Emergency Method for Radiochemical Separations in Bioassay and Environmental Samples

2015-RRMC, Iowa City, IA

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WIPP LABORATORIES
Carlsbad, NM

NWP
Nuclear Waste Partnership LLC
An AECOM-led partnership with B&W and AREVA

WIPP LABORATORIES

CAPABILITIES:

- ALPHA SPECTROSCOPY
- GAS PROPORTIONAL COUNTING
- GAMMA SPECTROSCOPY
- LIQUID SCINTILLATION COUNTING
- ICP-MASS SPECTROSCOPY

MATRICES:

- URINE
- FECES
- AIR FILTERS
- WATERS
- SOILS/SEDIMENTS
- ANIMAL TISSUE
- VEGETATION
- ROCK SALT
- BRINE
- OTHERS, AS REQUESTED

PERFORMANCE EVALUATION:

- DOELAP
- NRIP ROUTINE/EMERGENCY
- MAPEP
- EPA

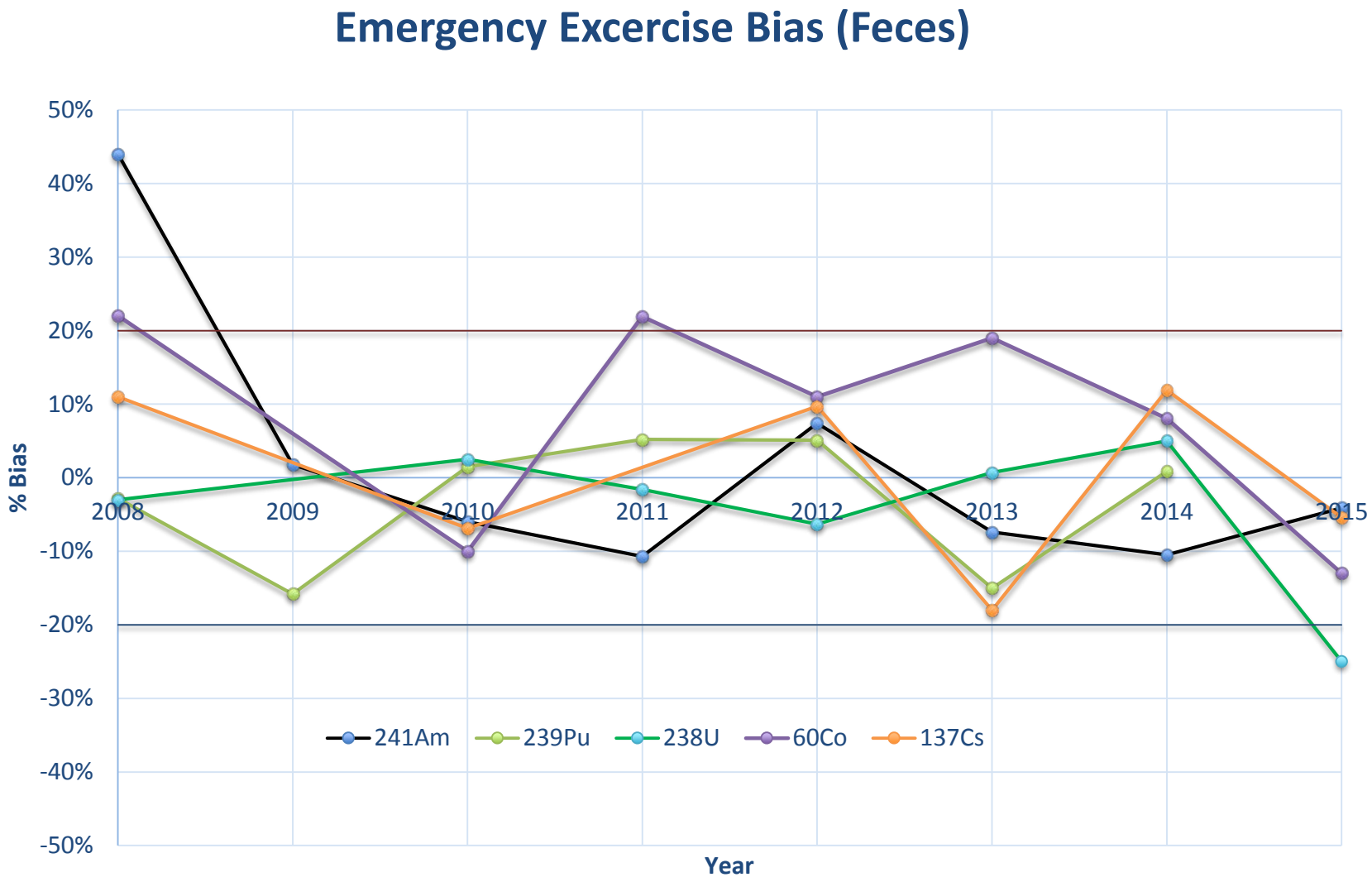
History of NRIP Emergency Samples at WIPP Labs

