

# **Hanford Special Exposure Cohort Petition Evaluation Report (SEC-00155)**

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# Talking Points

- **Quick petition review**
- **Discuss Hanford's bioassay program during this time period**
  - **Focus on Super S and fecal sampling**
- **Discuss OTIB-0049**
- **Discuss application of OTIB-0049 at Hanford for cases involving fecal sampling**

# Petition Overview

- **Petition received on November 10, 2009**
- **Petitioner proposed class definition:**
  - **All personnel who were internally monitored (urine or fecal), who worked at the Plutonium Finishing Plant in the 200 Area at the Hanford Site, from January 1, 1987 through December 31, 1989**
- **May 3, 2010: Petition qualified for evaluation**
  - **Accepted petition basis: Radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed**

# Petition Overview—cont.

- **Four SEC classes previously added at Hanford:**
  1. **October 1, 1943 through August 31, 1946, for selected areas of Hanford (SEC-00057-1)**
  2. **September 1, 1946 through December 31, 1968, for selected areas of Hanford (SEC-00057-2)**
  3. **October 1, 1943 through June 30, 1972, for all areas of Hanford (this class subsumed previous two classes; SEC-00152)**
  4. **July 1, 1972 through December 31, 1983, for all areas of Hanford (SEC-00201)**

# Petition Overview—cont.

- **SEC-00057 petition requested the SEC class be continued through 1990**
  - **Advisory Board and NIOSH continue to review post 1983**
- **The timeframe associated with SEC-00155 was encompassed by SEC-00057**
- **SEC-00155 was specific and focused on data falsification and was deemed appropriate for separate review**

# Petition Overview—cont.

- **The petitioner's specific evidence of accusations by the U.S. EPA of purposeful wrong doing by US Testing (UST) resulted in NIOSH determining that issues regarding quality of bioassay data required further investigation as a separate issue from the continuing Board evaluation of SEC-00057**
- **The intent of NIOSH's separate evaluation of SEC-00155 was to ensure that issues identified with UST's non-bioassay analytical programs did not also adversely affect the company's bioassay analysis operations in Richland, WA**

# Periods of NIOSH Evaluation

- **NIOSH evaluated the time period requested by the petitioner January 1, 1987 through December 31, 1989**
- **While the location was specified as employees who worked at the Plutonium Finishing Plant, the evaluation was primarily focused on the overall program which applies to all of Hanford**

# Some Sources of Exposure: 1987-1989

- **Plutonium Finishing Plant (1987-9)**
  - Weapons grade metal production, Remote Mechanical C Line\*
  - Plutonium Reclamation Facility
  - Miscellaneous treatment system glovebox operations
  - Analytical laboratory operation
  - Development laboratory operations
  - Polycube processing (a polycube is a solid mixture of polystyrene and plutonium oxide)
- **PUREX**
  - Oxide production line was run during the early part of this time frame\*

**\*Identified at Hanford as being a potential source of insoluble plutonium with low 241Am content (fresh plutonium)**



# Personal Monitoring Data

- **Internal monitoring data**
  - **US Testing processed many thousands of bioassay samples during the period in question**
    - Urinalysis was the principal plutonium bioassay method
    - Workers deemed to have a higher risk or those involved in potential incident may also have fecal samples
    - Americium typically monitored with *in-vivo* counting methods, usually as an indicator of plutonium intake
  - **Hanford maintained an extensive area monitoring program (was not the focus of this review)**

