2025 USTUR Scientific Advisory Committee Meeting

Hampton Inn, Richland, Washington; April 9–10, 2025

Radiochemistry Laboratory Operations

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"Learning from Plutonium and Uranium Workers"
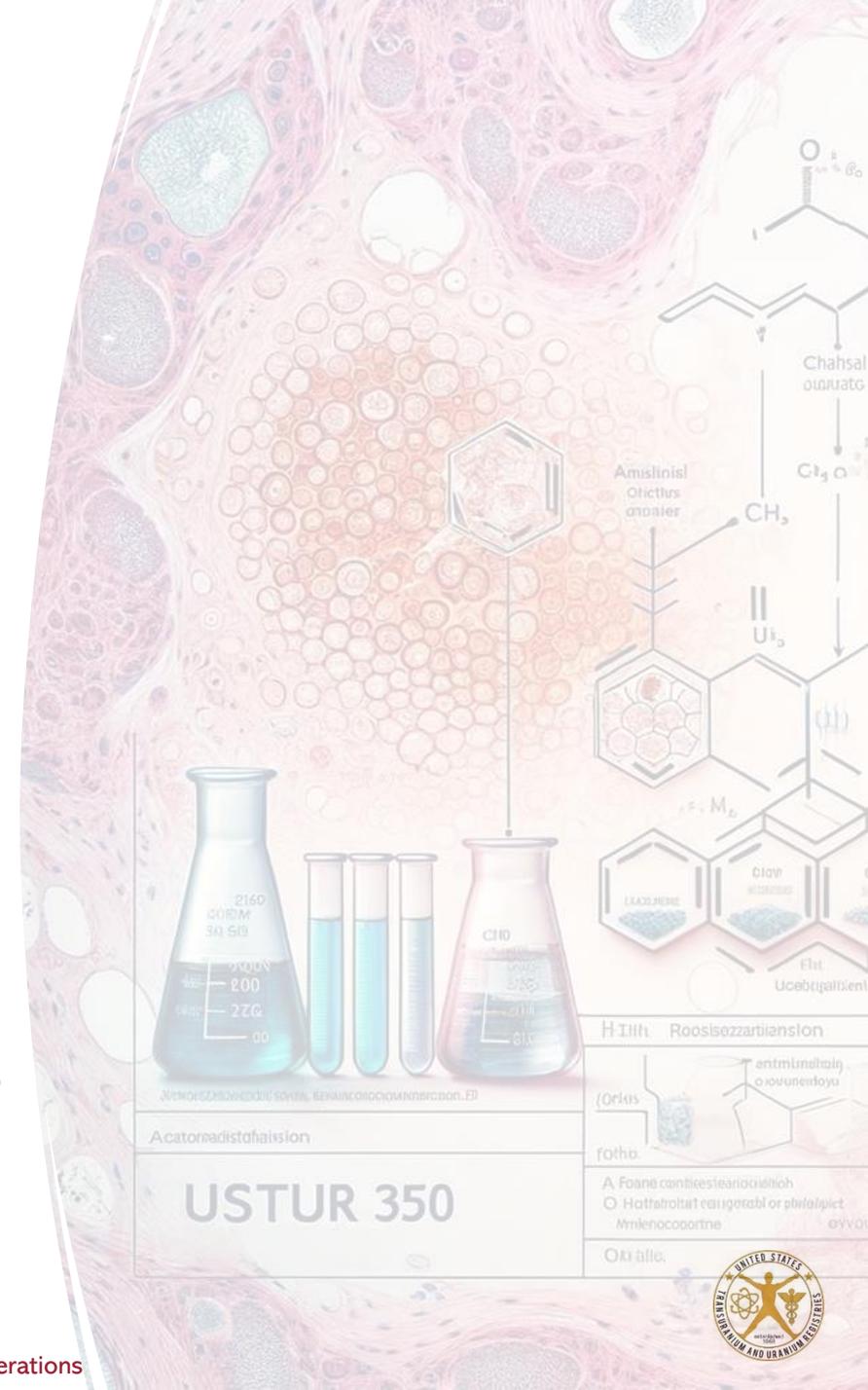
Outline

FY2025 progress

- DQO implementation

- Tissue analyses

- Case analyses

- Status summary
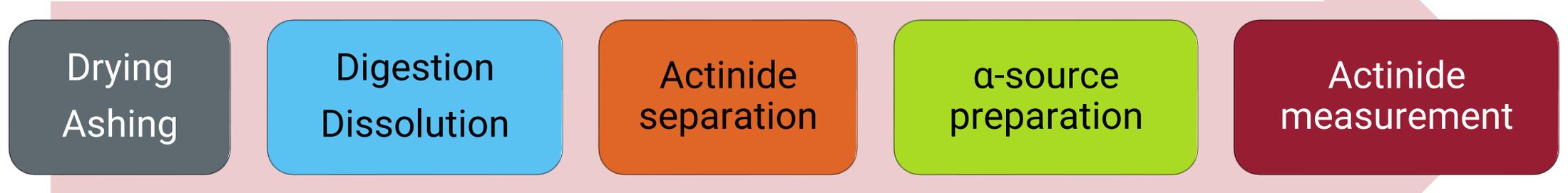
Tissue sample backlog

- FY2026 analysis strategy

- Completion of tissue sample analyses

Facility and equipment

- Expanding analytical/measurement capabilities

- Improving tissue sample preparation

Flowchart of Tissue Analysis Protocol

DQO Implementation
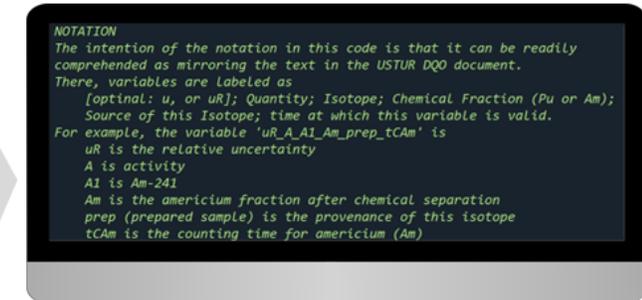
USTUR Python code "URpy" was developed

- DQO document equations implemented into a Python code
- The DQO document was revised to serve as the software specification for the URpy code
- Uncertainties were propagated throughout entire USTUR radiochemistry process

Verification and validation of USTUR cases

- Existing cases were used to validate the code

What's next?