Year	Matrix	Measured Analyses	TAT (Destructive)	TAT (Non-Destructive)
2004	Water/Filters	Co-60,Ba-133,Cs-137, Eu-152	NA	<8 hours
2005	Filters	Mn-54, Zn-65, Cs-137, Gross Alpha & Beta	NA	<8 hours
2006	Soil	U-238, U-234, Pu-238, Pu-239+240, Am-241, Cs-137, Zn-65, Mn-54,	24 hours	NA
2007	Synthetic Urine	Pu-238, Pu-239, Am-241, U-238, U-234, Th-230, Sr-90, Co-60, Ba-133, Cs-237, Eu-152	9.8 hours	4 hours
2008	Synthetic Urine/ Synthetic Feces	Am-241, Cm-243, Pu-238, Pu-240, U-238, U-234, Sr-90, Co-60, Co-57, Cs-137	8.7 hours (urine) 10.5 hours (Feces)	4.2 hours
2009	Synthetic Urine/ Synthetic Feces	Am-241, Pu-238, Pu-240, Sr-90, Co-60, Co-57, Cs-137	7.5 hours (urine) 11.9 hours (Feces)	3.7 hours

History of Emergency Samples at WIPP Labs Continued

Year	Matrix	Measured Analyses	TAT (Destructive)	TAT (Non-Destructive)
2010	Synthetic Urine/ Synthetic Feces	Cm-243, Am-241, Pu-238, Pu-240, U-238, U-235, U-234, Sr-90, Co-60, Co-57, Cs-237	7.9 hours (urine) 9.8 hours (feces)	4.9 hours
2011	Synthetic Feces	Am-241, Pu-238, Pu-240, U-238, U-235, U-234, Sr-90, Mn-54, Co-60, Cs-134	8 hours	8 hours
2012	Synthetic Feces	Cm-243, Am-241, Pu-238, Pu-240, U-238, U-235, U-234, Sr-90, Co-60, Cs-137	8 hours	3.8 hours
2013	Synthetic Feces	Am-241, Pu-240, Pu-238, U-238, U-234, Sr-90, Cs-134, Co-60	7.7 hours	6.0 hours
2014	Synthetic Feces	Am-241, Pu-240, Pu-238, U-238, U-234, Sr-90, Cs-137, Co-60	8.1 hours	5.1 hours
2015	Synthetic Feces/ Synthetic Urine	Am-241, Pu-240, Pu-238, U-238, U-234, Sr-90, Cs-137, Co-60	7.8 hours (urine) 7.9 hours (feces)	2.8 hours (urine) 4.0 hours (Feces)

