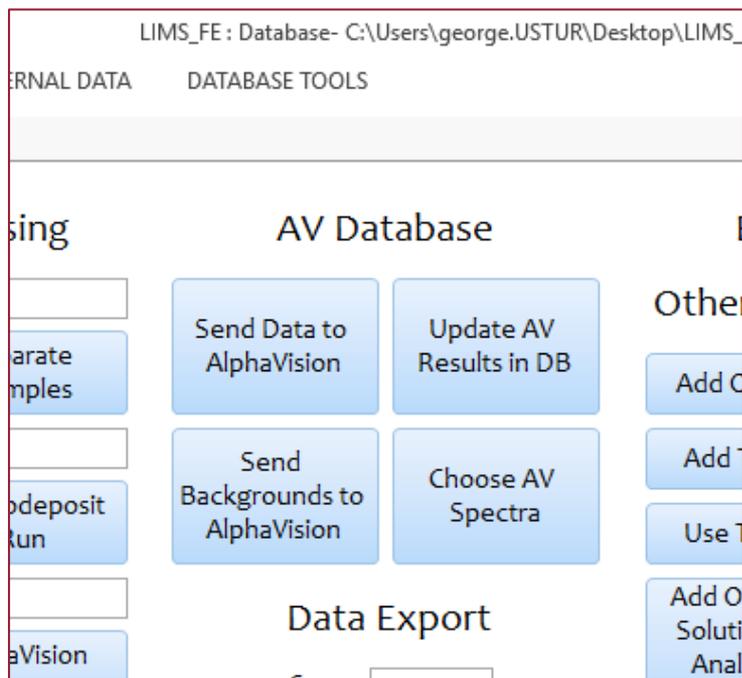
Record: 1 of 144 | Unfiltered | Search

USTUR Case Number | NUM LOCK



Radiochemistry Database: *Integration with AlphaVision Database*

- Data exchange with AlphaVision® database



Radiochemistry Database: *Analysis Results*

- Comprehensive summary of the results

LIMS_FE: Database- C:\Users\george.USTUR\Desktop\LIMS_FE.accdb (Access 2007 - 2013 file format) - Access

FILE HOME CREATE EXTERNAL DATA DATABASE TOOLS

George

Navigation Pane

Lab	Aliquot Samp	Tissue	Prepared Ml	Ashed Samp	Pu Tracer Recovery	Pu-239 (Bq)	Pu-239 Activity Unce	< MDA	Pu-239 (Bq/kg Wet)	Pu-239 Uncertainty
RRL	006A	Pulmonary (R) LN	3.10	0.03	97.4%	1.21E+00	4.76E-02	False	3.90E+02	1.53E+01
RRL	006B	Pulmonary (R) LN	3.10	0.03				False		
RRL	008A	Larynx	47.62	2.22	101.3%	2.00E-02	1.27E-03	False	4.20E-01	2.66E-02
RRL	008B	Larynx	47.62	2.22	99.7%	2.93E-02	9.17E-03	True	6.16E-01	1.92E-01
RRL	009A	Trachea	24.67	0.69	106.0%	2.67E-02	1.43E-03	False	1.08E+00	5.78E-02
RRL	610A	Lung: Superior (R)	301.04	3.61	103.8%	2.32E+00	8.62E-02	False	7.72E+00	2.86E-01
RRL	630A	Lung: Inferior (R)	547.34	6.04	102.0%	2.36E+00	8.35E-02	False	4.32E+00	1.53E-01
RRL	630B	Lung: Inferior (R)	547.34	6.04				False		
RRL	027A	Liver (R)	461.10	13.85	84.7%	2.71E+00	9.95E-02	False	5.87E+00	2.16E-01
RRL	027B	Liver (R)	461.10	13.85	87.5%	2.94E+00	2.38E-01	True	6.37E+00	5.17E-01
RRL	027C	Liver (R)	461.10	13.85				False		
RRL	023A	Prostate	133.44	1.45	103.4%	1.42E-03	3.00E-04	False	1.07E-02	2.25E-03