- Reanalyze all cases with URpy
- Compare new and old analysis results
- Apply data QA/QC steps within the code

```
NOTATION
The intention of the notation in this code is that it can be readily
comprehended as mirroring the text in the USTUR DQO document.
There, variables are labeled as
    [optinal: u, or uR]; Quantity; Isotope; Chemical Fraction (Pu or Am);
    Source of this Isotope; time at which this variable is valid.
For example, the variable 'uR_A_A1_Am_prep_tCAm' is
    uR is the relative uncertainty
    A is activity
    A1 is Am-241
    Am is the americium fraction after chemical separation
    prep (prepared sample) is the provenance of this isotope
    tCAm is the counting time for americium (Am)
```

$$A_{\text{A1,Am,P1inP2tr}}(t_{\text{C,Am}})$$
$$= C_{\text{P1,P2tr}}(t_{\text{ref,P2}})V'_{\text{P2tr}}\frac{\lambda_{\text{A1}}}{\lambda_{\text{A1}} - \lambda_{\text{P1}}}\left(e^{-\lambda_{\text{P1}}(t_{\text{sep}} - t_{\text{ref,P2}})}\right.$$
$$\left. - e^{-\lambda_{\text{A1}}(t_{\text{sep}} - t_{\text{ref,P2}})}\right)e^{-\lambda_{\text{A1}}(t_{\text{C,Am}} - t_{\text{sep}})}$$

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Case and Tissue Analyses

- Tissue samples analyzed from one whole- and one partial-body donation

$$13 + 38 = 51$$

■ Bone   ■ Soft tissue

- Case and tissue analysis summary

Cases analyzed

	FY2021	FY2022	FY2023	FY2024	FY2025
	1	2	4	1	2

Tissues analyzed

	FY2021	FY2022	FY2023	FY2024	FY2025
	40	99	116	46	51

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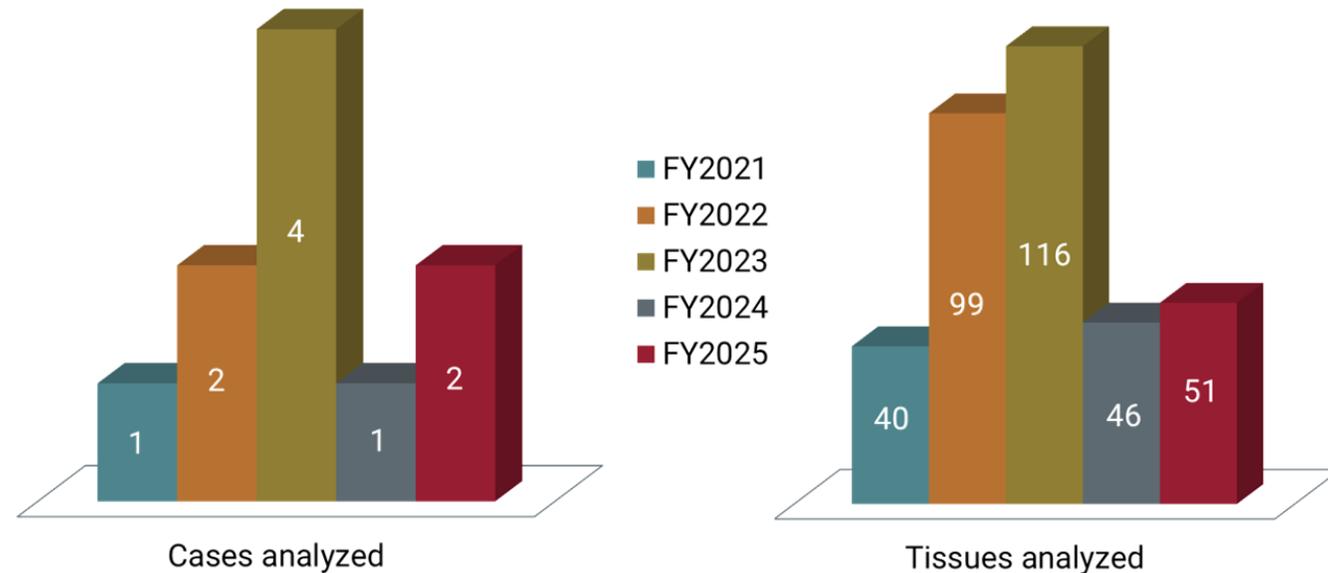
Case Analysis Progress: Whole-body

- One new whole-body donation, Case 0409, received in FY2025
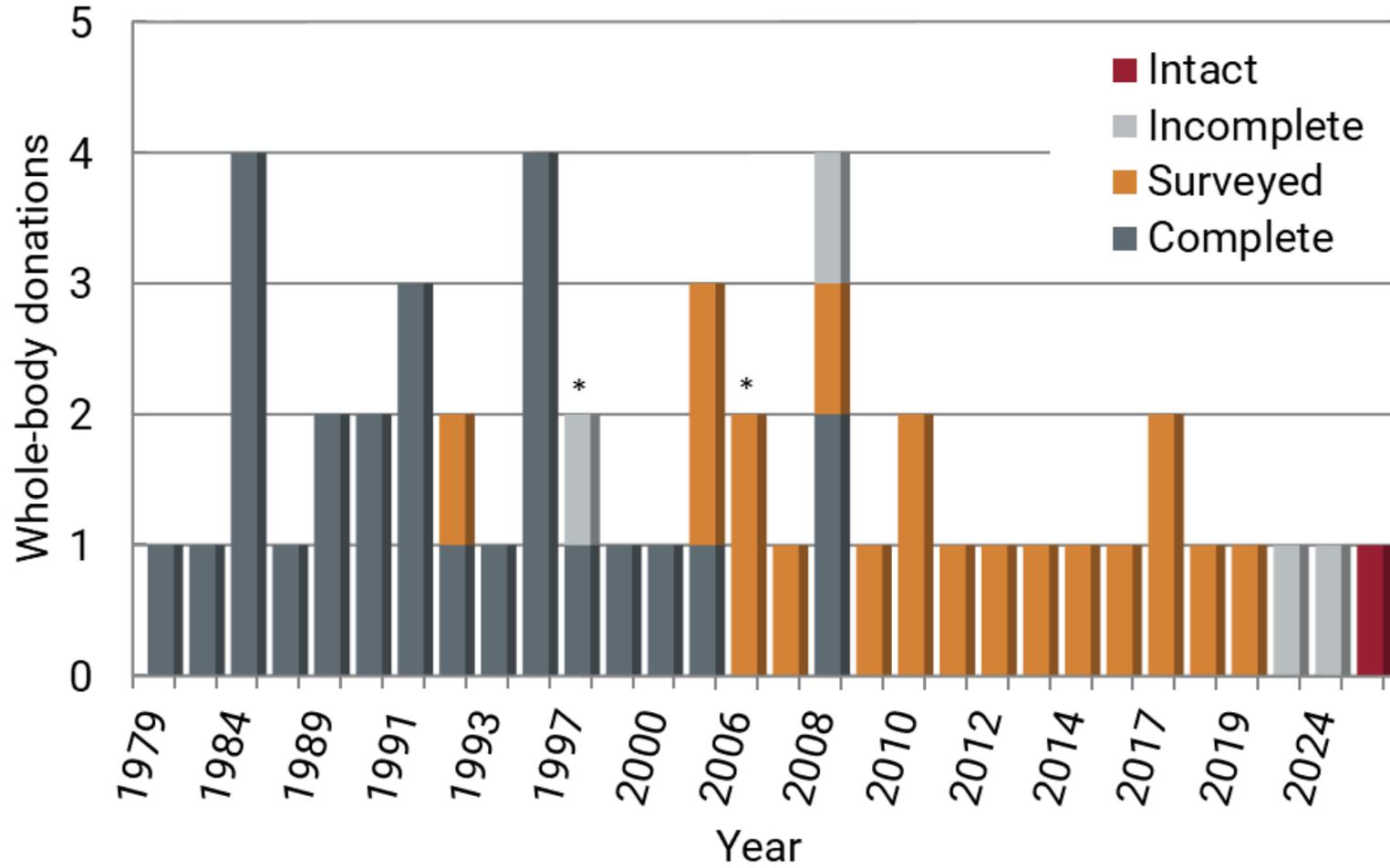- Intact → Incomplete: 0763 (2024)
- Intact → Incomplete: 0802 (2022)

