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Improvement in the Plutonium Parameter Files of the FRAM Isotopic Analysis Code

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by

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ABSTRACT

The isotopic analysis code Fixed-energy Response-function Analysis with Multiple efficiency (FRAM) employs user-editable parameter sets to analyze a broad range of sample types. This report presents new parameter files, based upon a new set of plutonium branding ratios, which give more accurate isotope results than the current parameter files that use FRAM.

I. INTRODUCTION

FRAM is the acronym for Fixed-energy Response-function Analysis with Multiple efficiency. This code has been developed and is continuing to be refined at Los Alamos National Laboratory for the gamma-ray spectrometry measurement of the isotopic composition of plutonium, uranium, and other actinides. It is a code based on a self-calibration using several gamma-ray peaks for determining the isotopic ratios. The versatile-parameter database structure governs all facets of the data analysis. User editing of the parameter sets allows great flexibility in handling data with different isotopic distributions, interfering isotopes, and different acquisition parameters such as energy calibration and detector type.[1-3]

FRAM uses only a single detector to acquire data. Single detector systems use a minimum of facility space and are versatile, reliable, easy to use, and less expensive. FRAM can obtain a complete isotopic analysis using either a single planar or a single coaxial detector. When using the planar detector, FRAM has most often been used to collect and analyze data in the 120- to 420-keV range although it is not limited to this range. The traditional parameter file for the planar detector is Widerange6. The most widely used mode of operation with the coaxial detector is to acquire the spectra in the range from 0 to 1024 keV. If the region between 120 and 200 keV is available, FRAM usually works best analyzing in an energy range from 120 to 460 keV. The customary parameter file for the coaxial detector in this energy region is Coax8k125.3. When gamma rays below 200 keV are not available, such as in the case of a sample inside a lead-lined container, FRAM can still obtain a complete isotopic analysis using only gamma rays above 200 keV from a single coaxial detector spectrum. The current parameter file for this region is ShieldCoax4.3. These parameter file names are those used by Los Alamos National Laboratory (LANL) personnel. Users may rename these files.

These three parameter files are the basic parameter sets that FRAM uses to analyze plutonium isotopic composition. All other parameter sets (such as those for nonequilibrium, heterogeneous samples or samples with other interference isotopes) are derived from these basic three. These three parameter files were “fine tuned” specifically for their applications. The tuning process involves assigning the region of interest, background regions and shapes, peaks for analysis, peak energy, branching ratios (BR), etc. As a result, the BRs of many gamma rays from one parameter set are different from the gamma rays from the other sets. These differences do not invalidate the BRs used in these parameter sets or the accuracy of the results. Instead, they merely show that the absolute BRs of these peaks are not correct. However, since FRAM uses only relative BRs instead of absolute BRs in determining the isotope ratios, the isotopic results are still valid.

The fact that different parameter files using different BRs do not cause a problem with the analysis can still cause some problems for the user who wants to work in different energy region or who wants to combine both low- and high-energy regions of the Coax8k125.3 and ShieldCoax4.3 into one. It is of interest to obtain a set of BRs that would work with FRAM in any energy region or in a wide energy range from 120 keV up to 1 MeV.

II. FRAM: VERSIONS AND METHODS

Two different FRAM versions were used in determining the new BRs of plutonium isotopes. The latest commercially available version of FRAM is 3.x. It uses an empirical relative efficiency curve.[4]

$$\ln(\text{Area/BR}) = c_1 + c_2/E^2 + c_3(\ln E) + c_4(\ln E)^2 + c_5(\ln E)^3 + c_i + c_j/E\,, \qquad (1)$$

where E is the energy in MeV, c_i is associated with additional isotopes beyond the first one, and each c_j is associated with an efficiency function beyond the first one.

This empirical relative efficiency curve has been very successful for nearly all measurement situations. However, its empirical nature and polynomial structure makes it behave unphysically in some situations, notably when extrapolated outside its range of definition or when used with very weak data.

A new version of FRAM is under development. We have developed new efficiency curve formalism based on the physical properties of the analyzed material and surrounding materials. In the beta-test phase, this new efficiency curve was built upon an older version of FRAM, version 2.2. This beta version is called FRAM v2.99. The new efficiency curve is constructed as:

$$\text{Area/BR} = \left[\frac{1-e^{-\mu_{Pu}x_{Pu}}}{\mu_{Pu}x_{Pu}}\right]\times\left[e^{-\mu_{Cd}x_{Cd}}e^{-\mu_{Fe}x_{Fe}}e^{-\mu_{Pb}x_{Pb}}\right]\times\left[I_i\right]\times\left[e^{c_j/E}\right]\times\left[\text{Det eff}\right]\times\left[\text{Correction}\right], \qquad (2)$$

where the term inside the first square bracket associates with the U/Pu attenuation, the term inside the second square bracket associates with the Cd/Fe/Pb attenuation, I_i is associated with the activity of the isotope i, c_j associates with an efficiency function beyond the first one, “Det eff” is the detector efficiency that is measured with actual detectors, and “Correction” is to correct for the variations of the actual detector efficiency and the attenuation of the measured materials and the absorbers. In this modified version of FRAM, we used the modified Hoerl formula $E^b c^{1/E}$ for the “Correction” factor, where E is the energy in MeV and b and c are variables in the fitting process.

III. SPECTRA

We have a large archive of spectra that we collected over many years using both planar and coaxial detectors. Tables I and II show the specifications of the samples and the spectra taken of these samples. All these samples cover a very wide range of plutonium composition, from very low to very high burn-up, and a wide range of mass, from 0.4 g to 2 kg. The isotopic units are weight percent (wt%), while ^{241}Am is in parts per million (ppm) relative to plutonium.

Table I. Specifications of the samples taken with the planar detector.