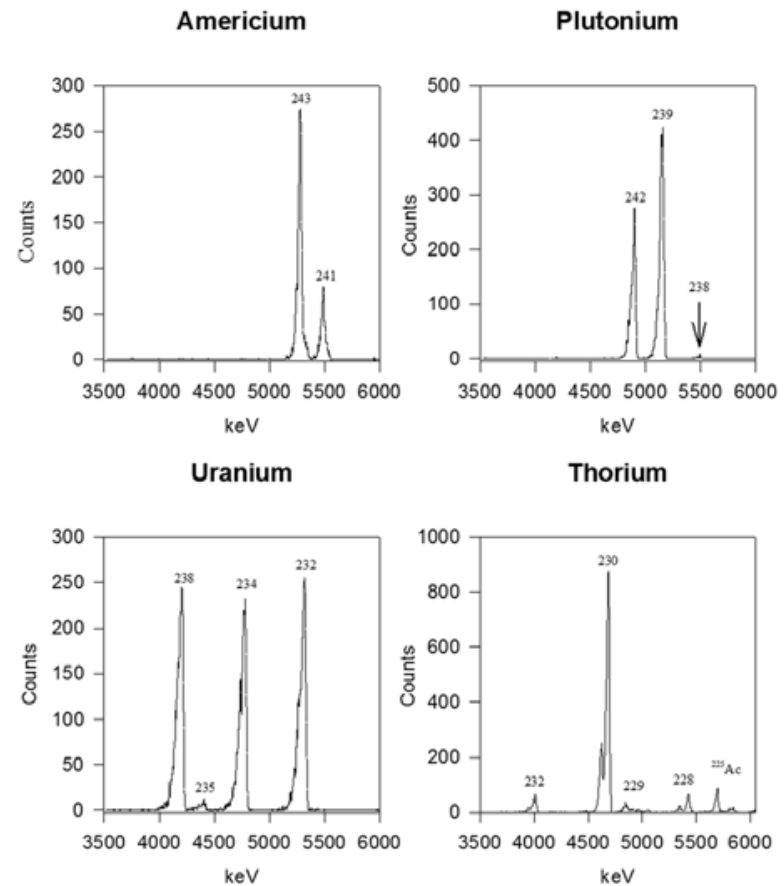
# Background

- **Pacific Northwest National Laboratories (PNNL) was responsible for overseeing the quality of the data produced by US Testing for Hanford from 1979 thru the 1991**
  - **Quality assurance program included blind bioassay samples (~250 blanks and quality control during 1987 thru 1989)**
  - **Annual reports during the time period of interest were reviewed by NIOSH as part of this evaluation**

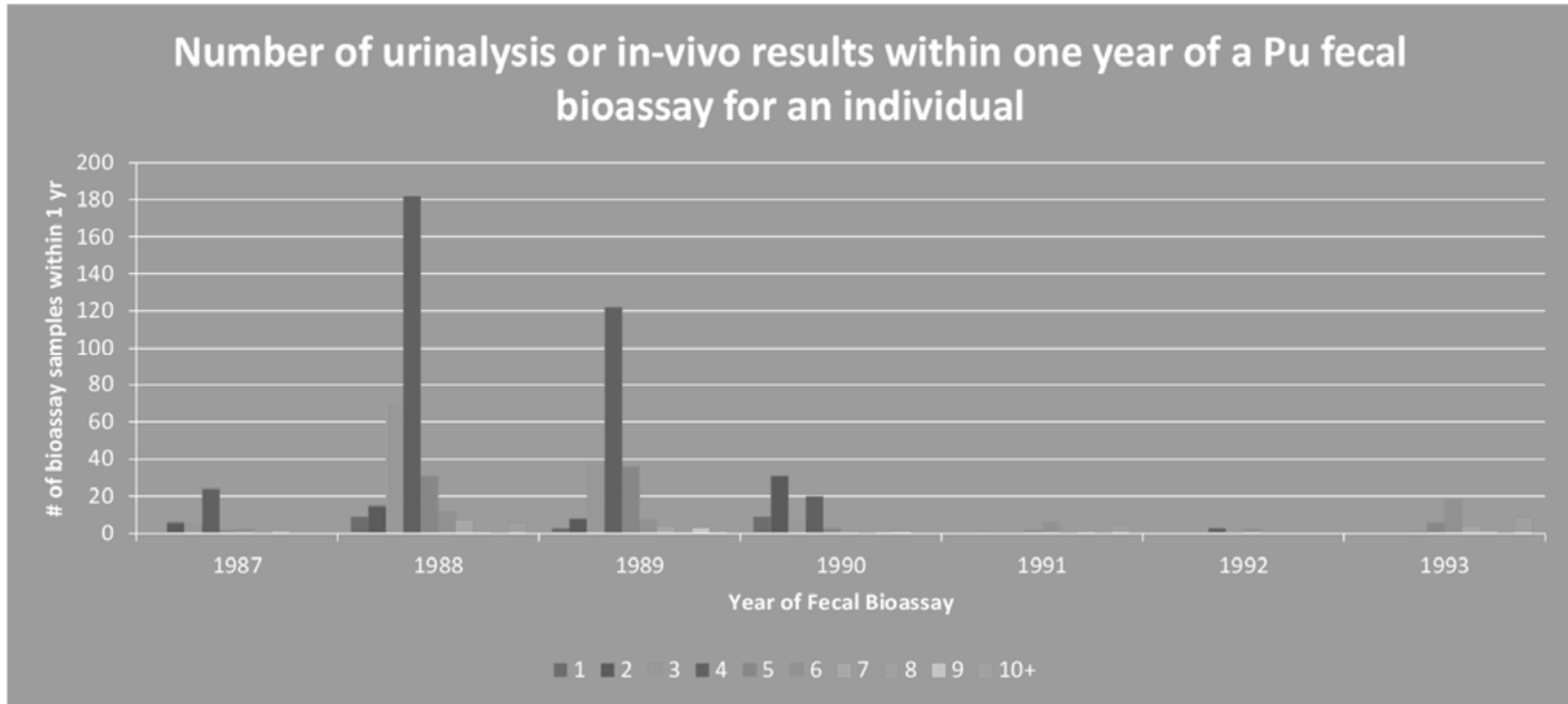
# Background—cont.