RRL	024A	Pancreas	81.50	0.60	79.8%	1.11E-02	9.81E-04	False	1.36E-01	1.20E-02
RRL	026A	Adrenal (R)	3.62	0.02	93.2%	6.99E-04	2.27E-04	True	1.93E-01	6.27E-02
RRL	035A	Kidney (R)	108.11	1.31	98.5%	1.66E-02	1.11E-03	False	1.53E-01	1.03E-02
RRL	035B	Kidney (R)	108.11	1.31				False		
RRL	014A	Axillary (R) LN	0.48	0.00	105.7%	0.00E+00	1.04E-03	True	0.00E+00	2.17E+00
RRL	016A	Cerebral Lobe (R)	524.58	7.97	99.8%	1.34E-02	1.27E-03	False	2.56E-02	2.43E-03
RRL	034A	Spleen	212.57	2.81	104.8%	1.25E-01	4.72E-03	False	5.89E-01	2.22E-02
RRL	042A	Testis (R)	11.56	0.13	97.5%	2.81E-03	4.23E-04	False	2.43E-01	3.66E-02
RRL	052A1	Colon - Right (Ash Scraping		0.74	97.5%	1.68E-03	3.05E-04	False		
RRL	052B	Colon - Right	314.03	2.50	91.5%	3.15E-03	4.00E-04	False	1.00E-02	1.27E-03
RRL	400A	Front: abdominal muscle	259.42	2.05	98.7%	2.93E-03	4.51E-04	False	1.13E-02	1.74E-03
RRL	600A	Front: abdominal skin	92.54	0.51	92.0%	2.68E-03	4.21E-04	False	2.90E-02	4.55E-03
RRL	870A	Hand Muscle: (R)	110.04	1.33	106.5%	2.93E-02	1.54E-03	False	2.67E-01	1.40E-02
RRL	985A	Hand Skin: (R)	83.56	0.74	94.3%	5.22E-02	2.46E-03	False	6.25E-01	2.94E-02
RRL	107A	Temporal 2 (R)	41.82	17.47	93.2%	5.81E-02	4.42E-03	False	1.39E+00	1.06E-01
RRL	140A	Thoracic 7 - Arch	16.08	3.71	97.0%	2.56E-02	1.76E-03	False	1.59E+00	1.09E-01
RRL	141A	Thoracic 7 - Body	23.46	2.82	100.3%	2.36E-02	1.71E-03	False	1.01E+00	7.27E-02
RRL	141B	Thoracic 7 - Body	23.46	2.82				False		