Sample Name	238 Pu	239 Pu	240 Pu	241 Pu	242 Pu	241 Am	Mass g	No runs	Cnt rate kHz	Cnt time hr	Data Date
SRPISO3	0.006	96.317	3.562	0.096	0.018	321	11.0	15	7.5	1.5	7-Jul-1989
A1-92	0.009	94.606	5.262	0.110	0.014	1760	10.0	20	18.5	1.0	23-Mar-1988
A1-86	0.010	94.228	5.605	0.138	0.018	1869	10.0	20	22.0	1.0	20-Jul-1988
STDR3	0.010	94.041	5.766	0.162	0.021	1885	21.0	6	7.1	1.0	16-May-1988
J001325	0.011	93.876	5.903	0.182	0.028	1214	500.0	15	22.0	1.0	25-May-1988
CALEX	0.010	93.860	5.860	0.241	0.029	1354	400.0	15	23.0	0.5	9-May-1988
PUEU7	0.014	93.782	5.862	0.276	0.066	234	1747	20	41.0	1.0	8-Feb-1989
STD117	0.015	93.579	6.154	0.213	0.039	1209	1.7	15	3.6	1.0	13-Jun-1988
SRPISO6	0.014	93.540	6.130	0.259	0.057	628	8.4	15	6.8	1.0	5-Jul-1989
STD6	0.010	93.476	6.328	0.161	0.025	1344	120.0	15	27.0	1.0	25-May-1988
STD8	0.010	93.476	6.328	0.161	0.025	1344	240.0	5	32.0	1.0	23-May-1988
CBNM93	0.011	93.459	6.314	0.176	0.040	1513	6.0	25	10.0	1.0	1-Jun-1991
SRPISO9	0.021	92.660	6.891	0.356	0.073	757	11.9	15	8.7	1.0	6-Jul-1989
STD3	0.023	91.930	7.615	0.354	0.077	3113	60.0	6	21.0	1.0	17-May-1988
STD118	0.026	90.385	9.000	0.485	0.104	2731	1.6	6	3.4	1.0	27-May-1988
PEO382C3	0.026	89.690	9.693	0.478	0.112	4225	150.0	15	31.0	0.5	20-Jun-1988
STD119	0.037	87.262	11.784	0.749	0.168	4231	1.7	8	5.2	1.0	3-Jun-1988
STD40	0.065	87.139	11.768	0.828	0.200	4334	875.0	15	40.0	0.5	29-Apr-1988
SRPISO12	0.057	87.087	11.821	0.814	0.222	2651	20.2	15	11.0	1.0	4-Jul-1989
CBNM84	0.068	84.529	14.234	0.811	0.358	4342	6.0	20	10.0	1.0	31-May-1991
SRPISO15	0.166	82.295	15.437	1.390	0.712	2851	12.3	14	10.8	1.0	5-Jul-1989
LAO225	0.059	82.122	16.614	0.952	0.354	6425	870.0	20	40.0	0.5	23-Jul-1991
STD121	0.060	81.899	16.491	1.106	0.353	4889	3.0	15	7.4	1.0	3-Jun-1988
STD120	0.364	79.806	15.455	3.326	1.050	25743	1.6	15	18.7	1.0	1-Jun-1988
STD116	0.364	79.804	15.455	3.327	1.050	18459	1.7	15	12.0	1.0	28-May-1988
CBNM70	0.823	74.209	18.509	4.356	2.103	23453	6.0	20	25.0	1.0	29-May-1991
CBNM61	1.168	63.460	25.776	5.339	4.256	28902	6.0	20	25.0	1.0	30-May-1991

Table II. Specifications of the samples taken with the coaxial detector. The values inside the parenthesis in the first column represent the thickness (inches) of the lead absorber used in the data acquisition.

Sample Name	238 Pu	239 Pu	240 Pu	241 Pu	242 Pu	241 Am	Mass g	No runs	Cnt rate kHz	Cnt time hr	Data Date
STDISO3	0.006	96.338	3.561	0.076	0.018	518	11.0	10	30	2	10-May-1994
STDSGA100	0.006	96.336	3.562	0.078	0.018	499	100.0	10	30	2	21-Oct-1993
A1-92	0.008	94.633	5.261	0.084	0.014	2004	10.0	10	30	2	18-Oct-1993
A1-86	0.010	94.261	5.605	0.106	0.018	2192	10.0	10	30	2	20-Oct-1993
JOO132501	0.011	93.925	5.904	0.132	0.028	1694	499.6	11	30	1	22-Dec-1994
JOO132501 (1/32Pb)	0.011	93.925	5.904	0.132	0.028	1693	499.6	11	30	1	20-Dec-1994
JOO132501 (3/32Pb)	0.011	93.925	5.904	0.132	0.028	1693	499.6	11	30	1	17-Dec-1994
CALEX (1/16Pb)	0.009	93.925	5.861	0.176	0.029	1995	398.2	11	30	1	6-Dec-1994
CALEX	0.009	93.924	5.861	0.176	0.029	1987	398.2	10	30	1	2-Nov-1994
STDPUEU7 (1/16Pb)	0.014	93.848	5.863	0.209	0.066	900	2000	11	30	1	8-Nov-1994
STDPUEU7	0.014	93.847	5.863	0.209	0.066	898	2000	11	30	1	3-Nov-1994
STDEUPU7	0.014	93.837	5.863	0.220	0.066	793	5.0	10	30	2	22-Oct-1993
PIDIE6-1	0.010	93.834	5.991	0.131	0.035	2928	0.4	21	3	1	3-Oct-1996
STDISO6	0.013	93.593	6.131	0.206	0.057	1163	8.5	10	30	2	6-May-1994
STD8	0.009	93.546	6.303	0.116	0.025	1758	239.5	11	30	1	10-Jan-1995
STD8 (1/16Pb)	0.009	93.546	6.303	0.117	0.025	1755	239.5	11	30	1	23-Dec-1994
CBNM93	0.011	93.478	6.314	0.157	0.040	1697	6.0	10	30	2	9-Oct-1993
STDISO9	0.020	92.731	6.893	0.282	0.073	1490	11.9	10	30	2	7-May-1994
2G 118	0.025	90.490	9.007	0.374	0.104	3822	2.5	10	30	2	23-Oct-1993
PIDIE6-2	0.021	89.483	10.109	0.293	0.094	4148	0.4	21	3.2	1	4-Oct-1996
2G 119	0.036	87.417	11.801	0.578	0.168	5919	2.5	10	30	2	24-Oct-1993
STD40 (1/16Pb)	0.062	87.343	11.789	0.605	0.201	6543	869.0	11	30	1	21-Nov-1994
STD40	0.062	87.342	11.789	0.606	0.201	6534	869.0	11	30	1	9-Nov-1994
STDISO12	0.055	87.240	11.837	0.645	0.222	4330	20.2	10	30	2	8-May-1994
PIDIE6-3	0.044	84.881	14.185	0.655	0.235	9569	0.4	21	3.2	1	3-Oct-1996
CBNM84	0.067	84.606	14.244	0.724	0.359	5203	6.0	10	30	2	10-Oct-1993
STDISO15	0.160	82.544	15.478	1.103	0.715	5735	12.3	10	30	2	9-May-1994
LAO225	0.057	82.246	16.534	0.809	0.354	7846	868.8	10	30	1	20-Dec-1994
LAO225 (1/16Pb)	0.058	82.245	16.534	0.809	0.354	7841	868.8	11	30	1	15-Dec-1994
2G 121	0.058	82.207	16.528	0.853	0.354	7403	2.5	10	30	2	3-Nov-1993
PIDIE6-4	0.102	78.238	19.886	1.204	0.571	21980	0.4	21	5	1	4-Dec-1996
PIDIE6-5	0.123	76.455	21.361	1.352	0.708	24409	0.4	21	15	1	29-Nov-1996
CBNM70	0.812	74.573	18.597	3.904	2.113	28204	6.0	10	30	2	10-Oct-1993
PIDIE6-6	0.884	67.646	24.342	3.502	3.627	56522	0.4	21	28	1	1-Dec-1996
CBNM61	1.154	63.845	25.928	4.791	4.282	34776	6.0	10	30	2	11-Oct-1993
PIDIE6-7	1.196	63.490	26.198	4.324	4.791	59164	0.4	21	29	1	1-Dec-1996