- Hanford modernized its bioassay methods from total alpha to recovery corrected alpha spectrometric methods (use of an isotopic tracer) in about 1983
- UST developed methods to respond to expedited samples (such as to determine if chelation was needed) which may have different Minimum Detectable Activities (MDA's).

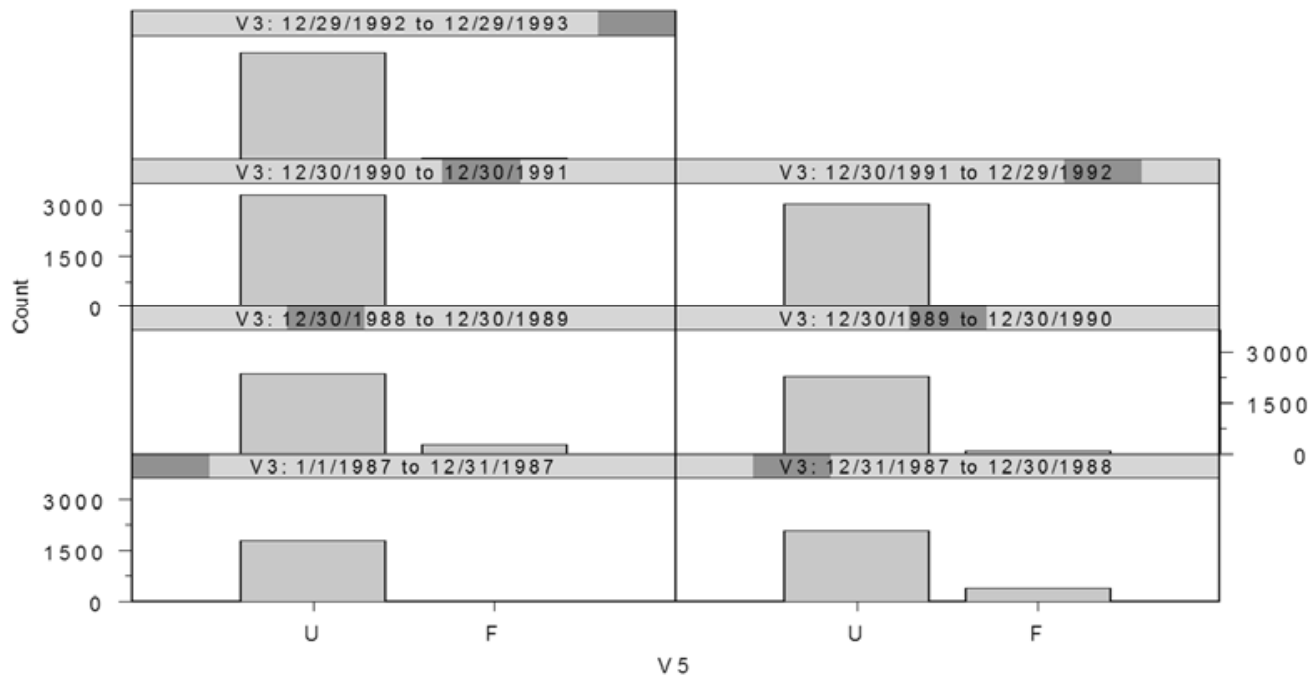
*Alpha Spectra of Typical Radionuclides*