History of Emergency Samples at WIPP Labs



Standard Procedure for Emergency Samples at WIPP Labs

1. Aliquot tracers prior to arrival

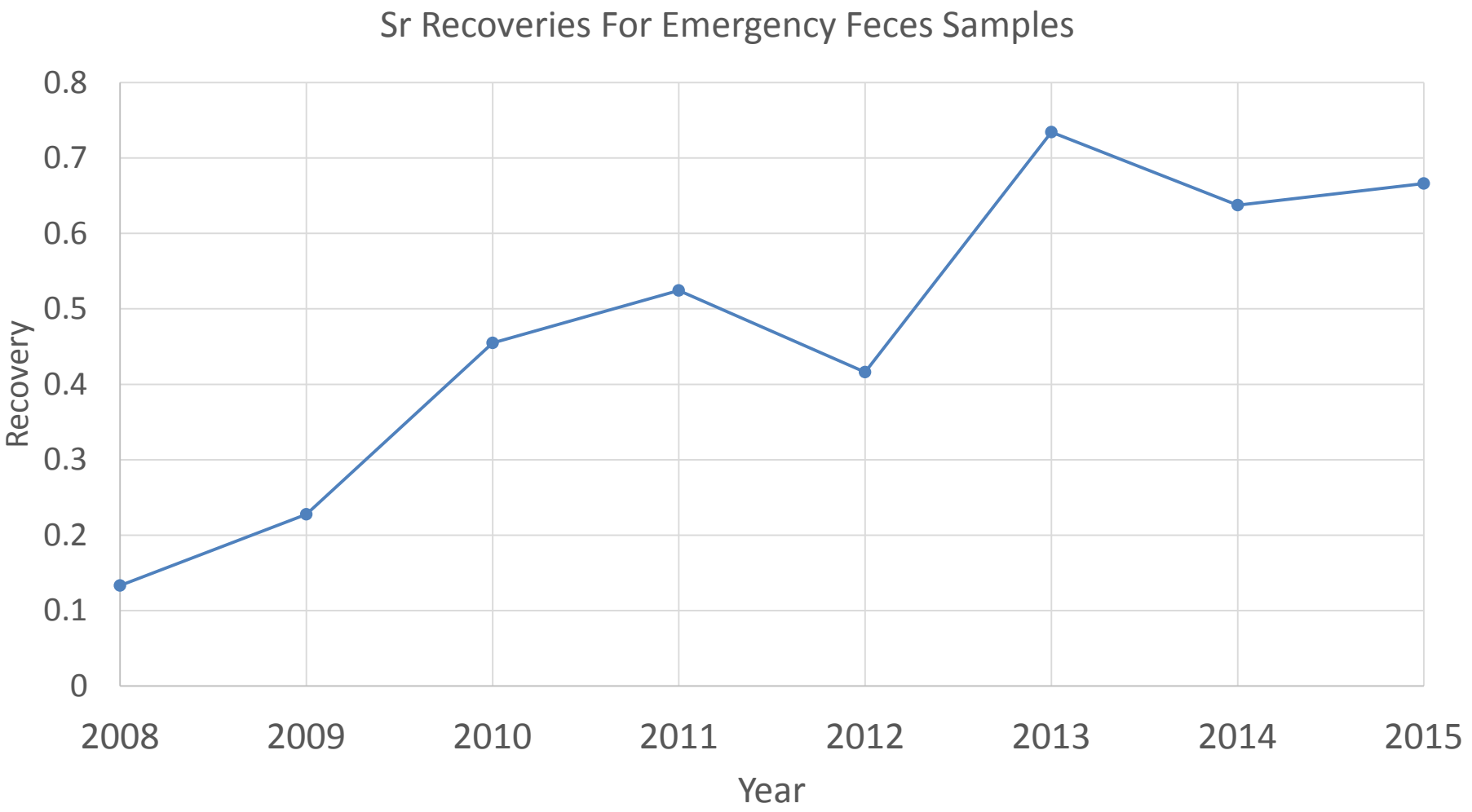
2. Rapid digestion methods

3. Standard Eichrom Vacuum Box Methods
   A. TEVA/TRU/SR column cartridge stack
   B. Double SR resin to increase Sr recoveries

4. NdF_3 micro-precipitation, utilizing vacuum box to filter multiple samples simultaneously

5. Improved back end data V+V with implementation of automated LIMS

History of Emergency Samples at WIPP Labs

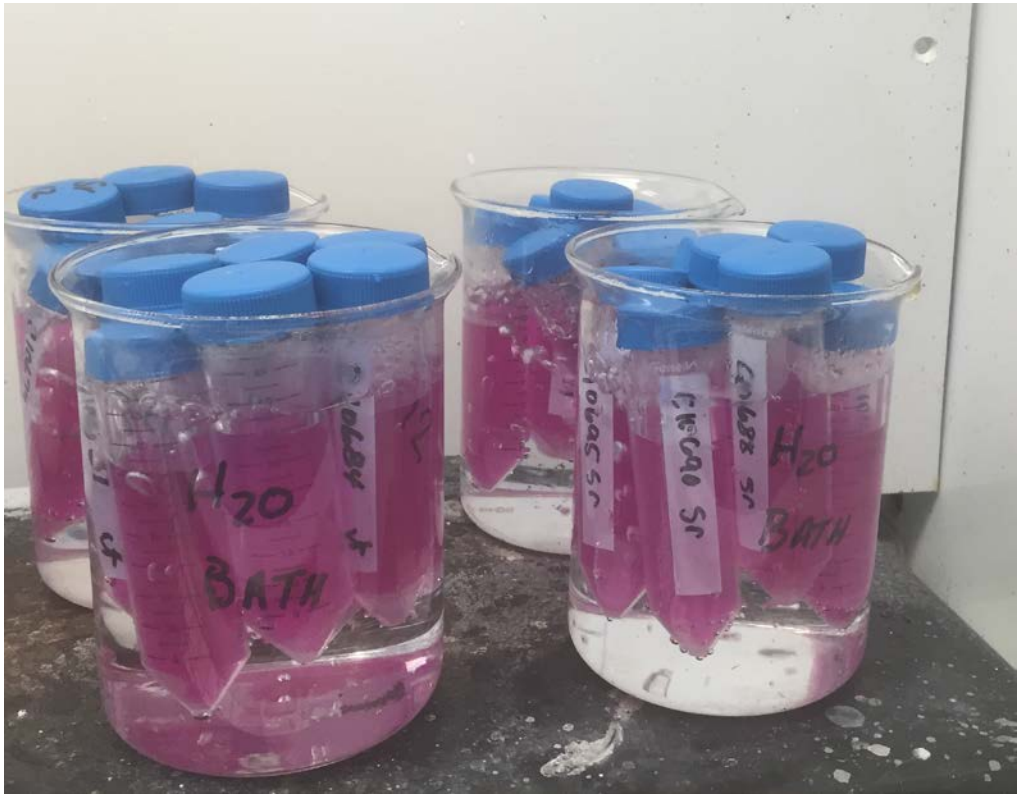


Assembly Line Processing
Sample Loading

- OXIDATION STATE ADJUSMENT
  - 1.5M SULFAMIC ACID
  - 1.5M ASCORBIC ACID
  - 5mg/mL FERRIC NITRATE
  - 3.5M SODIUM NITRITE
- LOAD COLUMNS