IV. DETERMINING THE NEW BRANCHING RATIOS

Most plutonium samples contain the isotopes ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu. Americium-241, a decay product of ^{241}Pu, is always present, as is ^{237}U, another decay product. The most widely used branching ratios are those in Gunnink, et al.[5] The published BRs of plutonium were mostly obtained by analyzing separated isotopes. The BR of a gamma ray maybe correct relative to the BRs of other gamma rays in the same isotope but may not be when compared with the BRs of the gamma rays in another isotope. It is therefore necessary to find a set of BRs for all the isotopes that are correct relative to one another.

A. Least-squares fitting the relative efficiency curves

To reduce the complexity and time, 12 sets of data from 12 different samples taken with the coaxial detector were used to calculate the relative efficiency curves. Those 12 sets of data are CBNM61, CBNM70, CBNM84, CBNM93, Pidie6_1, Pidie6_3, Pidie6_5, Pidie6_7, A1_92, A1_86, StdEuPu, and StdPuEu. These 12 data sets were chosen to cover a wide range of isotopic compositions, from very low to very high burnup, and a wide range of ^{241}Pu to ^{241}Am ratios. The reason a wide range of ^{241}Pu to ^{241}Am ratios is needed is for the accurate determination of the BRs of the co-energetic peak pairs of ^{241}Pu to ^{237}U and ^{241}Am, which is discussed later.

To reduce the time analyzing the data, the individual spectra from each set were summed together and the summed spectrum were analyzed. A generic parameter file was constructed to analyze these 12 summed spectra. The areas of the 11 clean peaks (129.3-, 203.5-, 255.4-, 345.0-, 375.0-, 451.5-, 645.9-, and 769.3-keV peaks of ^{239}Pu; 148.6-keV peak of ^{241}Pu; and 662.5- and 722.0-keV peaks of ^{241}Am) were obtained. Note that the 769.3-keV peak areas of ^{239}Pu can be cleanly determined for low-burnup plutonium only. For high-burnup plutonium, that peak is strongly interfered by the 770.5-keV peak of ^{241}Am. However, because it is an important peak for determining the relative efficiency curve at high energy, it is included. The process of stripping out the interference peak at 770.5 keV is described in Section IV.B. These steps, the least-squares fitting the relative efficiency curves and the stripping of the 770.5-keV peak, were iterated twice in order to accurately determine the BR of the 769.3-keV peak.

The peaks of ^{241}Pu and ^{241}Am were normalized to ^{239}Pu using the known activities of these isotopes in the samples. These data were then fitted to the equation

$$\ln(\text{Area/det eff})_i = \ln(\text{BR}) + \ln\left(\frac{1 - e^{\mu_{Pu} x_{Pui}}}{\mu_{Pu} x_{Pui}}\right) - \mu_{Cd} x_{Cdi} - \mu_{Fe} x_{Fei} + a_i + b_i \ln E + c_i / E\,, \quad (3)$$

where the subscript *i* represents each of the 12 data sets. This equation is similar to the equation representing the physical based efficiency curve in Section II (Eq. 2) with the rearrangement of the terms and the removal of the terms associating with the second efficiency function and the lead absorber. (No lead absorber was used in measuring these samples.) The variable a_i is now associated with ^{239}Pu only since other isotopes have been normalized to ^{239}Pu. This is a variable redundancy equation. That is, it gives rise to an infinite number of solutions. As an example, after a solution is obtained, one increases all the BRs by a value and decreases a_i by the same value then one would get another solution. Therefore, in the least-squares fit, we kept the BR of the 375-keV peak fixed at the value 1.553e-5 to remove the variable redundancy problem. This value is taken from Firestone and Shirley.[6]

From the fit, the BRs of these 11 peaks and the efficiency curves of the 12 spectra were found. The BRs of other peaks of all the isotopes were determined by least-squares fitting equation 3 above of individual energy peaks using the now known constants x_{Pui}, x_{Cdi}, x_{Fei}, a_i, b_i, and c_i.

Parameter files for various energy regions were constructed using the resulting BRs. They worked well with FRAM v2.99 (physical efficiency model) but not with the FRAM v3.x. That was somewhat expected since the new BRs were obtained with the physical efficiency model. The goal of this work is to find a BR set that would work well at all different energy range and with both the physical and empirical efficiency models. Therefore, the BRs obtained with the physical model above needed to be modified somewhat so they would also work with the empirical model.

A second set of BRs were also constructed using the empirical equation

$$\ln(\text{Area})_i = \ln(\text{BR}) + c_{1i} + c_{2i}/E^2 + c_{3i}(\ln E) + c_{4i}(\ln E)^2 + c_{5i}(\ln E)^3, \quad (4)$$

where the subscript i represents each of the 12 data sets. This equation is similar to the equation representing the empirical based efficiency curve in Section II (Eq. 1) with the rearrangement of the terms and the removal of the term associating with the second efficiency function. The term associating with the additional isotopes beyond the first one was also removed since the other isotopes were already normalized to ^{239}Pu.

The areas of 11 peaks from all 12 data sets were least-squares fitted to this empirical formula and we found the BRs of these peaks. The average of these 11 BRs and the 11 BRs obtained earlier with the physical efficiency model was assumed to be the best representation for both models.

Refitting the data to the Eq. 3 with the BR values fixed to these average BRs, we obtained a new set of constants x_{Pui}, x_{Cdi}, x_{Fei}, a_i, b_i, and c_i. These constants were then used later throughout the remaining work (together with Eq. 3) to find the BRs of other peaks. The resulting BRs work well with both the physical and empirical FRAM versions.

B. Analysis of the complex regions

The work to determine the BRs from plutonium samples containing all the plutonium isotopes and ^{241}Am is complicated due to large number of gamma rays from many different isotopes and many of those gamma rays interfere with other gamma rays from different isotopes. To unravel these peaks, one needs to look carefully at each region for a way to do it successfully.

1. 125-keV complex

There are three peaks in this region: 124.5, 125.2, and 125.3 keV. The first two belong to ^{239}Pu and the last one is from ^{241}Am. The objective is to obtain the correct area of the 125.3-keV peak. This region is difficult to unravel due to the inability to set the background (BG) region on the left of the region of interest (ROI). Figure 1 shows the region for the 93.5% and 63.4% ^{239}Pu sources.