# Background—cont.



# Number of Plutonium Urine (U) and Fecal (F) Bioassay Samples Per Period



# Bioassay at Hanford related to Potentially Super S Plutonium Compounds

- Hanford presented overview of technology shortfalls for Super Class Y (aka Super S) in a 1988 document, “Methods to Improve Pu Monitoring”
- Document uses ICRP 30 biokinetic models and data from modified retention in the ICRP 26 lung model and found that both urine and lung counting would be insufficient to meet DOE orders to determine intakes of 100 mrem Annual Effective Dose Equivalent
  - The amount of Pu going to the urine was too low to be observed using the alpha spectrometric methods
  - Hanford had several processes that produced freshly separated plutonium during this time period which reduced the capabilities of the lung counting program since it relies on  $^{241}\text{Am}$  measurements

# Target Intake Amounts from 1988 Document

**TABLE 2.** Target Detectable Intakes for Fresh 6% Plutonium Mixtures<sup>(a)</sup>

<u>Inhalation Class</u>	<u>Mass of Intake, ng</u>	<u>Isotopic Composition of Intake</u>			
		<u><math>^{238}\text{Pu}</math>, nCi</u>	<u><math>^{239}+^{240}\text{Pu}</math>, nCi</u>	<u><math>^{241}\text{Pu}</math>, nCi</u>	<u><math>^{241}\text{Am}</math>, nCi</u>
Y	41	3.5E-1	2.9	3.3E+1	2.1E-3
Super Y	35	3.0E-1	2.5	2.9E+1	1.8E-3

(a) Assuming a particle size of 1- $\mu\text{m}$  activity median aerodynamic diameter.

# Bioassay Challenges (from 1988 document)

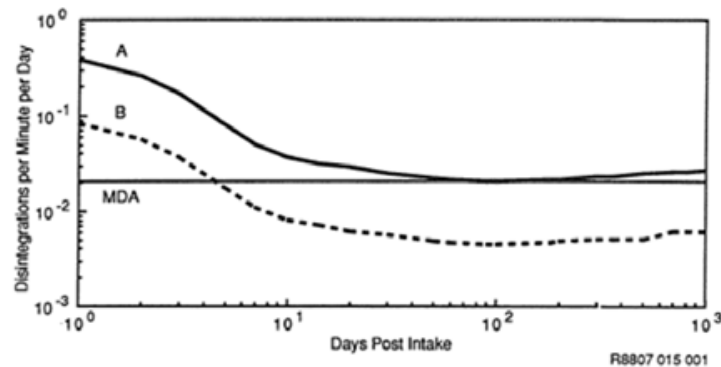


FIGURE 1. Urinary Excretion from Acute Inhalation of Class Y Plutonium  
A: Intake detectable by annual urine sampling  
B: Target detectable intake

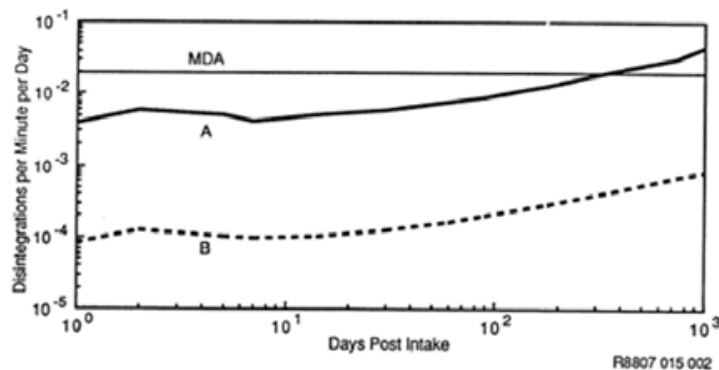


FIGURE 2. Urinary Excretion from Acute Inhalation of Super Class Y Plutonium  
A: Intake detectable by annual urine sampling  
B: Target detectable intake

- For both graphs, curve A is the excretion in urine from acute intake measurable at one year
- Curve B shows what the expected urine excretion would be for the 'target' intake



# Pilot Program Notes

- **1986-87: Pilot fecal program conducted to evaluate the feasibility of a routine program. Approximately 50 workers participated, quarterly sampling. Issues regarding providing samples and sample amount reported.**
  - Only 58 of 84 scheduled samples received.
  - 1719 Pu urinalysis samples for 1987
  - Not well received by the workers

# Pilot Program Notes—cont.

- **1988: Pilot program was continued for 100 workers at the Plutonium Finishing Plant. Fecal samples showed 40-50% of the workers statistically greater than controls (details in 1993 Health Physics publication), and the results confirmed by special air sampling.**
  - Pu urinalysis: 2008 routine, 130 special
  - Pu fecal analysis: 37 routine and 34 special