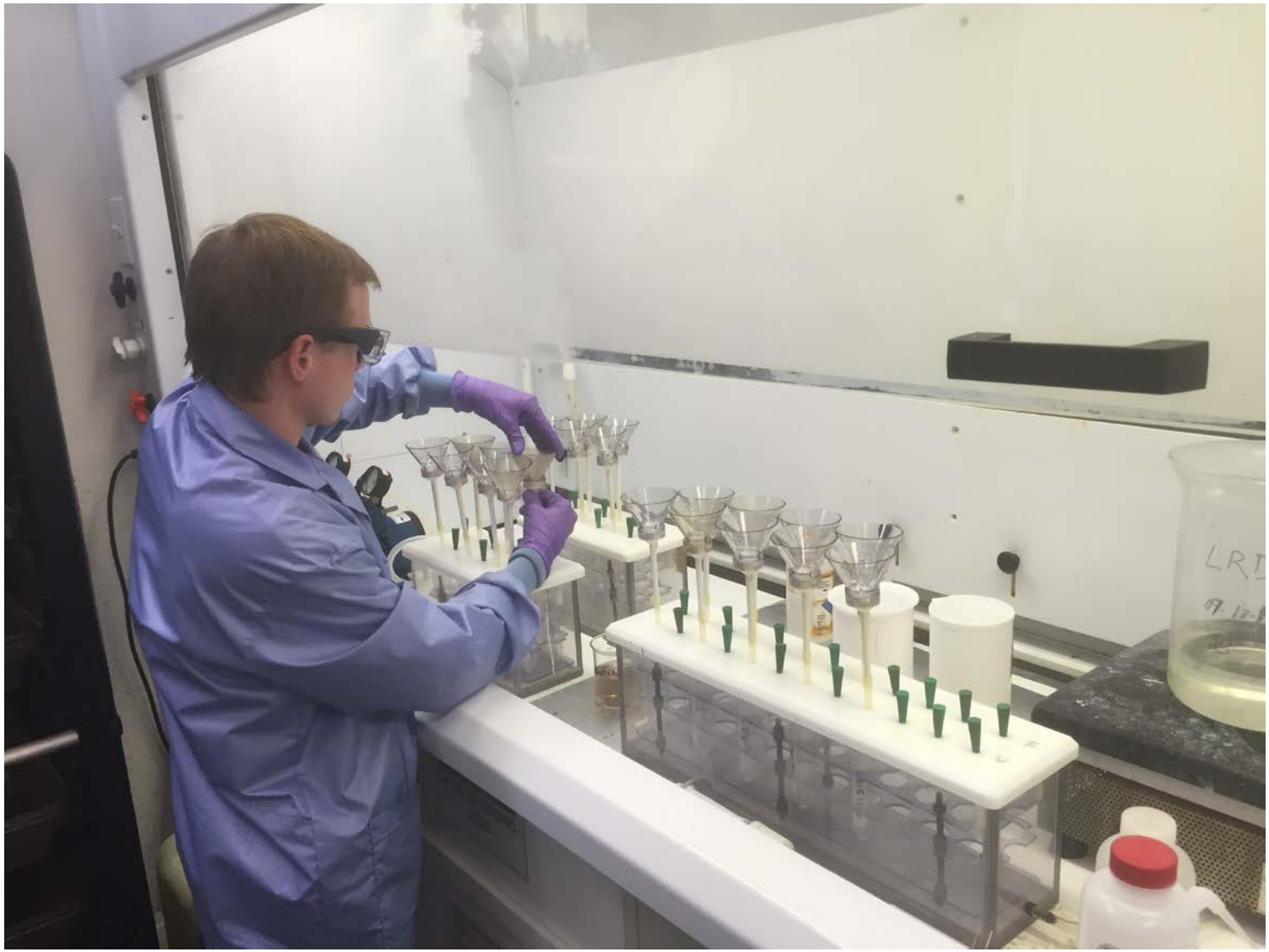
Assembly Line Processing
Split Columns

Assembly Line Processing
$SrCO_3$ Precipitation