4/1/2023: 49

2 (4%)   2 (4%)
26 (53%)   19 (39%)

4/1/2024: 49+1

1 (2%)   4 (8%)
26 (52%)   19 (38%)

■ Intact ■ Incomplete ■ Surveyed ■ Complete

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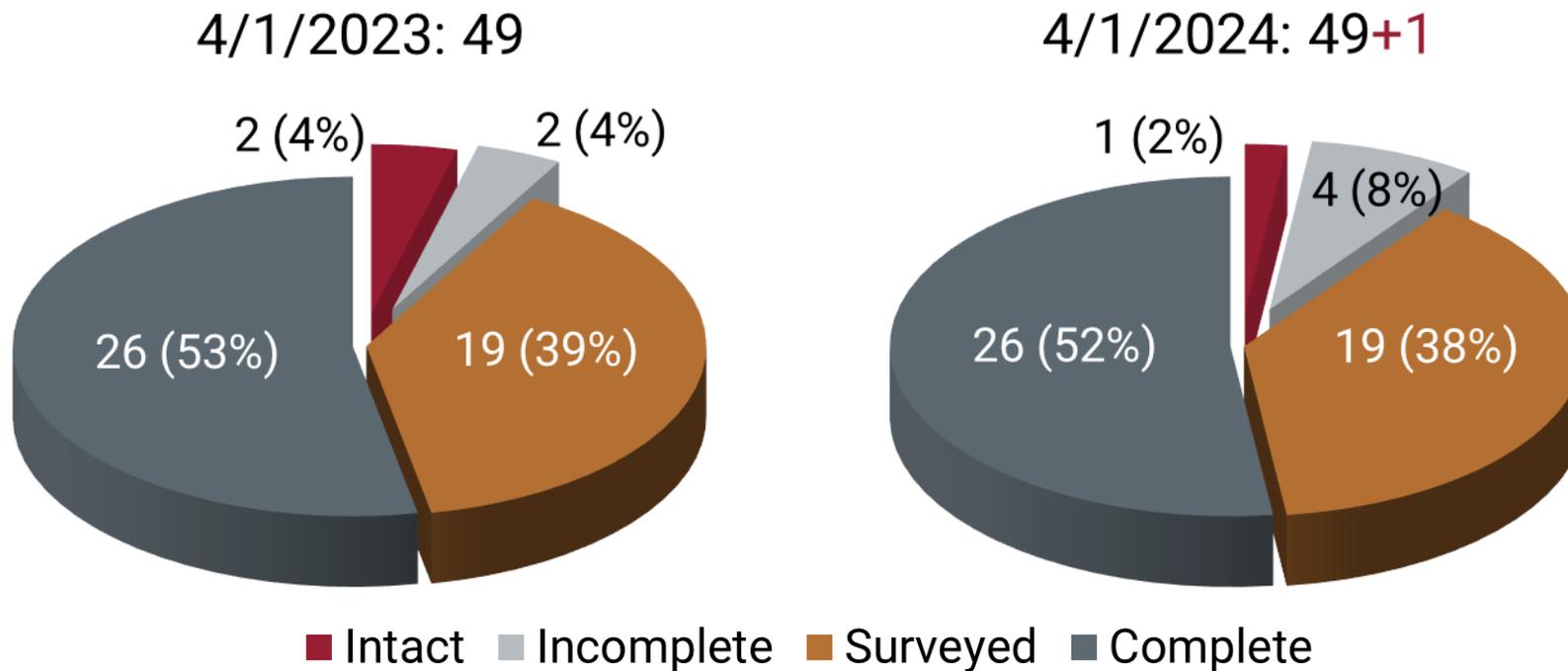
Case Analysis Progress: Partial-body

- No new partial-body donations received in FY2025

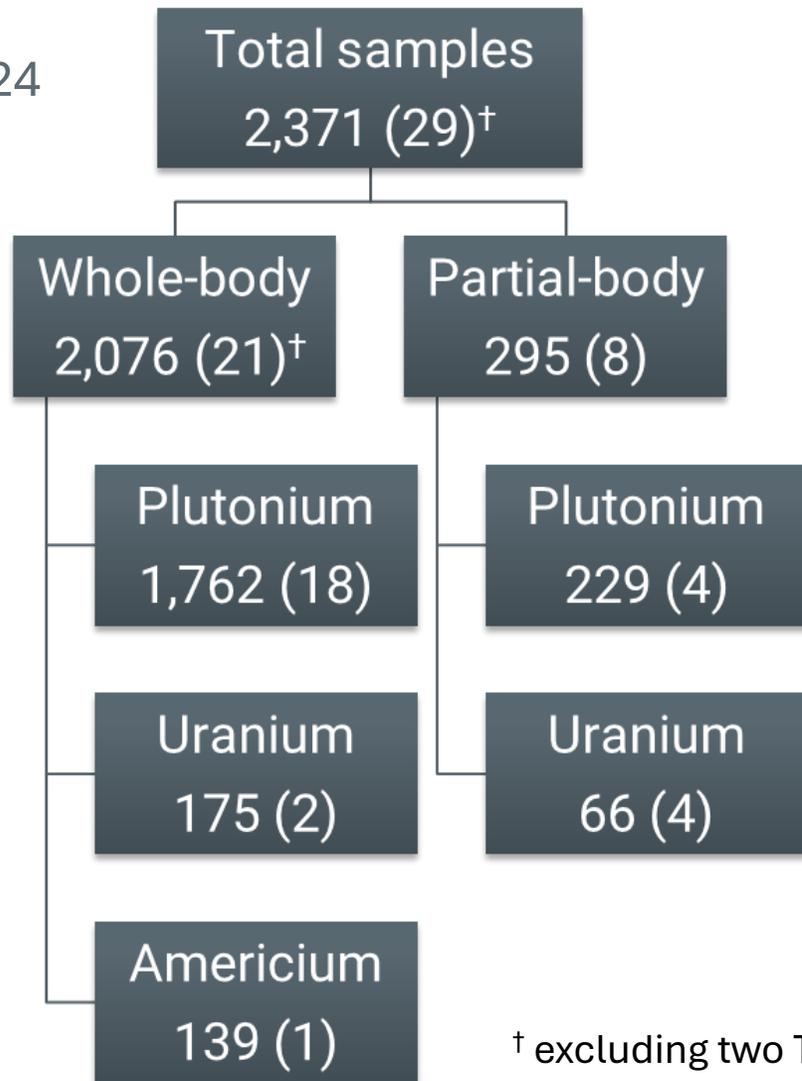- Incomplete → Complete: 0718 (2021)