The solution was to fit this region with a linear BG and to let the 124.5-keV peak free. This free 124.5-keV peak would correct for the otherwise too large area of the 125.3-keV peak of ^{241}Am caused by the nonexistence of the step (in a linear step background fit).

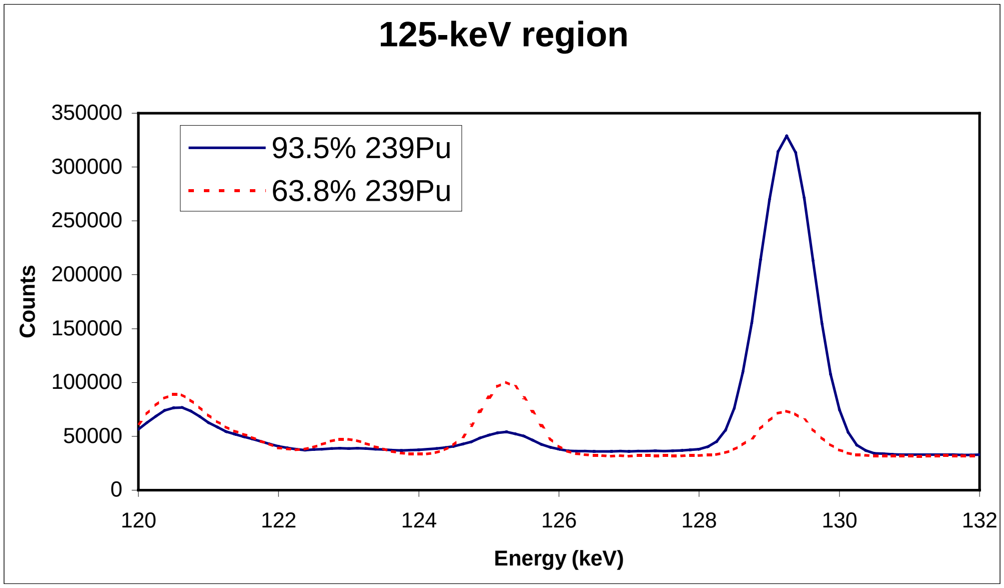

Fig. 1. Sample spectra for the 93.5% and 63.4% ^{239}Pu sources in the 125-keV region.

a. 125.2-keV BR determination

As for the 125.2-keV peak of ^{239}Pu, it was fixed to the 129.2-keV peak. Its BR was changed to three different values and the 12 spectra listed in Section IV.A above was analyzed. The corresponding areas of the 125.3-keV peak of ^{241}Am were obtained. These areas were then least-squares fitted to Eq. 3 and the residual sums of squares were recorded. From these three points, which a quadratic curve can be applied, we calculated the BR value of the 125.2-keV that would give the smallest residual sum of squares.

b. 124.5- and 125.2-keV peak energy determination

The energies of the 124.5- and 125.2-keV peaks were also modified slightly to fit the data better. The spectra taken of the Stdiso3 source with the planar detector were used. The planar detector has much better energy resolution in this low-energy region than the coaxial detector so the energies of the peaks can be determined better. The reason this source was chosen because it has a very small ratio of ^{241}Am to ^{239}Pu and the intensities of the 124.5- and 125.2-keV peaks of ^{239}Pu are comparable to the intensity of the 125.3-keV peak of ^{241}Am.

The summed spectrum of these spectra was analyzed. The energy of the 124.5-keV peak was changed slightly to three different values and the spectra were analyzed. From the least-squares fits of this region, we found three different residual sums of squares. From these three values, the best energy for this 124.5-keV peak was obtained. The best energy for the 125.2-keV peak was also found in a similar manner.

2. 160-keV complex

This is an important region for the analysis using the peaks in the range 120 to 500 keV. This region is the only choice for measuring ^{240}Pu. There are four peaks in this small region: 160.0 keV from ^{241}Pu, 160.2 and 161.5 keV from ^{239}Pu, and 160.3 keV from ^{240}Pu. The goal is to accurately determine the intensity of the 160.3-keV peak of ^{240}Pu.

The 160.2-keV peak of ^{239}Pu is weak and the 161.5-keV peak of ^{239}Pu is sufficiently far away from the 160.3-keV peak that they both do not significantly affect the outcome of the 160.3-keV peak. However, the 160.0-keV peak of ^{241}Pu is intense, even more intense than the 160.3-keV peak for high burnup plutonium. Therefore, it is very important to correctly strip out the 160.0-keV peak of ^{241}Pu.

In the parameter file, the 160.0-keV peak was fixed to the 148.6-keV peak of ^{241}Pu. The BR and energy of the 160.0-keV peak were determined the same way as described in Section IV.B.1.a and IV.B.1.b.

3. 332-keV complex

This complex consists of the two co-energetic peaks at 332.4 keV of ^{241}Pu-^{237}U and ^{241}Am and the 332.8-keV peak of ^{239}Pu. The 332.8-keV peak was fixed to the 345.0-keV peak of ^{239}Pu. The BR of the 332.8-keV peak was determined in a similar manner as in section IV.B.1.a with one exception: the residual sums of squares were obtained from the fit of the co-energetic peak pair at 332.4 keV instead of the simple least-squares fit the Eq. 3 of the single peak. The technique to fit the co-energetic peak pairs of ^{241}Pu and ^{241}Am will be described later.

4. 335-keV complex

This complex consists of the two co-energetic peaks at 335.4 keV of ^{241}Pu and ^{241}Am and the 336.1-keV peak of ^{239}Pu. The 336.1-keV peak was fixed to the 345.0-keV peak of ^{239}Pu. This BR of the 336.1-keV peak was determined exactly the same way as the 332.8-keV peak in the 332-keV complex.

5. 368-keV complex

Four gamma rays are present in this complex: the 367.0- and 368.5-keV peaks of ^{239}Pu and the two co-energetic peaks of ^{241}Pu and ^{241}Am at 368.6 keV. The 367.0-keV peak is far enough that it only weakly interfered with determining the intensity of the 368.6-keV co-energetic pair. Only the BR of the 368.5-keV peak needs to be determined accurately in order to obtain the intensity of the 368.6-keV pair correctly.

In the parameter file, the 368.5-keV peak was fixed to the 367.0-keV peak of ^{239}Pu. Its BR was determined exactly the same way as the 332.8-keV peak in the 332-keV complex.