•Double SR resin cartridge for improved Sr recoveries

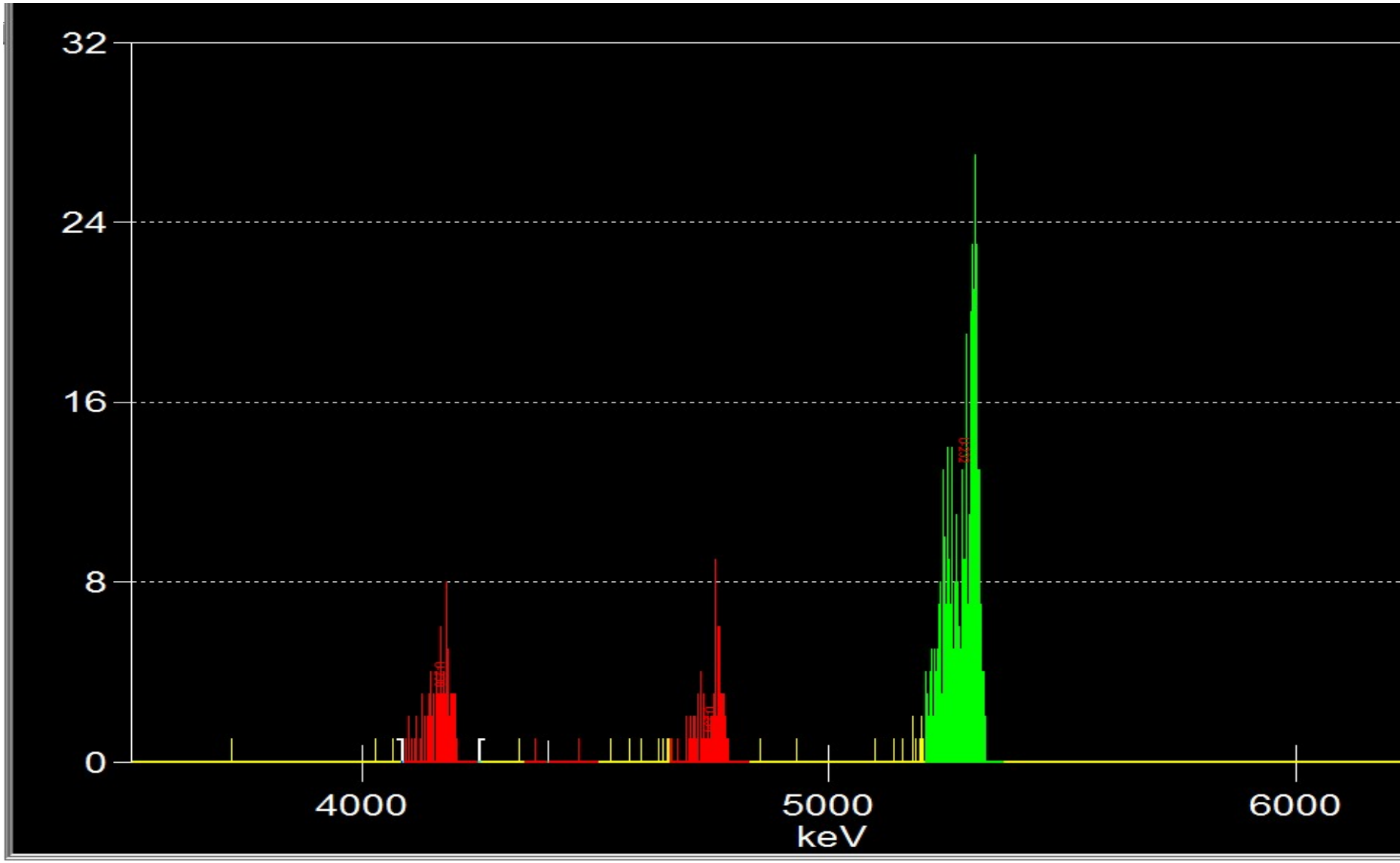
Assembly Line Processing
Rapid Micro-Filtration