- Intact → Incomplete: 0398 (2023)

4/1/2024: 319

2 (0.6%)   6 (1.9%)

311 (97.5%)

4/1/2025: 319

1 (0.3%)   6 (1.9%)

312 (97.8%)

■ Intact   ■ Incomplete   ■ Complete
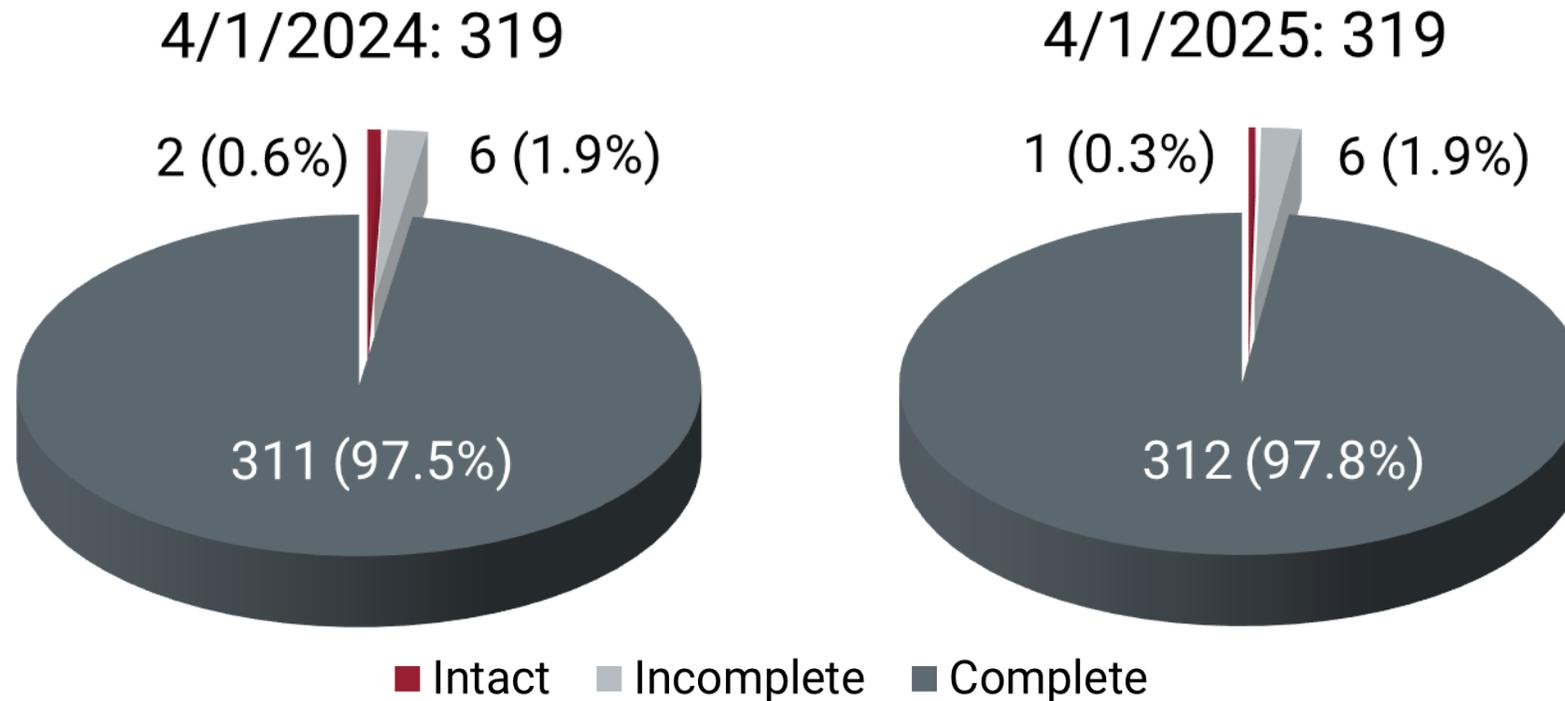
Case Status Summary: Whole-body

Case Status Summary: Partial-body

Tissue Sample Backlog

4/1/2024

Total samples
2,371 (29)[†]

Whole-body
2,076 (21)[†]

Partial-body
295 (8)

Plutonium
1,762 (18)

Plutonium
229 (4)

Uranium
175 (2)

Uranium
66 (4)

Americium
139 (1)

4/1/2025

Total samples
2,491 (29)[†]

Whole-body
2,254 (22)[†]

Partial-body
237 (7)

Plutonium
1,951 (19)

Plutonium
171 (3)

Uranium
175 (2)

Uranium
66 (4)