Record: 1 of 38 No Filter Search

Datasheet View NUM LOCK SQL



Radiochemistry Database: Analysis Results Integration with Health Physics Database

- Retrospective (prior to 2014) data entry
- Incorporation into USTUR Administrative Database

Lab	Aliquot Samp.	Tissue	Prepared Mi	Ashed Samp	Pu Tracer Recovery	Pu-239 (Bq)	Pu-239 Activity (unc)	MDA	Pu-239 (Bq Wet)	Pu-239 Uncertainty
RRL 006A		Pulmonary (R) LN	3.10	0.03	97.4%	1.22E+00	4.76E-02	False	3.90E+02	1.53E+01
RRL 006B		Pulmonary (R) LN	3.10	0.03				False		
RRL 008A		Larynx	47.62	2.22	101.3%	2.00E-02	1.77E-03	False	4.20E-01	2.66E-02
RRL 008B		Larynx	47.62	2.22	99.7%	2.93E-02	9.17E-03	True	6.16E-01	1.92E-01
RRL 009A		Trachea	24.67	0.69	106.0%	2.67E-02	1.43E-03	False	1.08E+00	5.78E-02
RRL 610A		Lung: Superior (R)	301.04	3.61	103.8%	2.32E+00	8.62E-02	False	7.72E+00	2.86E-01
RRL 630A		Lung: Inferior (R)	547.34	6.04	102.0%	2.36E+00	8.35E-02	False	4.32E+00	1.53E-01
RRL 630B		Lung: Inferior (R)	547.34	6.04				False		
RRL 027A		Liver (R)	461.10	13.85	84.7%	2.71E+00	9.95E-02	False	5.87E+00	2.16E-01
RRL 027B		Liver (R)	461.10	13.85	87.5%	2.94E+00	2.38E-01	True	6.37E+00	5.17E-01
RRL 027C		Liver (R)	461.10	13.85				False		
RRL 023A		Prostate	133.44	1.45	103.4%	1.42E-03	3.00E-04	False	1.07E-02	
RRL 024A		Pancreas	81.50	0.60	79.8%	1.11E-02	9.81E-04	False	1.86E-01	
RRL 026A		Adrenal (R)	3.62	0.02	93.2%	6.99E-04	2.27E-04	True	1.93E-01	
RRL 035A		Kidney (R)	108.11	1.31	98.3%	1.66E-02	1.11E-03	False	1.53E-01	
RRL 035B		Kidney (R)	108.11	1.31				False		
RRL 014A		Axillary (R) LN	0.48	0.00	105.7%	0.00E+00	1.04E-03	True	0.00E+00	2.77E-00
RRL 016A		Cerebral Lobe (R)	524.58	7.97	99.8%	1.34E-02	1.27E-03	False	2.56E-02	2.43E-03
RRL 034A		Spleen	212.57	2.81	104.8%	1.25E-01	4.72E-03	False	5.89E-01	2.22E-02
RRL 042A		Testis (R)	11.56	0.13	97.5%	2.81E-03	4.23E-04	False	2.43E-01	3.66E-02
RRL 023A3		Colon - Right (Ash Scraping)			97.5%	1.68E-03	3.05E-04	False		
RRL 052B		Colon - Right	334.03	2.50	91.5%	3.15E-03	4.00E-04	False	1.00E-02	1.27E-03
RRL 400A		Front: abdominal muscle	259.42	2.05	98.7%	2.93E-03	4.51E-04	False	1.13E-02	1.74E-03
RRL 600A		Front: abdominal skin	92.54	0.51	92.0%	2.68E-03	4.21E-04	False	2.90E-02	4.55E-03
RRL 870A		Hand Muscle: (R)	110.04	1.33	106.5%	2.93E-02	1.54E-03	False	2.67E-01	1.40E-02
RRL 985A		Hand Skin: (R)	83.56	0.74	94.3%	5.22E-02	2.46E-03	False	6.25E-01	2.94E-02
RRL 127A		Temporal 2 (R)	41.82	17.47	93.2%	9.81E-02	4.42E-03	False	1.39E+00	1.06E-01
RRL 140A		Thoracic 7 - Arch	16.08	3.71	97.0%	2.56E-02	1.76E-03	False	1.59E+00	1.09E-01
RRL 141A		Thoracic 7 - Body	23.46	2.82	100.3%	2.86E-02	1.71E-03	False	1.01E+00	7.27E-02
RRL 141B		Thoracic 7 - Body	23.46	2.82				False		