6. 414-keV complex

There are three known gamma rays in this complex: the 411.0- and 413.7-keV peaks of ^{239}Pu and the 415.8-keV peak of ^{237}Np. (Neptunium-237 is the decay product of ^{241}Pu and ^{241}Am and is always present in plutonium samples.) The 411.0- and 415.8-keV peaks are very weak and should not significantly interfere with determining the intensity of the 413.7-keV peak. However, this region exhibits additional complexity from the random sum peak of the 208-keV gamma rays. The 208-keV peak is often the strongest peak in the energy region above 120 keV and its intensity becomes much larger as the burnup increases. For high burnup plutonium, the sum peak of two 208-keV gamma rays at about 416 keV could significantly interfere with determining the intensity of the 413.7-keV peak. This sum peak is very difficult to strip out of the 414-keV complex because the peak is much broader than the normal peaks and its intensity is not known.

Its intensity depends on many factors: burnup, source and absorber thickness, source-detector distance, detector size and efficiency, etc.

In this work, we introduced two close lying peaks near 416 keV as approximation for the broad 416-keV sum peak. These two peaks were arbitrarily chosen to have the same intensity. One peak is free and the other is fixed to its partner. The energies of these peaks were manually adjusted such that the intensity of the 413.7-keV peak appears to fit well into the relative efficiency curve and the least-squares fit of the 414-keV complex appears to be reasonable.

We also introduce one more peak into this complex. The 411.8-keV peak was set to be free. We don't know where this peak comes from but it apparently fits well into this complex and makes the least-squares fit of this complex appear better.

7. 642-keV complex

This complex consists of three peaks: the 640.0-keV peak of ^{239}Pu, the 641.5-keV peak of ^{241}Am, and the 642.5-keV peak of ^{240}Pu. The objective is to determine the intensity of the 642.5-keV peak. It is the only peak above 165 keV that can be used to measure the activity of ^{240}Pu. The 640.0-keV peak is far enough away from the 642.5-keV peak that its interference is negligible. The intensity of the 641.5-keV peak needs to be stripped out. It was fixed to the 662.5-keV line of ^{241}Am and its BR was determined the same way as in Section IV.B.1.a.

8. 766-keV complex

This complex has many peaks: 763.3, 766.9, 770.5, and 772.1 keV from ^{241}Am; 766.4 keV from ^{238}Pu; and 766.5, 767.5, and 769.3 keV from ^{239}Pu. The two peaks that need to be correctly determined are the 766.4- and 769.3-keV peaks. The 766.4-keV gamma ray is the only peak above 155 keV to be used for the activity of ^{238}Pu. The 769.3-keV gamma ray of ^{239}Pu is useful in low burnup materials for extending the efficiency curve to this high-energy region.

The main interference of the 766.4-keV peak comes from the 766.5- and 766.9-keV lines. The 766.5-keV line was fixed to the 769.3-keV peak of ^{239}Pu and the 766.9-keV line was fixed to the 722.0-keV peak of ^{241}Am. The BRs and energy of these two peaks were determined the same ways as in Section IV.B.1.

The main interference of the 769.3-keV peak comes from the 770.5-keV peak that was fixed to the 722.0-keV line of ^{241}Am. The intensity and energy of this peak were manually adjusted such that the intensity of the 769.3-keV peak appears to fit well into the relative efficiency curve and the least-squares fit of the region appears to be reasonable.

C. Obtaining the BRs of the co-energetic pairs of 241Pu and 241Am

Plutonium-241 decays to both ^{241}Am and ^{237}U. Uranium-237 has short half-life, 6.75 days. After about seven half-lives, the decay rate of ^{237}U becomes the same as the decay rate of ^{241}Pu. After that time, gamma rays from the decay of ^{237}U can be used as a measure of the amount of ^{241}Pu in a sample. Because ^{237}U has several strong gamma rays, it is an important isotope for plutonium isotopic determination.

Both ^{237}U and ^{241}Am decay to the same isotope, ^{237}Np. Many of these decays populate the same excited states in ^{237}Np and give rise to identical gamma rays. Thus, most of the intense, useful ^{237}U gamma rays have a contribution from the ^{241}Am in the sample. The amount of this interference depends upon the particular gamma ray and how long the ^{241}Am has grown into the sample. To obtain the intensities of these peaks correctly, the relative BRs of these peaks must be very accurately known.

It is observed that the three co-energetic pairs at 164.6, 208.0, and 267.5 keV decay from the same excited level of ^{237}Np. Therefore, the ^{241}Pu peak to ^{241}Am peak ratios of these three pairs must be the same. Similarly, the ^{241}Pu peak to ^{241}Am peak ratios of the 335.4- and 368.6-keV pairs must also be the same. These were taken into account in determining the BRs of these peaks.

After the steps in Section IV.A, the relative efficiency curves of the 12 spectra and the areas of the peaks were obtained. For these co-energetic pairs, the areas of the single peaks may not be correct because of the incorrect BRs used in the parameter file. However, the sum area of a co-energetic pair is correct. From Eq. 2, we have

$$\text{Area/BR} = \varepsilon I_i,$$

where ε is the relative efficiency (the right hand side of Eq. 2 without the isotope activity) and I_i is the activity of the isotope i. Then for the ^{241}Pu and ^{241}Am,

$$\text{Area}_{\text{peak of 241Pu}}/\varepsilon = I^{241}{}_{\text{Pu}}\text{BR}_{\text{peak of 241Pu}} \text{ and } \text{Area}_{\text{peak of 241Am}}/\varepsilon = I_{\text{241Am}}\text{BR}_{\text{peak of 241Am}}\ .$$

For a pair of co-energetic peaks, the relative efficiency ε is the same. Therefore they can be combined.

$$\text{Area}_{\text{total}}/\varepsilon = I_{\text{241Pu}}\text{BR}_{\text{peak of 241Pu}} + I_{\text{241Am}}\text{BR}_{\text{peak of 241Am}}\quad , \tag{5}$$

where $\text{Area}_{\text{total}} = \text{Area}_{\text{peak of 241Pu}} + \text{Area}_{\text{peak of 241Am}}$.

Rearranging the terms to account for the fact that the ^{241}Pu peak to ^{241}Am peak ratios of some of the co-energetic pairs are the same, then

$$\text{Area}_{\text{total}}/\varepsilon = I_{j\text{241Am}}\,(r\text{BR}_{\text{peak of 241Pu}} + \text{BR}_{\text{peak of 241Am}})\quad , \tag{6}$$

where r is the ^{241}Pu peak to ^{241}Am peak ratio and j is the index for a group of pairs with the same ^{241}Pu peak to ^{241}Am peak ratio. The value j ranges from one to three for the three co-energetic pairs at 164.6, 208.0, and 267.5 keV, from one to two for the two pairs at the 335.4- and 368.6-keV, and for all other pairs, j is just one. Expressing the equation this way, one can be assured that the ^{241}Pu peak to ^{241}Am peak ratios of the peaks decaying from the same excited level of ^{237}Np would be the same.