Americium
128 (1)
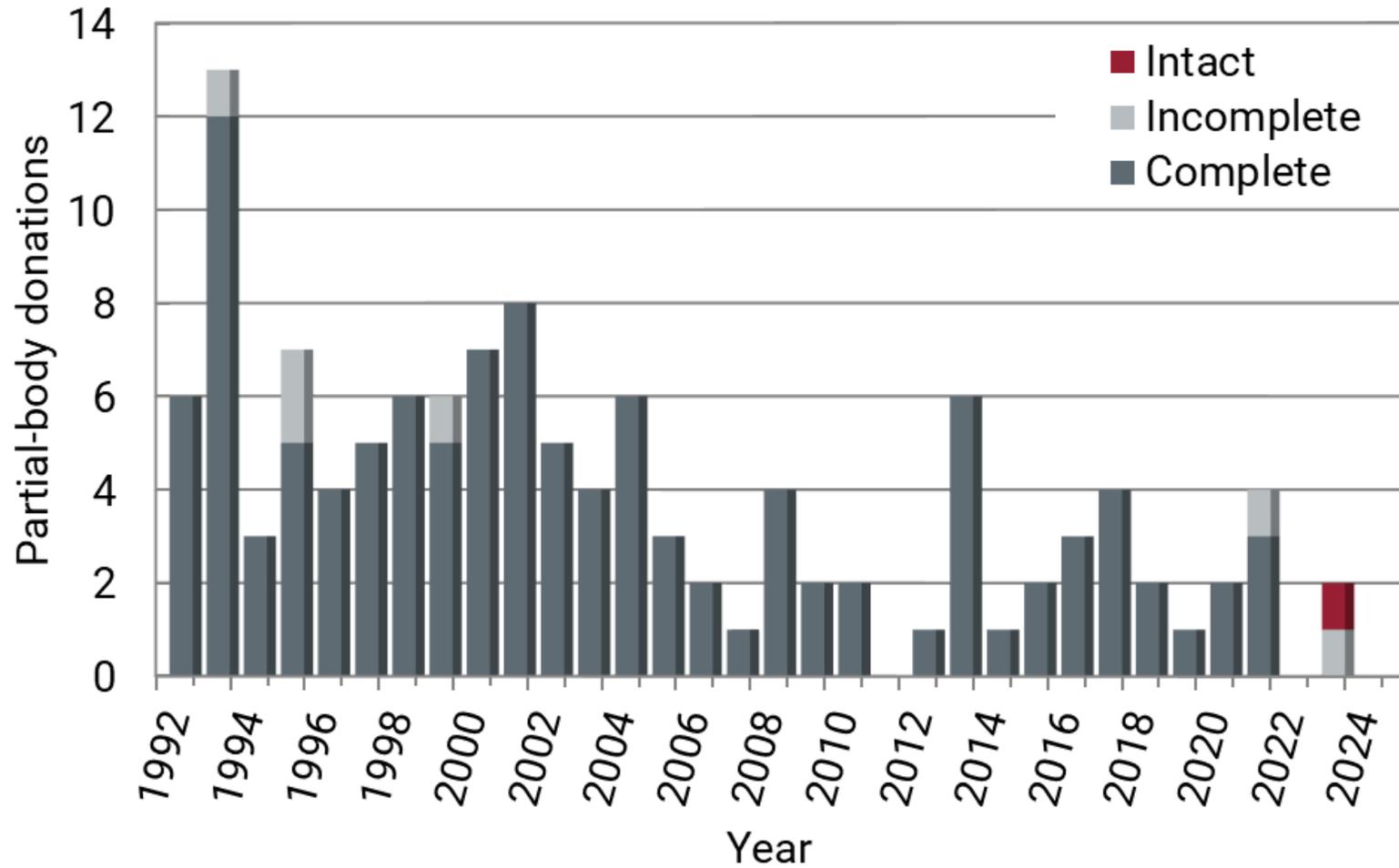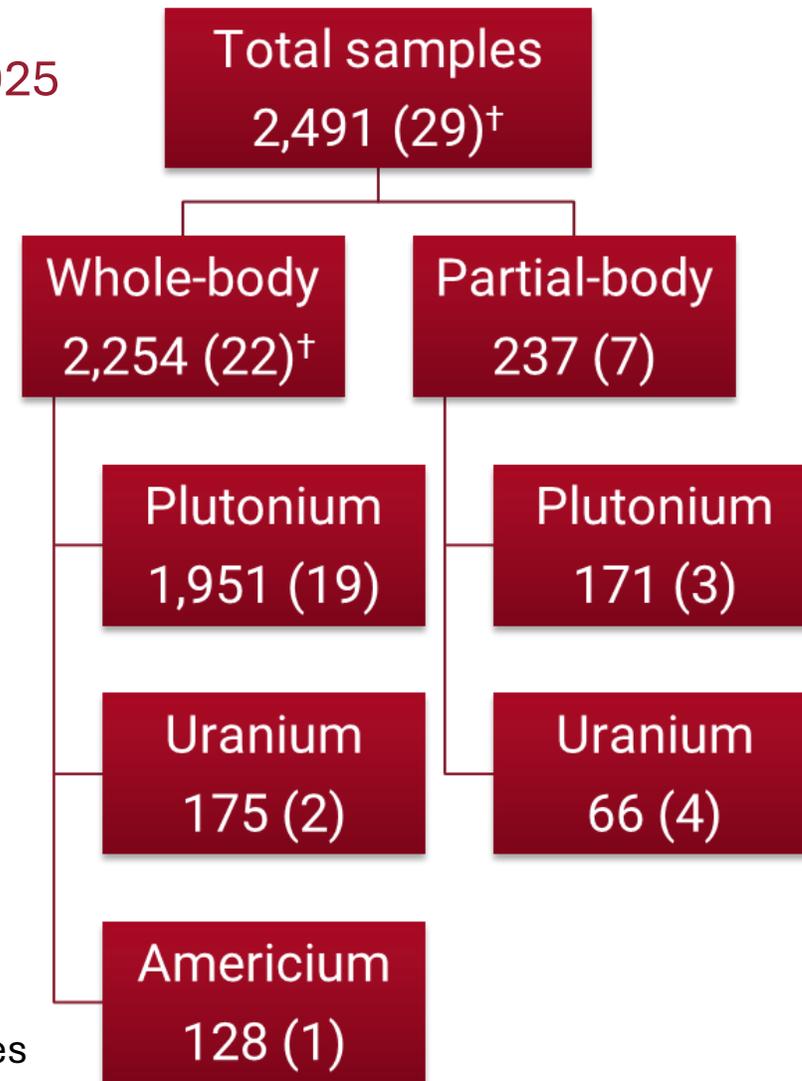
† excluding two Thorotrast cases

FY2026 Analysis Strategy

- Tissue analysis throughput: 600
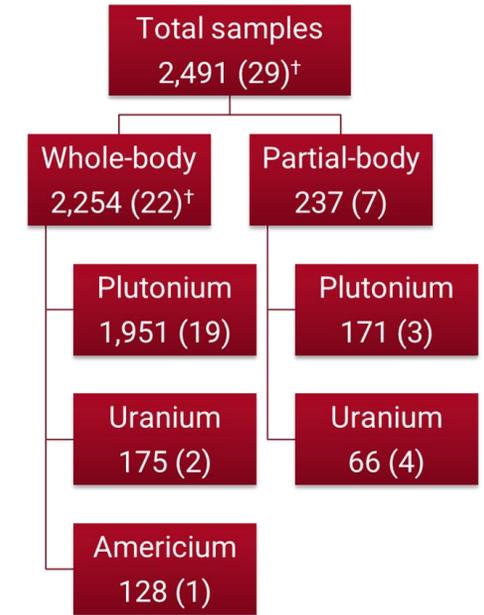
- From new donations: 140

