

**Worst-Case Am-241 Concentration in Building 123  
Roofing Materials**

James M. Langsted, CHP  
Rocky Mountain Remediation Services  
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Completed by: James M. Langsted, CHP Date: 4/27/98  
Peer Reviewed by: J. Parsons Date: 4/27/98  
Approved by: Bruehl Water, CEO Date: 4/27/98

## I. Introduction

Radionuclide analyses of roofing materials taken from Building 123 were very low (Attachment 1). All Am-241 values were below the stated minimum detectable activities (MDA) for these analyses. Although there are both site procedural<sup>1</sup> and industry standard<sup>2</sup> guidance for averaging results below MDA, it is prudent to estimate a worse-case Am-241 concentration based on process history for these roofing materials.

## II. Calculation

### *Assumptions*

The worst-case situation would be if weapons grade plutonium were deposited (presumably from site airborne releases) onto the roof of Building 123 immediately after it was built in 1952, and ingrowth of Am-241 has occurred during the intervening 46 years. It is assumed that the weapons grade plutonium deposited on the roof did not contain any Am-241 initially. This is reasonable in that during this period the plant was using relatively "young" plutonium, from the production reactors at Hanford and Savannah River, with little time for Am-241 ingrowth to have occurred.

Laboratory activities in Building 123 did handle nanocurie quantities of Am-241 in environmental and biological samples. These samples were analyzed using wet dissolution techniques which could result in release of this radionuclide, however the intent of these analyses was to retain the radionuclide for analysis, rather than release any of this material. Any release resulting in roof deposition would have been through exhaust filters and later a caustic scrubber system. Thus, it is highly unlikely this source term contributed significantly to any Am-241 deposition on the roof. Hypothetical calculation of this source term would be unproductive.

### *Pu/Am Ratio*

The ratio of Pu-239/240 to Am-241 was determined by a spreadsheet<sup>3</sup> developed for use on the T-1 Source Term Removal Project.<sup>4</sup> This spreadsheet (Attachment 2) calculates the activity of the various plutonium isotopes and Am-241 for a given age, and determines several ratios. The initial mixture of plutonium isotopes was taken from plant records appropriate for that period, and is documented in the referenced report. The ratio of Pu-239/240 to Am-241 is determined to be 4.11 for 46 year old weapons grade plutonium.

### *Worst-Case Am-241 Concentration*

Using the highest Pu-239/240 result from the Building 123 roofing material:

$$0.052 \text{ pCi } (^{239/240}\text{Pu})/\text{g} + 4.11 (^{239/240}\text{Pu}/^{241}\text{Am}) = 0.0127 \text{ pCi } (^{241}\text{Am})/\text{g}.$$

This worst-case value is above that determined by sampling of the material, indicating that these worst-case assumptions are in fact, conservative.

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<sup>1</sup> REP-1006, RADIOLOGICAL CHARACTERIZATION OF BULK OR VOLUME MATERIALS, 4-U50-REP-1006, Revision 0, 5/23/95.

<sup>2</sup> HPS-N13.30-1996, Performance Criteria for Radiobioassay, An American National Standard --, American National Standards Institute, Inc., May 1996.

<sup>3</sup> Aged Pu Mixture.xls

<sup>4</sup> Plutonium to Americium Ratios for Various Purposes on T-1 Source Removal Project, James M. Langsted, April 2, 1998.

### **III. Conclusion**

The worst-case concentration of Am-241 in Building 123 roofing materials based on process knowledge (0.0127 pCi/g) is below that of site soils (0.0227 pCi/g) used for comparison. These site soils values are taken from the Radiological Engineering procedure. Thus, the worst case Am-241 concentration is demonstrated to be below that necessary for free release.



# Am/Pu Ratios for Aged Weapons Grade Plutonium

Aged Plutonium Mixture		Age=		46 years			
Isotope	Original Mixture (wt. %)	Specific Activity (Ci/g-isotope)	Original Mixture (Ci)	Half Life (yr)	(Ci)	Aged Mixture (g)	(wt%)
Pu-238	0.05	1.71E+01	0.00855	87.74	5.94E-03	3.48E-04	0.03
Pu-239	93.714	6.22E-02	0.05829	2.41E+04	5.82E-02	9.36E-01	93.769
Pu-240	5.593	2.28E-01	0.012752	6.54E+03	1.27E-02	5.57E-02	5.576
Pu-241	0.5932	1.03E+02	0.610996	14.4	6.67E-02	6.48E-04	0.0649
Pu-242	0.05	3.93E-03	1.97E-06	3.76E+05	1.96E-06	5.00E-04	0.05
Am-241		3.43E+00		432.2	1.73E-02	5.03E-03	0.50
Total	100.00		0.69059		1.61E-01	9.98E-01	100.00

Total Pu 1.44E-01  
 Total Pu/Am 8.3  
 pCi Am-241 corresponding to 50 pCi total Pu 6.01  
 Pu-239/240 7.09E-02  
<sup>239/240</sup>Pu/Am 4.11