# Pilot Program Notes—cont.

- **1989: In April, after 12 months as a pilot program, sampling frequency was changed to annual with provision of obtaining approximately equal number of samples each quarter**
  - **1989 Pu urinalyses: 2156 routine + 70 specials**
  - **1989 Pu fecal analyses: 259 routine + 16 specials**

# Pilot Program Notes—cont.

- **Implemented using the experiences learned during the pilot program**
- **Mandated by the employers**
- **While external spike fecal samples were not provided, they did still use standard radiochemistry required practices**
  - **Reagent blank with each batch**
  - **Spiked quality control sample with each batch**

# Pilot Program Notes—cont.

- **1990: Routine fecal program operated normally until contract default with UST on June 1, 1990**
  - May samples never analyzed
- **In September, before an interim contract could be put in place for routine analysis of fecal samples, Hanford terminated the program. This was done because Hanford facilities were no longer processing material that could be classified as freshly separated super class Y plutonium.**

# Pilot Program Notes—cont.

- **Dose determinations made for workers in the program at the start of the year, assumed chronic exposure January through September, based on fecal results obtained December 1989 through April 1990**
  - **1990 Pu urinalyses: 759 routine + 56 specials**
  - **1990 Pu fecal analyses: 35 routine + 44 specials**

# Pilot Program Notes—cont.

- **1993 published paper on the experiences of a routine fecal sampling program**
- **Approximately 100 workers**
- **Quality control samples using artificial and known blank natural samples included to compare the results of the workers**
  - **391 samples from workers provided**
  - **47 control samples (blanks), consisting of 31 artificial and 16 samples from unexposed individuals**

# **OTIB-0049: Estimation of Doses for Plutonium Strongly Retained in the Lung**

- **Sampling and radiochemical methods used described**
- **Estimation of doses for plutonium strongly retained in the lung**
- **While the newer International Commission on Radiological Protection (ICRP) insoluble plutonium increased the retention time compared to ICRP 30, various accident cases show longer retention**



# **OTIB-0049: Estimation of Doses for Plutonium Strongly Retained in the Lung—cont.**

- **OTIB-0049 developed based on nine cases from Rocky Flats and one case from Hanford that had well-defined intakes and exhibited long retention times**
- **Upper bound cases used to establish bounding dose for Super S materials**
- **Data compared to US Transuranium and Uranium Registries (USTUR) autopsy cases**

# OTIB-0049 Adjustment Factors

- TIB-0049 developed dose adjustment factors based on intakes from bioassay data using the type S ICRP model
- Dose adjustment depends on the type of data being used to determine intake (air, urine, lung, feces)

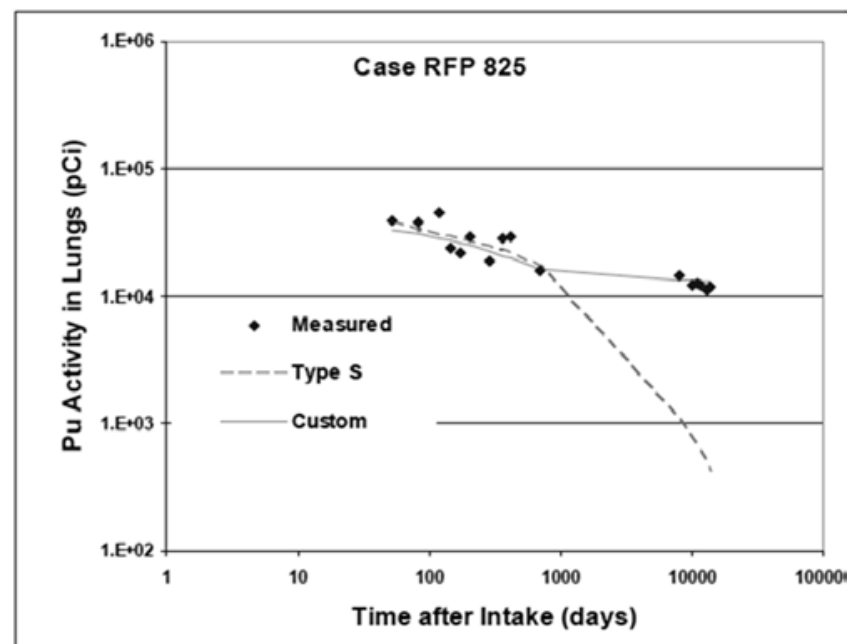


Figure A-3. Comparison of Type S and custom models for Case RFP 825.