- Tissue sample backlog: ≤460

Cases   Samples

Registrant donations

Expected → 1 — 35, 3 — 105 → 140

Previous → 3 — 226, 7 — 230 → 456

→ 596

0802[1], 0763[1], 0846
0398, 0605, 0288,
1015[2], 1024[2], 1025[2], 1059[2]
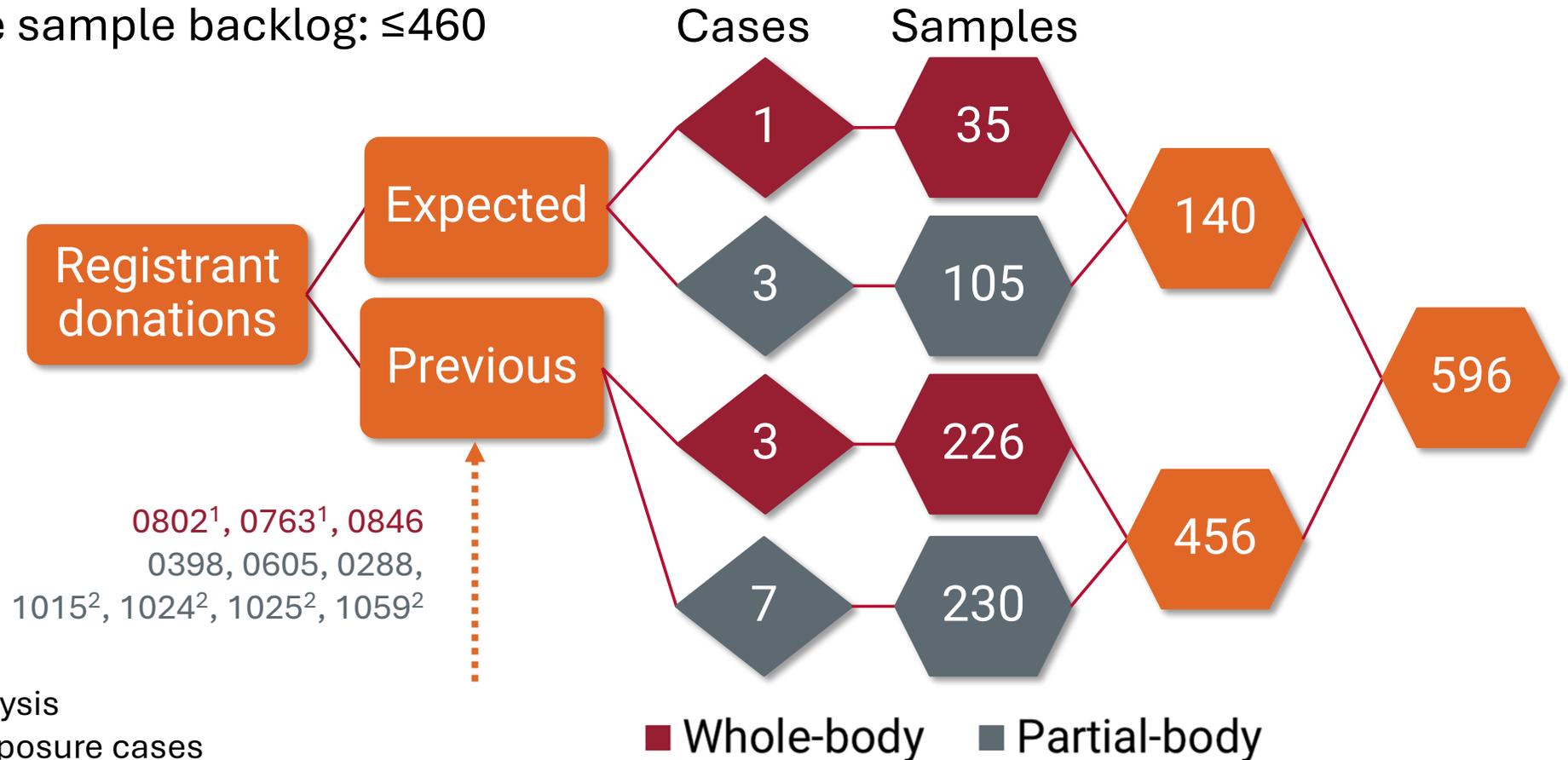
[1] survey analysis
[2] uranium exposure cases

■ Whole-body   ■ Partial-body

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Tissue Sample Analyses Timeline

- Current sample backlog   2,491
- Sample analysis throughout   600
- Expected samples to be analyzed

Whole-body × samples $2 \times 150 = 300$
Partial-body × samples $13 \times 35 = 455$

- Total tissue samples   3,246
- Time to complete $3{,}246/600 = 5.5$ years

Total samples
2,491 (29)[†]

Whole-body
2,254 (22)[†]

Partial-body
237 (7)

Plutonium
1,951 (19)

Plutonium
171 (3)

Uranium
175 (2)

Uranium
66 (4)

Americium
128 (1)

☐FY2026   ■FY2027   ■FY2028   ■FY2029   ■FY2030   ■FY2031

| 2,491 | 2,201 | 1,911 | 1,471 | 1,031 | 521 |

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%
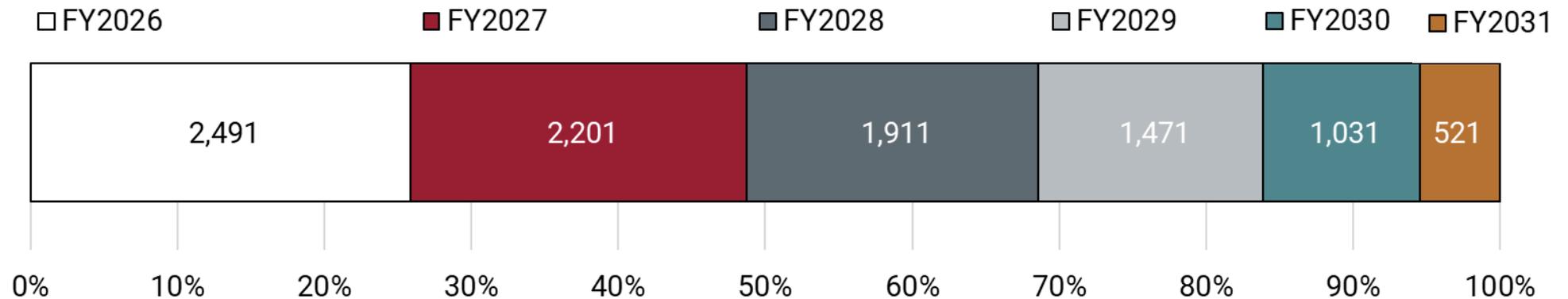
Laboratories Facility Maintenance

Radiation contamination survey by USTUR personnel (quarterly)

Radioactive waste disposal by the WSU RSO (quarterly)

HVAC system general maintenance by a certified contractor (quarterly)

Hazardous (acid) waste disposal by the WSU EH&S (biannually)

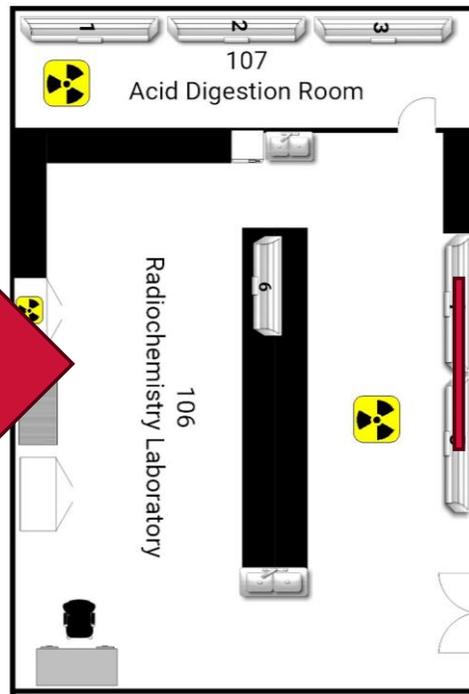Medical waste disposal by a certified contractor (biannually)

Fire safety inspections by a certified contractor (annually)

Equipment Upgrades: Airflow (Problem)

- Inadequate airflow, after two additional fume hoods installation in FY2024
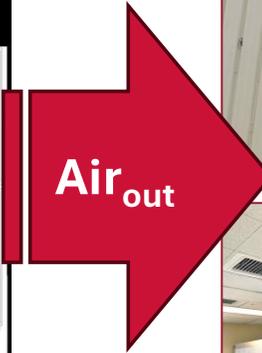
Equipment Upgrades: Airflow (Solution)