United States
Transuranium and Uranium Registries

Intake Type: **Mixed: Inhalation(s)/Wound(s)**
Contaminant(s): **Am-241**

Case No: Find Case

Admin Medical Rad Chem Health Physics Clinical Pathology Next of Kin

Name:
Address:
City: State: Zip:
M: Birth Date: Site: [LAW ?]
SSN: Autopsy Type: [wB] Race: [white]
Reg_No: Telephone:
Comment:

Deceased: Y
Deceased Date: Deceased Registrant:
Renew Date: Current Renewals:
Med History: Y 6/22/1977
Exposure History: Y
HP Completed: Y 10/30/2000
IH Received: X 5/18/2010
Radchem: COMPLETE
Category:
Autopsy Report: Y
Death Certificate: Y
Former Worker Prog:

Edit Case Find Record

Admin Report Case Narrative Registrant Numbers





Radiochemistry Database: *Backlog*

- One-stop shop for backlog analysis progress

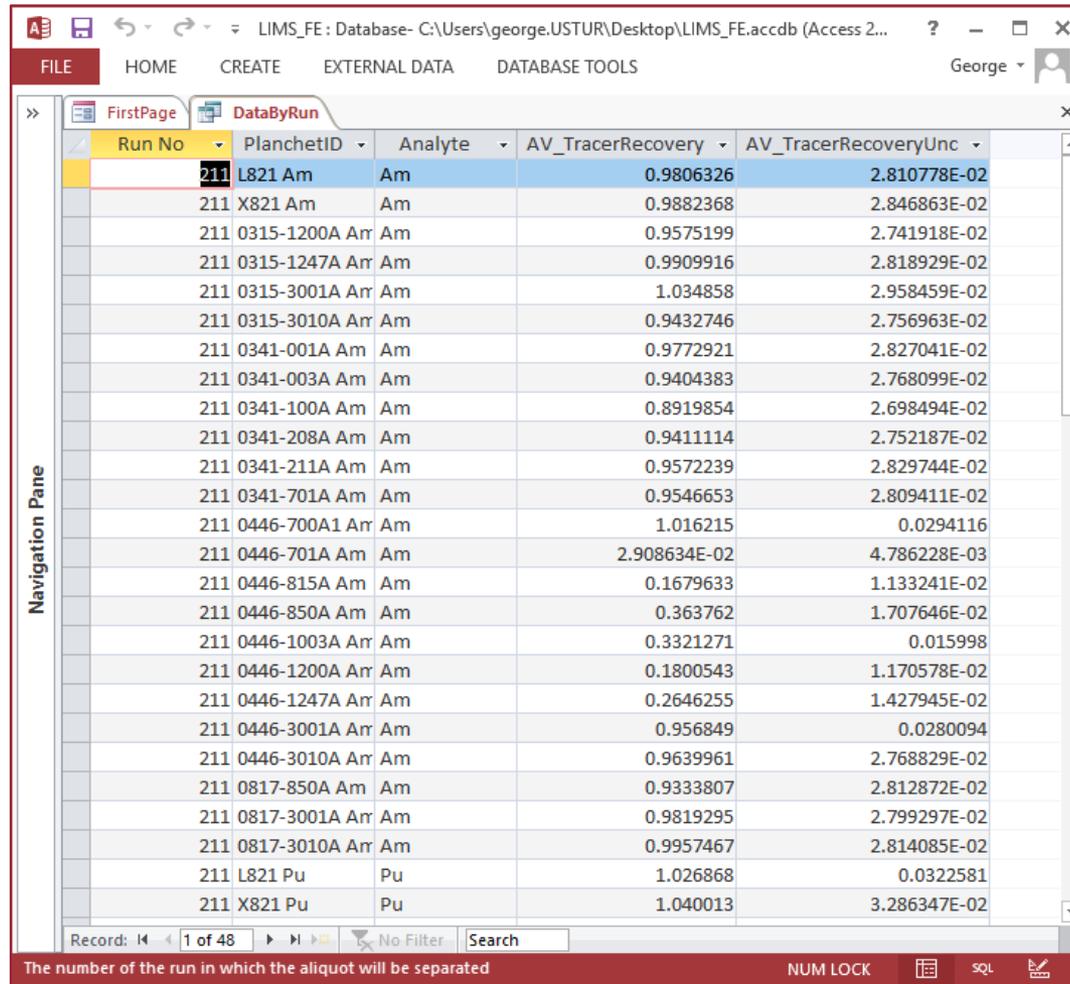
Backlog Report

Donation	Analyte	Case	Collection Date	Backlog			Counted
				Frozen	In Process	Total	
PB	Pu		2017	28	51	79	0
			2017	68	0	68	6
			2017	14	49	63	0
			2018	74	0	74	0
			2018	14	37	51	0
Totals for analyte within donation type				198	137	335	6
PB	U		1995	19	0	19	5
			1995	11	0	11	6
			1993	23	0	23	5
			1999	14	0	14	5
Totals for analyte within donation type			4	67	0	67	21
<u>Total backlog for donation type</u>			9	265	137	402	27
WB	Am		2008	106	0	106	47
Totals for analyte within donation type			1	106	0	106	47
WB	Pu		2008	7	87	94	56
			2014	105	0	105	40
			2006	94	0	94	32
			2008	91	0	91	70