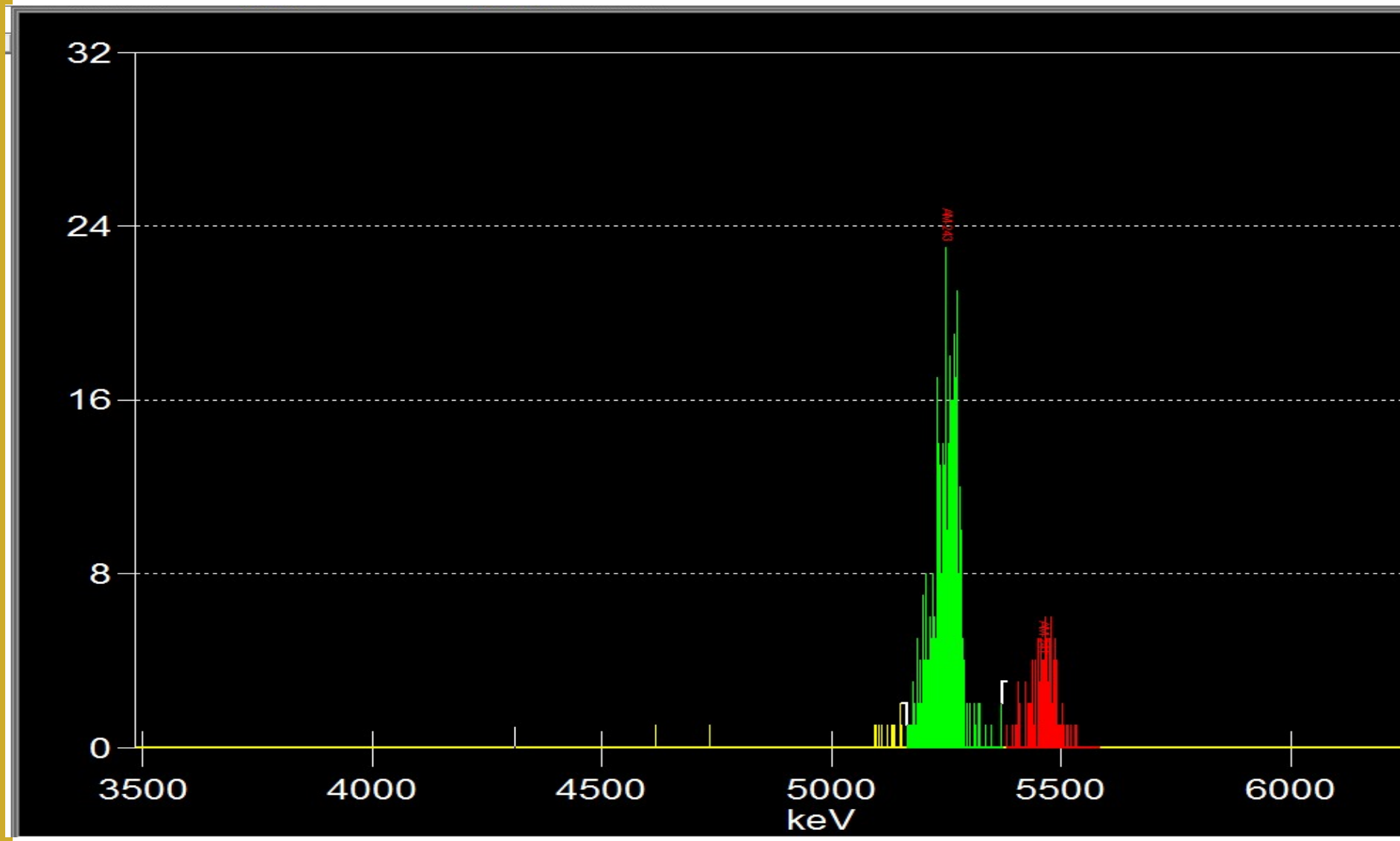
TIME BREAKDOWN
Fecal

	Pu	Am	U	Sr	Gamma
Column Prep	150	150	150	150	150
Separations	120	100	115	100	NA
Post Columning	10	10	10	60	NA
Mounting	20	20	20	30	NA
Count Time	60	60	60	30	30
Processing	60	60	60	40	20
V+V / Reporting	46	55	45	45	38
Total (min)	466	455	455	455	238
Total (Hours)	7.92	7.58	7.58	7.58	3.98
NIST Reporting Time (hrs)	7.92	7.58	7.58	7.58	3.98