- Replacing the existing make-up air unit and its controls in FY2025

Before
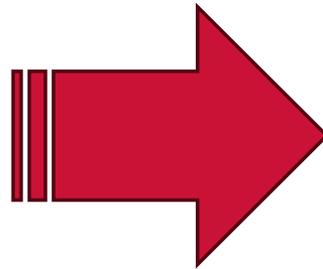
After

Equipment Upgrades: Alpha Spectrometry

Eight (8) new alpha detectors

- AMETEK/ORTEC's Alpha Ensemble®
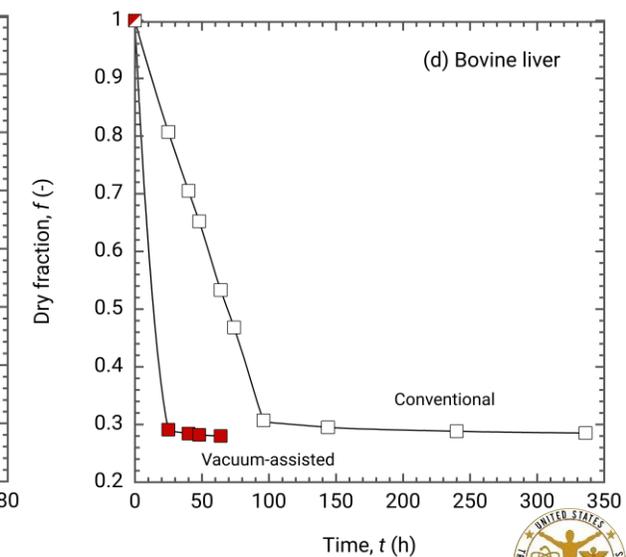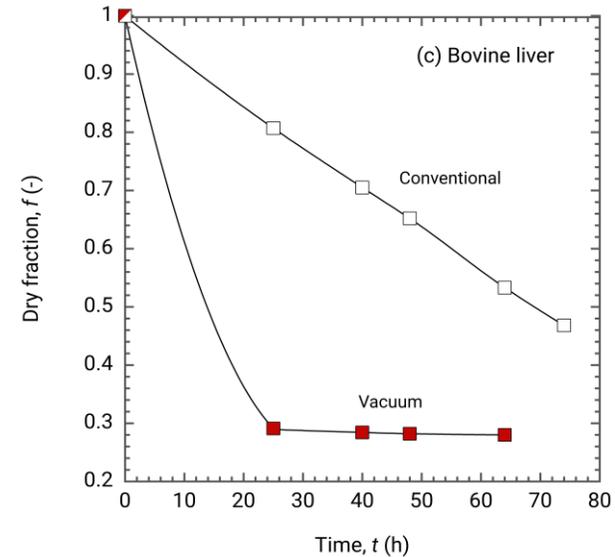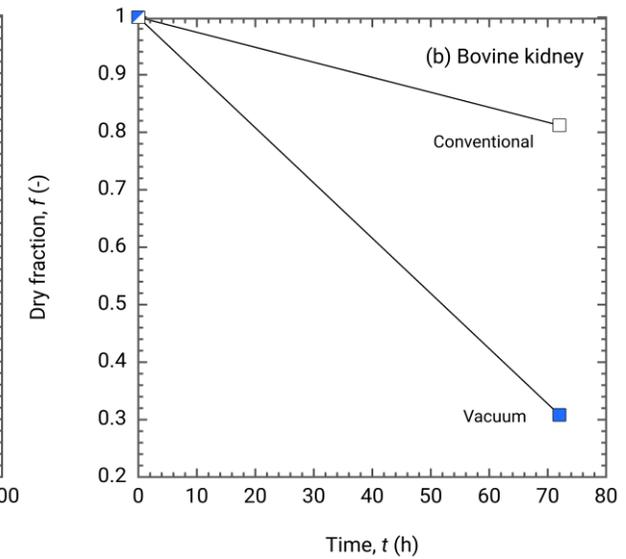
- Increased counting capacity to 48 detectors
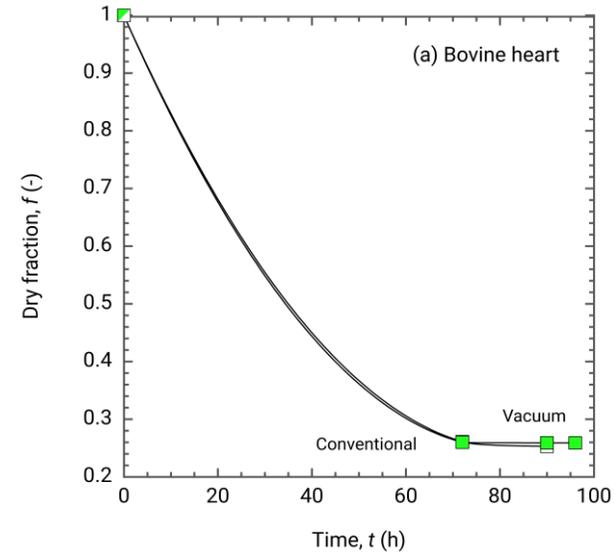
40 Am, Pu + 8 U, Th = 48
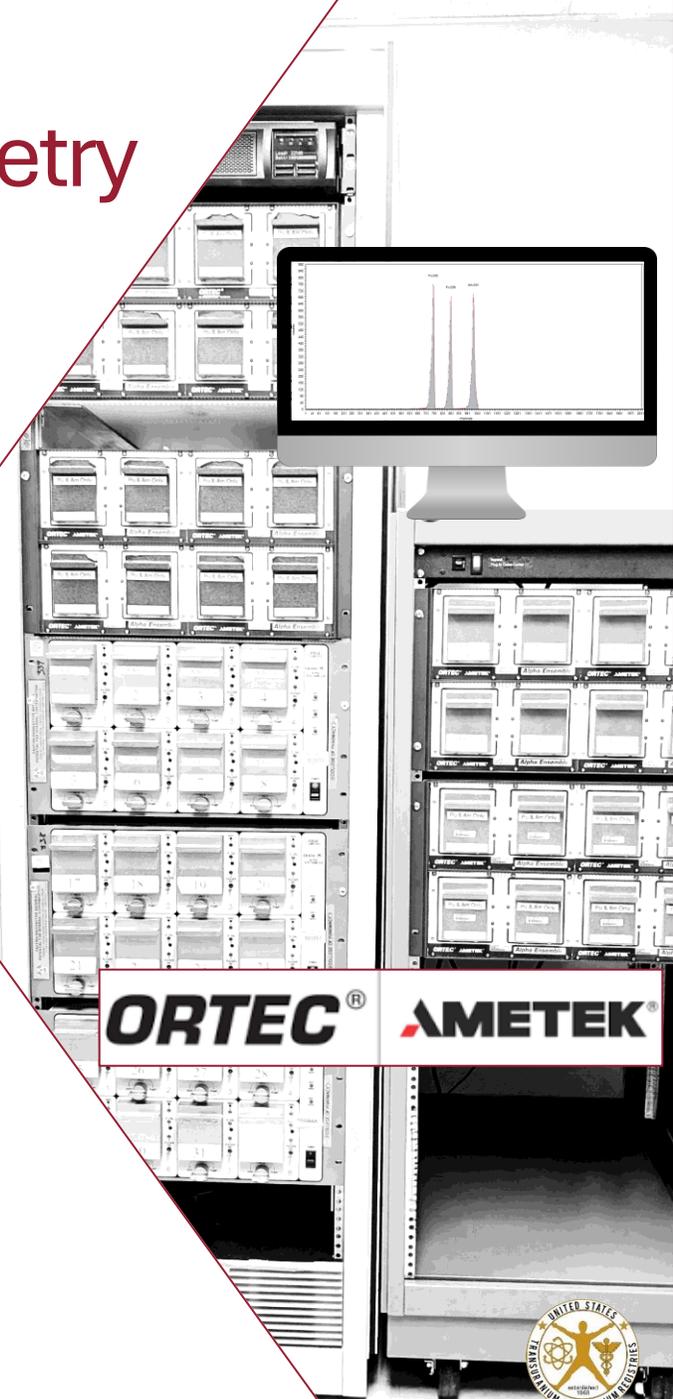
Testing Conventional and Vacuum-Assisted Drying