# Adjustment Factors—cont.

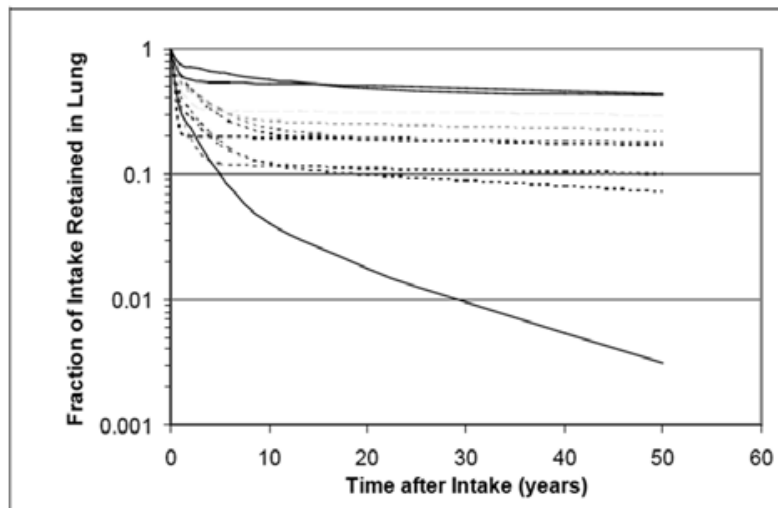


Figure B-1. Comparison of projected plutonium lung content for 10 design cases and standard Type S plutonium for acute intake of 1 Bq and particle size of 5  $\mu\text{m}$  AMAD. The two highest solid lines are HAN-1 and RFP 872 and the lowest solid line is standard Type S material.

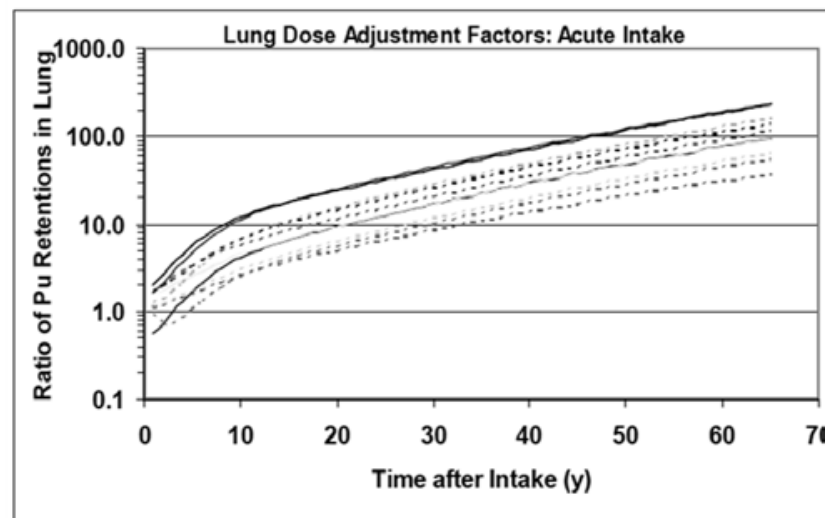


Figure B-2. Lung dose adjustment factors for design cases for acute intake. The highest solid lines are HAN-1 and RFP 872.

# Adjustment Factors—cont.

Table 4-8. Summary of Type SS adjustments.

	<b>Lung counts</b>	<b>Air concentrations</b>	<b>Urinalysis</b>
Lungs	Table D (normalized to last chest count)	Table D	Factor of 4 followed by Table D adjustment
Extra-thoracic	None	None	Factor of 4
GI tract	No adjustment	None	Factor of 4
Systemic organs	None	None	Prior to last urine sample: none  Post last urine sample: factor of 4

Note: For claims involved in high-fired events (e.g., the RFP fires), a particle size adjustment (as described in Section 4.2) of 2.6 should be included.