URANIUM SPECTRUM

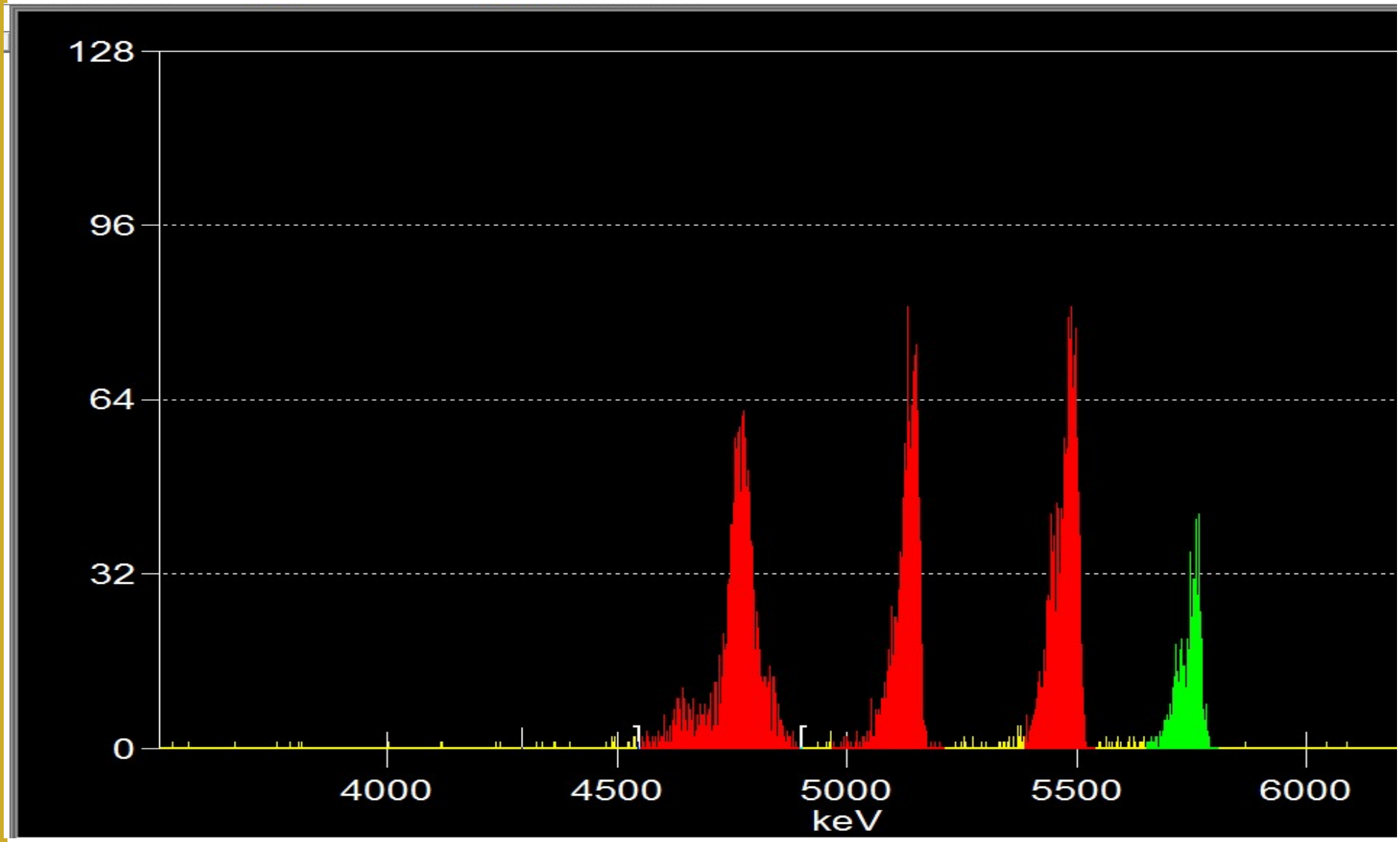


AMERICIUM SPECTRUM



PLUTONIUM SPECTRUM

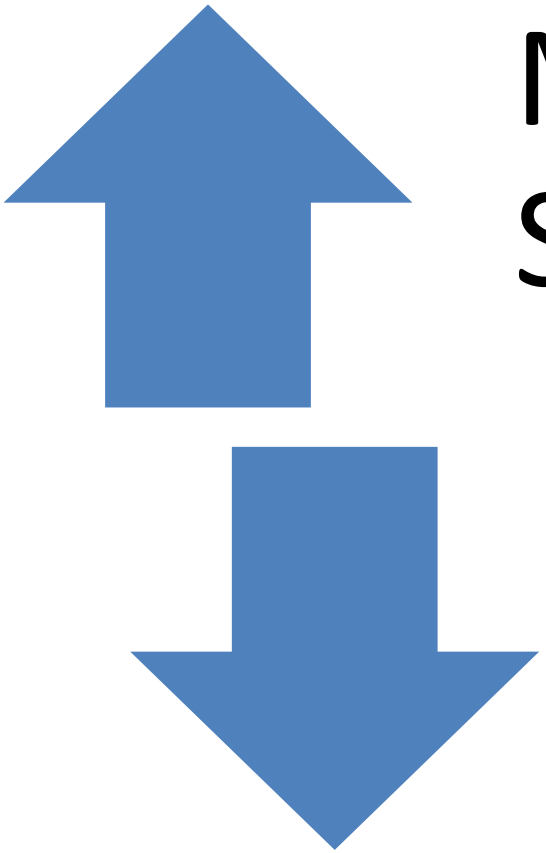
PLUTONIUM SPECTRUM
Normal TAT Urine



CURRENT & FUTURE IMPROVEMENTS

1. INCREASE (D)COUNT TIME TO DECREASE MDA 30 MINUTES TO 60 MINUTES
2. INCREASE COLUMN FLOW RATES, CUT SEPERATION TIME. PLAN TO CONDUCT FRACTIONATION STUDIES OF ELUTION PATTERNS
3. USING PU 236 TRACER FOR PU EMERGENCY SAMPLES
4. INCREASE (D) Sr RECOVERIES FOR MORE ACCURATE MEASUREMENTS DOUBLING CARTRIDGE
5. UTILIZATION OF LSA TO REDUCE INITIAL BACKGROUND
6. INCORPORATE LIMS SYSTEM TO STREAMLINE DATA PROCESSING