Comparison performed by DigiVac
- bovine heart (a)
- bovine kidney (b)
- **bovine liver** (c, d)

Conventional

Vacuum-assisted

Ashing after Conventional and Vacuum-Assisted Drying

- Conventional (left beakers) and vacuum-assisted drying (right beakers)

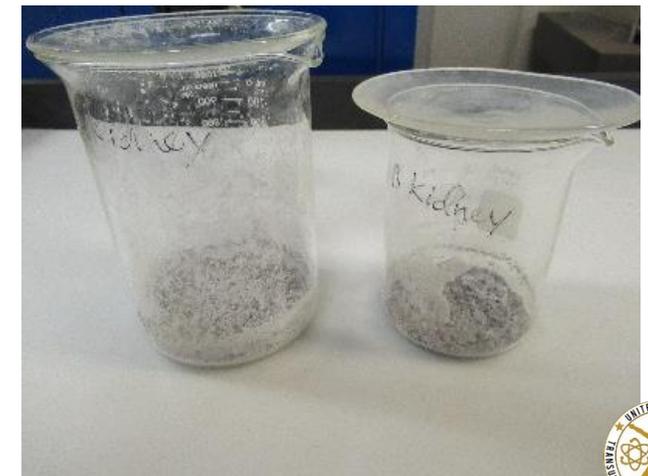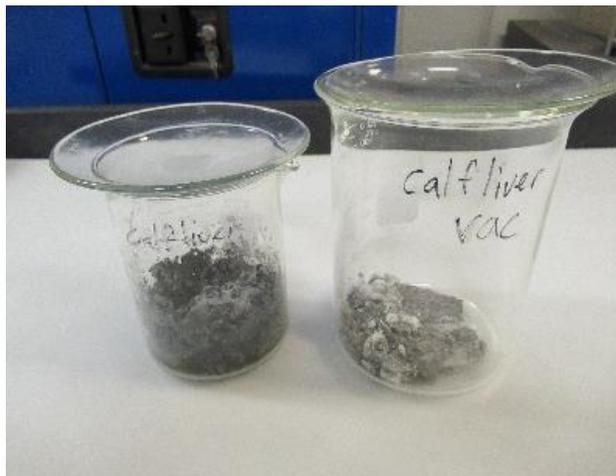# Results of Conventional and Vacuum-Assisted Drying

Tissue	Wet weight (g)		Dry weight (g)		Ash weight (g)		Ash fraction (%)	
	conventional	vacuum	conventional	vacuum	conventional	vacuum	conventional	vacuum
Liver	561.6	560.9	160.0	157.1	24.48	7.46	4.36	1.33
Heart	427.8	422.3	108.4	109.4	3.83	4.38	0.90	1.04
Kidney	461.8	498.7	375.2	115.4	4.49	4.12	0.97	0.87

- Overall, the vacuum drying produced a more uniform and cohesive sample texture resulting in a better efficiency of the ashing process

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Purchasing Vacuum-Assisted Drying Oven

- DigiVac Company: Yamato DP83C
- Drying cavity volume: 1000 L
- Operating temperature range: 40°C to 200°C
- Operating vacuum range: 760–0.05 Torr
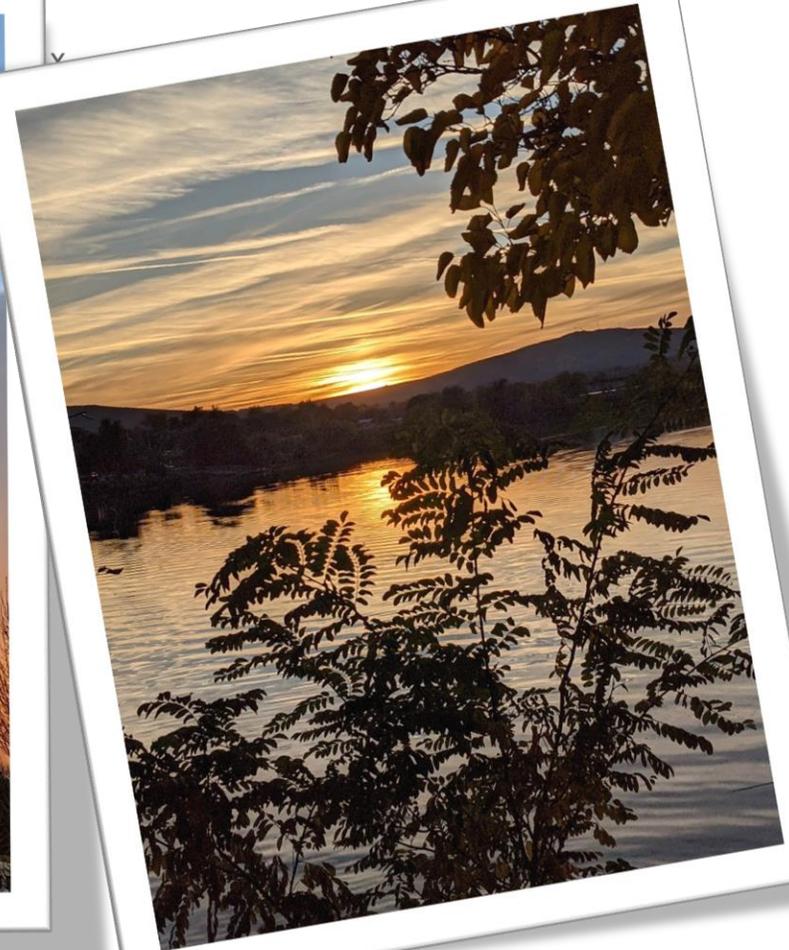
Ashing room upgrades

Doorway

Electrical

In-house testing

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QUESTIONS?

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