# Fecal Adjustment Factor

- **OTIB-0049 specifically addresses adjustment of fecal data**
- **Fecal samples collected less than 2 months after an acute inhalation intake or less than 2 months after the end of a chronic intake should be evaluated with the standard type S model**
- **Once intake is determined, dose is adjusted using direct measurement factors (e.g. air monitoring)**
- **Fecal samples collected after this 2 month time should be modeled as if they were urine samples and the dose adjusted upward by a factor of 3**

# Correction Factors for Super S Dose Based on Fecal Data

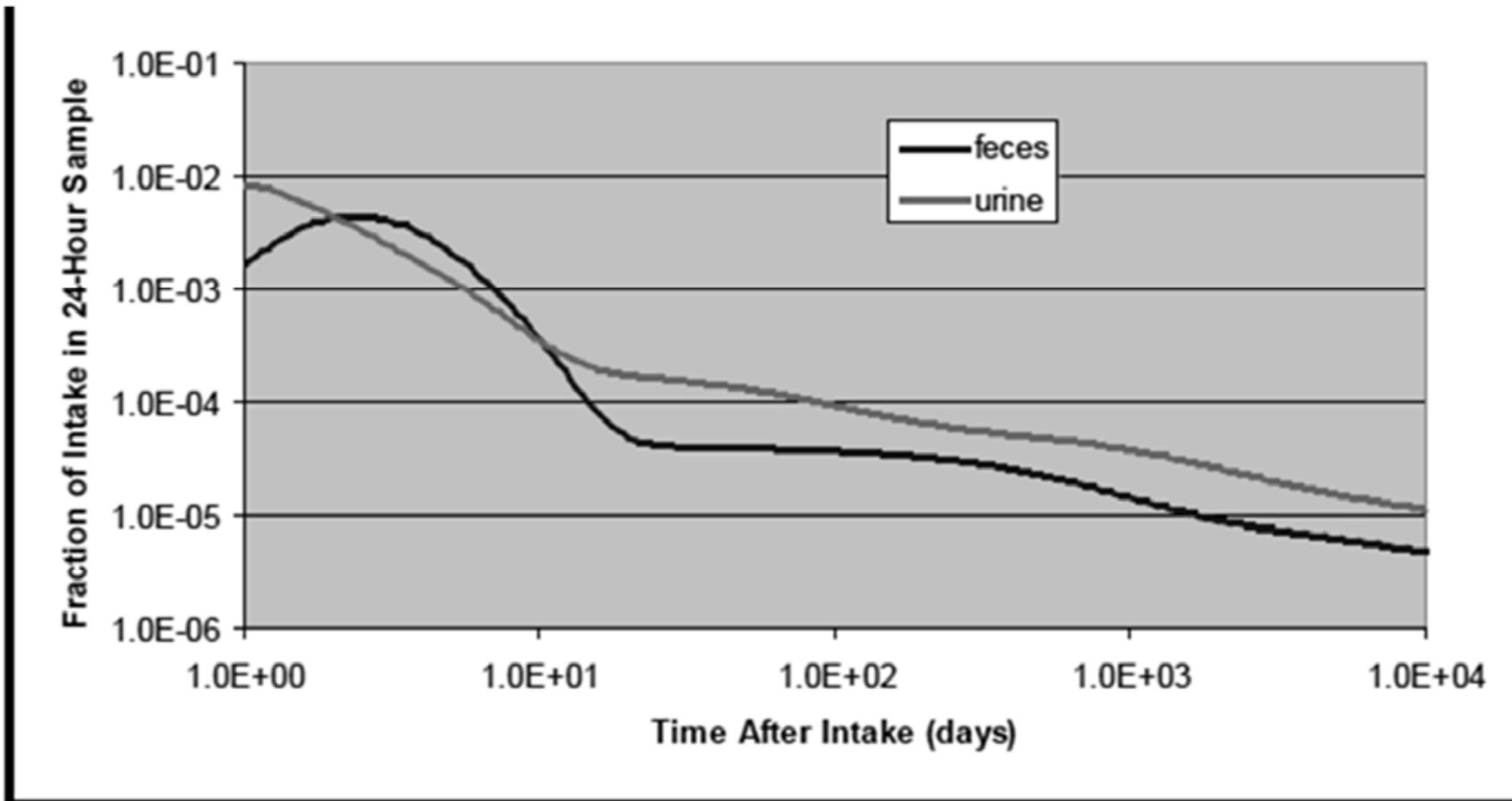


Figure E-3. Urine and fecal IRFs following an injection of  $^{239}\text{Pu}$ .