The BRs of these peaks were finally obtained by fitting the co-energetic pair data of the 12 spectra to Eq. 6.

V. PARAMETER FILES

A. Constructions of the parameter files

New parameter files were constructed using the new BRs. For the planar detector, the energy range was 125-414 keV with the energy calibration of 0.1 keV/ch. For the coaxial detector, three different energy ranges were used: 125 to 451 keV, 125 to 769 keV, and 203 to 769 keV. The energy calibration was 0.125 keV/ch. To make these parameter files as universal as possible, they all were constructed in a very similar way.

Because of different energy calibration and better resolution of the planar detector, the ROI and BG regions of the parameter file for the planar detector are slightly different than those for the coaxial detector. As for the peak dependencies (one peak is fixed to another peak in the striping of the peaks in a complex region) or peaks used in the calculations of the activities, efficiencies, energy calibrations, peak widths and shapes, all the peaks were set the same way within the parameters' energy ranges. All these settings were similar to those in the current parameter files.

The main exception was the peak dependencies of the co-energetic peak pairs of ^{241}Pu and ^{241}Am. In the current parameter files, for these co-energetic pairs, the peaks of ^{241}Am were fixed to and the areas were summed with the ^{241}Pu peaks in determining the activities. It was found that, especially with weak data, the code sometimes could not unravel the pairs, which resulted in wrong results for the concentration of ^{241}Pu and ^{241}Am. For the new parameters, we fix one of the peaks of a co-energetic pair to an intense peak of its respective isotope and let the other peak be free (the same way as with other interference peaks). This ensures that we always get the correct peak areas of these peaks.

Either method of unraveling these co-energetic pairs has some advantages and disadvantages. The method used in the current parameter files, in theory, is the best one. If the BRs are correct then, regardless of the relative intensities of the peaks in a pair, the intensities of the peaks can be calculated accurately and the errors will be at the minimum. However, the current FRAM codes (both v2.x and 3.x) underestimate the calculated errors of these components, which may affect determining the activities of both ^{241}Pu and ^{241}Am in the sample. So we resort to use the second method until the error calculations of these co-energetic pairs are fixed in the FRAM code.

The new method of unraveling the co-energetic pairs also has some disadvantages. The first disadvantage is that its errors are larger than those using the current method. The second disadvantage is that it works well with the samples where the ^{241}Am to ^{241}Pu ratio is in the range from about 0.1 to 10 (or the time since chemical separation of about 2 to 50 years) but may encounter some problem when outside of that range.

Figure 2 shows the ^{241}Am to ^{241}Pu peak area ratios for these co-energetic peak pairs since the time of chemical separation of the americium from the plutonium. Near the time of the separation, the ratios of all peaks are very small. But as the time increases, the ratios also increase quickly. For the 335-keV group, the ratio passes the value 1.0 (that is the intensity of ^{241}Am component becomes larger than that of ^{241}Pu) after only two years. For other groups, it is a bit longer. The ratio of the 370.9-keV pair takes a bit longer than 20 years to reach the value 1.0. For the 332.4-keV pair and the 208.0-keV group, they are 42 and 65 years, respectively.

Meanwhile, the isotopic fraction of ^{241}Am would surpass that of ^{241}Pu after about 14.5 years or about one half-life of ^{241}Pu.

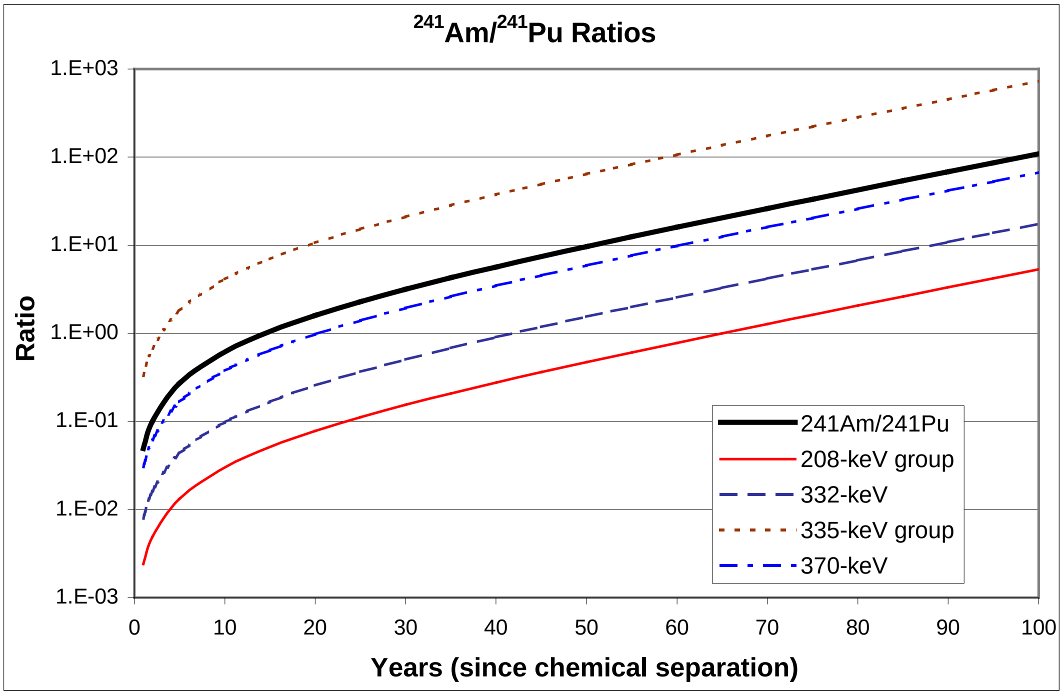

Fig. 2. The ^{241}Am to ^{241}Pu ratios for the co-energetic peak pairs. The 208-keV group consists of the 164.6-, 208.0-, and 267.5-keV peaks. The 335-keV group consists of the 335.4- and 368.6-keV peaks

Most of the plutonium samples that we analyze today have a separation date of 30 years or less. From Fig. 2, it is seen that for the 335-keV group, the ^{241}Am component is much larger than the ^{241}Pu component. Therefore, one should fix the ^{241}Pu peaks and use only the ^{241}Am peaks in this group to determine the activity (and maybe efficiency) of ^{241}Am in the plutonium material. Because of the large ^{241}Am to ^{241}Pu peak ratios, any error in calculating the intensity of the ^{241}Pu peaks will translate into a much smaller error for the ^{241}Am peaks. For this group, the peaks from ^{241}Pu are fixed to the 208-keV peak of ^{241}Pu while their counterparts from ^{241}Am are free.