Radiochemistry Database: *Chemical Recovery*

- Tracking chemical recoveries for individual run



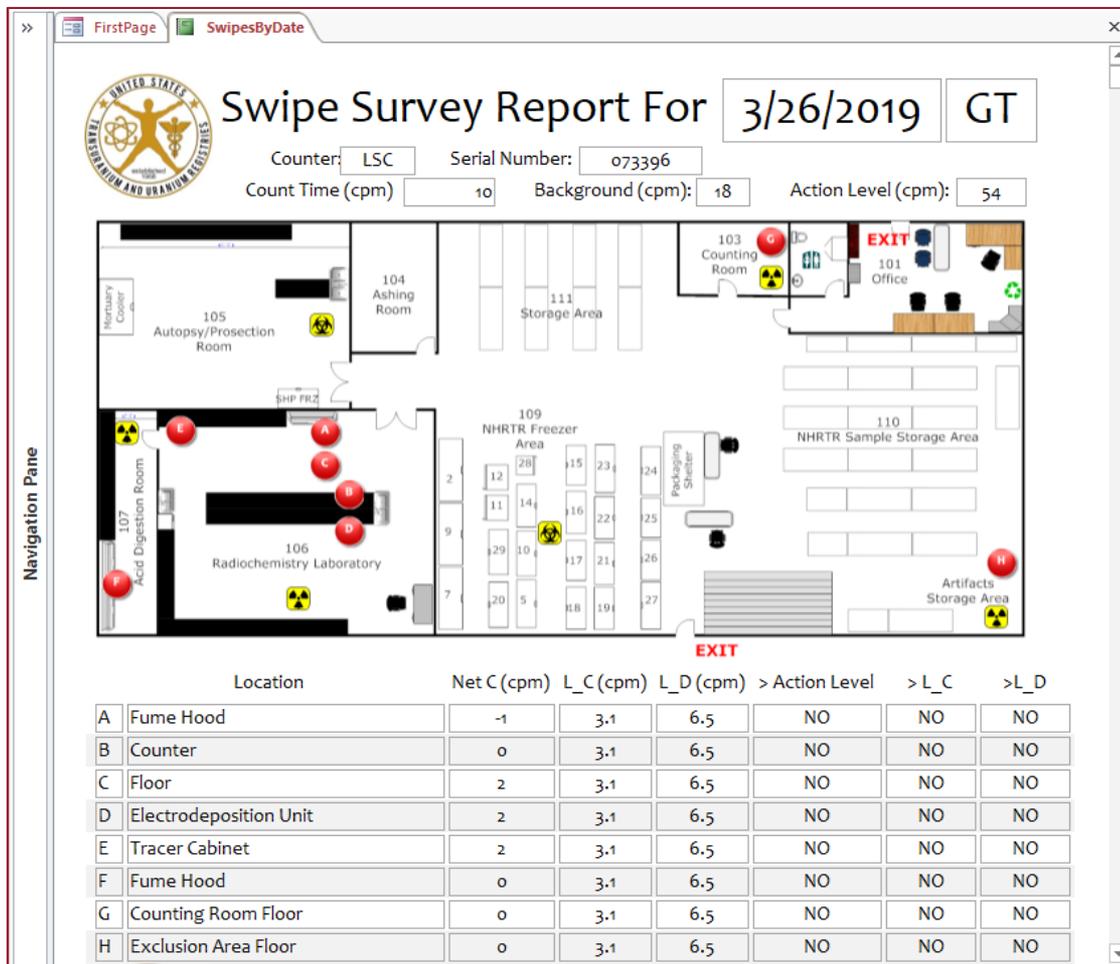
The screenshot displays a software interface for a radiochemistry database. The main window shows a table with columns for Run No, PlanchetID, Analyte, AV_TracerRecovery, and AV_TracerRecoveryUnc. The first row is highlighted in yellow, showing Run No 211, PlanchetID L821 Am, Analyte Am, AV_TracerRecovery 0.9806326, and AV_TracerRecoveryUnc 2.810778E-02. The table contains 48 rows of data. The interface includes a navigation pane on the left, a record count of 1 of 48, and a search bar at the bottom. The status bar at the bottom indicates 'The number of the run in which the aliquot will be separated' and 'NUM LOCK'.

Run No	PlanchetID	Analyte	AV_TracerRecovery	AV_TracerRecoveryUnc
211	L821 Am	Am	0.9806326	2.810778E-02
211	X821 Am	Am	0.9882368	2.846863E-02
211	0315-1200A Am	Am	0.9575199	2.741918E-02
211	0315-1247A Am	Am	0.9909916	2.818929E-02
211	0315-3001A Am	Am	1.034858	2.958459E-02
211	0315-3010A Am	Am	0.9432746	2.756963E-02
211	0341-001A Am	Am	0.9772921	2.827041E-02
211	0341-003A Am	Am	0.9404383	2.768099E-02
211	0341-100A Am	Am	0.8919854	2.698494E-02
211	0341-208A Am	Am	0.9411114	2.752187E-02
211	0341-211A Am	Am	0.9572239	2.829744E-02
211	0341-701A Am	Am	0.9546653	2.809411E-02
211	0446-700A1 Am	Am	1.016215	0.0294116
211	0446-701A Am	Am	2.908634E-02	4.786228E-03
211	0446-815A Am	Am	0.1679633	1.133241E-02
211	0446-850A Am	Am	0.363762	1.707646E-02
211	0446-1003A Am	Am	0.3321271	0.015998
211	0446-1200A Am	Am	0.1800543	1.170578E-02
211	0446-1247A Am	Am	0.2646255	1.427945E-02
211	0446-3001A Am	Am	0.956849	0.0280094
211	0446-3010A Am	Am	0.9639961	2.768829E-02
211	0817-850A Am	Am	0.9333807	2.812872E-02
211	0817-3001A Am	Am	0.9819295	2.799297E-02
211	0817-3010A Am	Am	0.9957467	2.814085E-02
211	L821 Pu	Pu	1.026868	0.0322581
211	X821 Pu	Pu	1.040013	3.286347E-02



Radiochemistry Database: *Swipe Reports*

- Laboratory swipe survey results





Thank you for your attention!

QUESTIONS?