# Urine/Fecal Activity Ratios from System Plutonium

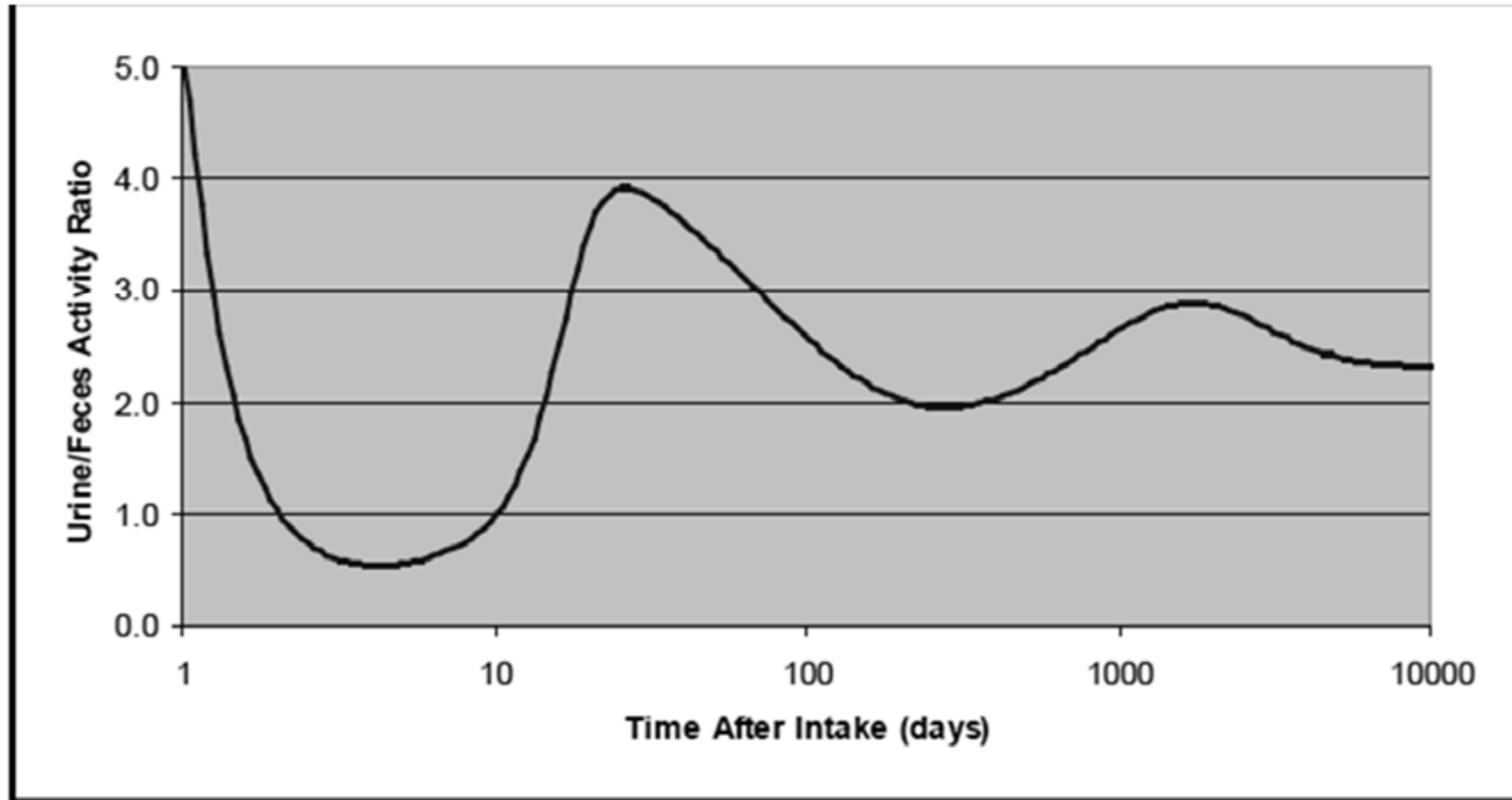


Figure E-4. Ratio of urine IRF to fecal IRF.

# Application at Hanford

- **During this period, standard DCAS procedures are applied to Hanford bioassay data**
- **Assumptions include the age of plutonium, the plutonium isotopic makeup (fuel grade or weapons grade), solubility class (including Super S if appropriate), and evaluation of the information available for a case**



# Dosimetry Assumptions

- NIOSH TBD currently uses the contractual MDA's
- Methods during this time period for SEC-00155 in the current TBD indicates 10 year old plutonium should be used
- Weapons grade and fuel grade may be evaluated
- Rarely is fecal data available, but OTIB-0049 should be used to evaluate and compare it with other intake indicators
- Sometimes intakes are not favorable assumptions if they would result in detection by other methods used
- Case specific data must be reviewed since in vivo data may make some assumptions not claimant favorable