Similiarly, for the 208-keV group and the 332.4-keV pair, one should fix the ^{241}Am component and use only the ^{241}Pu peaks for the calculation of the activity of ^{241}Pu. For the co-energetic peak pairs at 164.6, 208.0, and 267.5 keV, the peaks from ^{241}Am are fixed to the 125.3-keV peak and their counterparts from ^{241}Pu are free. For the parameter using the energy range from 203-769 keV, the 125.3-keV peak is not available. So those peaks from ^{241}Am are fixed to the 662.5-keV peak. For the co-energetic peak pair at 332.4 keV, the peak from ^{241}Am is fixed to the 335.4-keV peak of ^{241}Am and the peak from ^{241}Pu is free.

For the 370.9-keV pair, both components have similar intensity. Therefore, one can use either one to determine the activity. However, if the plutonium sample is heavily shielded, most of the low-energy peaks of ^{241}Pu may not be available and the 370.9-keV peak of ^{241}Pu will become important in determining ^{241}Pu. (Americium-241 has good peaks at high energy that it does not need the contribution from the 370.9-keV component.) For this pair, we fix the peak from ^{241}Am to that of its counterpart. The reason for this is that if the chemical separation time has been more than 20 years then the intensity of the ^{241}Am component will be more than that of the ^{241}Pu component. If for some reason the total intensity of this complex is off slightly and if the ^{241}Am peak is fixed to another peak of ^{241}Am, then any error in calculating that peak will be magnified in determining the ^{241}Pu peak error. Fixing the ^{241}Am peak to the ^{241}Pu peak has the effect of spreading the error over both the ^{241}Am and ^{241}Pu components. Thus the error of the ^{241}Pu peak will be less.

We also obtained the BRs of some weaker peaks of ^{239}Pu but do not use them in the new parameter files. The 144.2-keV peak was found to be interfered by some unknown peak. Its relative intensity increases rapidly as the burnup increases (up to 20% for high burnup plutonium, compared with low burnup plutonium). Because of the lack of time and the relative unimportance of this peak, we did not investigate the interference peak nor use this 144.2-keV peak in determining ^{239}Pu. Some other weaker peaks of ^{239}Pu above 600 keV were also found to be contaminated by some unknown peaks so they were not used.

B. Determination of the BRs from the 238Pu and 240Pu

Both ^{238}Pu and ^{240}Pu have only two peaks that can be used to determine their activities, one at low energy and one at high energy. Pu-238 has peaks at 152.7 and 766.4 keV. Pu-240 has peaks at 160.3 and 642.5 keV. The intensities of those peaks are relatively easier to determine than many others (such as some peaks described in section IV.B or those co-energetic peak pairs of ^{241}Pu and ^{241}Am). They, especially those of ^{240}Pu, are perhaps the most important peaks in the plutonium spectra. So the BRs of those peaks were adjusted to match the data after all other steps were done. We also employed all the data sets, instead of 12 sets as before, in determining these BRs.

All the single spectra from each source shown in Table I and II were summed together to obtain a single sum spectrum. Twenty-five sum spectra from the planar detector and 26 sum spectra from the coaxial detector were used. The spectra for the planar were all of those listed in Table I without those from the A1-92 and A1-86 sources. The spectra for the coaxial detector were all those without the lead absorber listed in Table II minus the ones from A1-92, A1-86, and the Pidie6-1 sources. The reason for excluding the A1-92, A1-86, and Pidie6-1 sources from the analysis is that after some preliminary analysis, we found that the accepted isotopic values for these sources may not be correct. For the sources with the lead absorber, the low energy peaks are not available so we do not use them.

For the low-energy peaks, the parameter files with the energy range from 125 to 414 keV (for the planar detector) and 125 to 451 keV (for the coaxial detector) were used to analyze these sum spectra. The BRs of the 152.7- and the 160.3-keV peaks were adjusted accordingly to obtain the best agreements between the accepted and calculated values.

For the high-energy peaks, the 26 files from the coaxial detector were analyzed using the parameter file with energy range from 203 to 769 keV. The BRs of the 642.5- and 766.4-keV peaks were also adjusted to obtain the best results.

VI. RESULTS WITH THE NEW BRANCHING RATIOS

Finally, the parameter files for both the planar and coaxial detectors were constructed for various energy regions. The new parameter files were given names according to the detector type and the energy ranges. Only one parameter file was created for the planar detector (Pu125_414Pl). Three parameter files was made for the coaxial detector covering three different energy ranges: Pu125_451Cx, Pu125_769Cx, and Pu203_769Cx. Appendix C lists the parameters of the Pu125_444Pl and Pu125_769Cx parameter sets. All the spectra from all the sources shown in Tables I and II were analyzed with these four new parameter files using both the empirical efficiency model (FRAM v3.2) and the physical based efficiency model (FRAM v2.99). When analyzed using the physical base model, the thickness limits for the plutonium and the absorbers were set at: 0.5 to 20 g/cm^2 for the plutonium, 1.5 to 4.0 mm for the cadmium absorber, and 0-2.0 mm for the steel absorber. If the lead absorber was also used then the limit for lead was 1.5 to 4.5 mm. The detector thickness for the planar detector was 15 mm and for the coaxial detector was 42 mm. They were also analyzed with the three current parameter files (Widerange6 for the planar detector data, Coax8k125.3 for the energy range of 125 to 451 keV of the coaxial detector, and ShldCoax4.3 for the energy range of 203 to 769 keV of the coaxial detector) using FRAM 3.2. For the analysis of the coaxial detector data at low energy, because the lead absorber absorbs all the low-energy gamma rays, only the spectra taken without the lead absorber were used. For the analysis using the Pu203_769Cx and ShldCoax4.3 parameter files, all the spectra from the coaxial detector were used.

A. Unweighted results

The average results from the analysis of each data set (or source) are shown in Appendix A. To have a better and simpler picture of the results, we average all these average results and report these "averages of the averages" in this section. The unweighted average is defined as

$$\bar{x} = \sum x_i \Big/ n\,,$$

where n is the number of data sets.

And the error is the standard deviation divided by the square root of the number of data sets, which is

$$\text{err} = \sigma \Big/ \sqrt{n} = \sqrt{\sum (x_i - \bar{x})^2 \big/ (n-1)} \Big/ \sqrt{n} = \sqrt{\sum (x_i - \bar{x})^2 \big/ [n(n-1)]}\,.$$

Table III shows the unweighted averages of the average results from each source divided by the accepted values. Not all the data points were used in the calculations of these average results. Some of the points where the results are unexpectedly far from the accepted values were not used. The excluded data points are shown in Appendix A.

Table III. Unweighted averages of the average results from each source divided by the accepted values.