Application of Emergency Methods to Routine samples

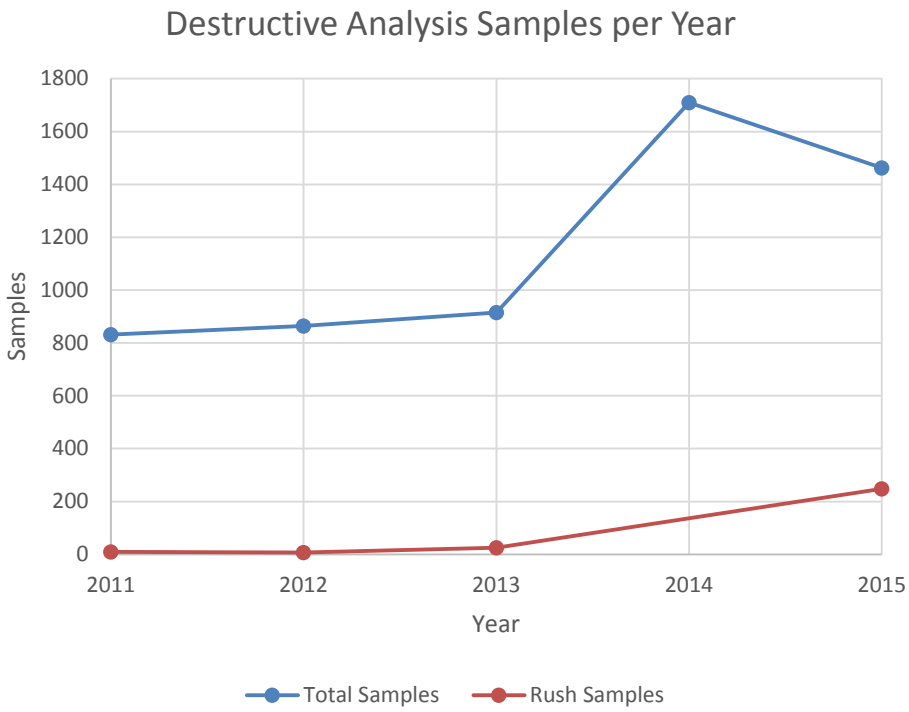


More Samples

Less Time

APPLICATION TO WIPP LABORATORIES

Year	Destructive Analysis Samples	Rush Sample Analyses
2011	832	9
2012	864	7
2013	915	25
2014	1710	N/A
2015	1170*	198*



*thru 10-1-15

- "New Normal" at WIPP Laboratories
- Apply Emergency methods to "every day" samples

New Normal

•Bioassay Monitoring Program

✓ 30 samples/quarter every year prior to February 2014

✓ 197 bioassay samples analyzed in 2014 for Pu and Am
✓ 213 samples analyzed in 2014 for Pu, Am, Sr, and Cs-137

✓ >120 samples/quarter since initial recovery requiring Pu, Am, Sr and Cs-137

New Normal

Standard Procedure for Rush Brine Samples at WIPP Labs

Communicate with Client (midday)

Aliquot tracers prior to arrival

Upon arrival (3:30PM) - Sample aliquot, precipitate, spin, prep for columns

New Normal

Standard Procedure for Rush Brine Samples at WIPP Labs

Separate through TEVA/TRU Stack, NdF_3 micro-precipitation (completed by 12:00PM day after arrival)

1000 minute overnight alpha count

Data reported to client (12:00 PM 2nd day) <48 hours after receipt

APPLICATION TO WIPP LABORATORIES

Rapid Sample Processing = Quality Data Consistently!

Analyte	Average Bioassay Tracer Recovery (2015)
Pu	95%
Am	80%
Sr	70%
U	85%

APPLICATION TO WIPP LABORATORIES

Rapid Sample Processing = Quality Data Consistently!

MAPEP Series 32 Biases				
Analyte	**Soil (%)**	**Water (%)**	**Vegetation (%)**	**Air Filter (%)**
^{238}Pu	-0.7	Sensitivity (A)	-0.9	False Pos. (A)
^{239}Pu	-2.0	-4.9	-3.4	-0.7
^{241}Am	-1.3	-10.4	-6.5	-7.5
^{90}Sr	-9.2	-2.2	0.0	-0.7
^{234}U	1.0	-3.4	6.0	-8.4
^{238}U	-5.0	-2.9	-10.2	-10.2

Conclusions

1. Trust the Data
   -Years of NRIP emergency exercise data show that the process works
   - Value in performance evaluations

2. Increased Quantity ≠ Decreased Quality

3. Adapt to the situation

ACKNOWLEGDGEMENTS

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