Parameter		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
Widerange6	Ave	1.00326	0.99980	1.00108	0.99746	0.99996	1.00003	1.00105
	Err	0.00538	0.00025	0.00122	0.00123	0.00307	0.00059	0.00115
Pu125_414Pl	Ave	0.99514	1.00024	0.99683	0.99614	0.99496	0.99859	0.99672
(empirical)	Err	0.00552	0.00026	0.00144	0.00150	0.00289	0.00049	0.00138
Pu125_414Pl	Ave	0.99781	1.00001	0.99919	0.99576	0.99602	0.99913	0.99904
(physical)	Err	0.00514	0.00030	0.00161	0.00140	0.00282	0.00064	0.00152
Coax8k125.3	Ave	1.00022	1.00005	0.99964	1.00157	0.99887	1.00038	1.00121
	Err	0.00347	0.00035	0.00177	0.00073	0.00350	0.00064	0.00231
Pu125_451Cx	Ave	0.99504	0.99983	1.00310	0.99945	1.00045	1.00028	1.00316
(empirical)	Err	0.00401	0.00017	0.00165	0.00084	0.00229	0.00031	0.00160
Pu125_451Cx	Ave	0.99326	0.99964	1.00446	0.99999	1.00132	1.00028	1.00442
(physical)	Err	0.00426	0.00020	0.00159	0.00074	0.00228	0.00027	0.00152
ShldCoax4.3	Ave	1.00684	0.99855	1.00383	0.99939	1.00260	1.00178	1.00294
	Err	0.00784	0.00052	0.00223	0.00354	0.00210	0.00100	0.00203
Pu203_769Cx	Ave	0.99460	1.00063	0.99468	0.99915	1.00172	0.99874	0.99250
(empirical)	Err	0.00573	0.00036	0.00189	0.00142	0.00147	0.00060	0.00197
Pu203_769Cx	Ave	0.99638	1.00074	0.99566	1.00105	1.00341	0.99905	0.99368
(physical)	Err	0.00579	0.00046	0.00216	0.00124	0.00141	0.00065	0.00215
Pu125_769Cx	Ave	0.98741	1.00005	0.99925	0.99971	1.00100	0.99955	0.99923
(empirical)	Err	0.00588	0.00015	0.00109	0.00084	0.00157	0.00054	0.00109
Pu125_769Cx	Ave	0.98698	0.99992	1.00071	1.00062	1.00421	0.99992	1.00061
(physical)	Err	0.00485	0.00011	0.00095	0.00083	0.00174	0.00053	0.00096

The biases of the average values (compared to the accepted value of one) appear to be most of the time less than 1%. However, if some or all of the discarded points were also used in the calculations of the averages then the results might be very much different. We did not include those points because while they are far from the accepted values, their errors are also very large. Also, some of the points determined to be different from the accepted values were due to the inaccuracy of the accepted values. From the Appendix A, we found that the accepted values of ^{238}Pu for the A1-92, A1-86, and Pidie6-1 were perhaps not correct. The sources contain only about 0.01% of ^{238}Pu so it is not surprising to see the chemical analysis reporting the results of these off by 10% or more.

B. Weighted results

If the errors of all the data sets are similar then the unweighted average results should be valid. However, if the errors were not the same, the data sets with large errors would tend to scatter more and influence the average and its error more than the sets with small errors. This is opposite of what should be; the data sets with larger errors should be less influential on the outcome.

Therefore, we believe it is better to obtain the average using the weighted average method. Table IV shows the weighted averages of the average results from each source divided by the accepted values. The values from A1-92, A1-86, and Pidie6-1 sources were not used.

Table IV. Weighted averages of the average results from each source divided by the accepted values.

Parameter		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
Widerange6	Ave	1.00908	0.99986	1.00209	0.99792	0.99505	0.99982	1.00220
	Err	0.00258	0.00013	0.00126	0.00116	0.00210	0.00056	0.00119
Pu125_414Pl (empirical)	Ave	0.99819	1.00030	0.99761	0.99713	0.99559	0.99861	0.99799
	Err	0.00228	0.00014	0.00117	0.00131	0.00147	0.00038	0.00112
Pu125_414Pl (physical)	Ave	0.99690	1.00019	0.99834	0.99533	0.99615	0.99859	0.99852
	Err	0.00215	0.00011	0.00086	0.00125	0.00143	0.00037	0.00082
Coax8k125.3	Ave	0.99778	1.00023	0.99616	1.00248	1.00354	1.00064	0.99670
	Err	0.00150	0.00018	0.00144	0.00065	0.00307	0.00068	0.00133
Pu125_451Cx (empirical)	Ave	1.00100	0.99980	1.00055	1.00035	1.00208	1.00055	1.00034
	Err	0.00138	0.00008	0.00092	0.00057	0.00123	0.00023	0.00083
Pu125_451Cx (physical)	Ave	1.00025	0.99968	1.00236	1.00031	1.00087	1.00051	1.00191
	Err	0.00139	0.00009	0.00091	0.00041	0.00121	0.00023	0.00083
ShldCoax4.3	Ave	1.00594	0.99969	1.00681	0.99735	0.99877	1.00113	1.00677
	Err	0.00442	0.00020	0.00169	0.00234	0.00164	0.00074	0.00156
Pu203_769Cx (empirical)	Ave	1.00020	1.00053	0.99725	1.00093	1.00109	0.99899	0.99739
	Err	0.00292	0.00013	0.00167	0.00080	0.00125	0.00042	0.00159
Pu203_769Cx (physical)	Ave	0.99931	1.00013	1.00133	1.00226	1.00270	0.99998	1.00108
	Err	0.00323	0.00017	0.00173	0.00067	0.00111	0.00046	0.00166
Pu125_769Cx (empirical)	Ave	1.00375	0.99990	1.00037	1.00013	1.00140	1.00066	1.00014
	Err	0.00182	0.00008	0.00084	0.00065	0.00124	0.00035	0.00077
Pu125_769Cx (physical)	Ave	1.00079	0.99979	1.00173	1.00066	1.00466	1.00100	1.00134
	Err	0.00162	0.00006	0.00072	0.00050	0.00151	0.00040	0.00067
Ave(4k & shld) (empirical)	Ave	1.00099	0.99998	1.00002	1.00059	1.00280	1.00054	0.99985
	Err	0.00139	0.00006	0.00060	0.00059	0.00110	0.00024	0.00054
Ave(4k & shld) (physical)	Ave	1.00010	0.99979	1.00196	1.00076	1.00294	1.00083	1.00144
	Err	0.00122	0.00008	0.00084	0.00046	0.00095	0.00028	0.00078

The equation for the weighted average is

$$\bar{x} = \left(\sum w_i x_i\right) \Big/ \sum w_i \quad ,$$

where $\bar{x}$ is the weighted average, x_i is the individual data, w_i = weight of data set i = square inverse of the error of data set i. The error of each individual set in turn is the standard deviation divided by the square root of the number of runs in each set. The number of runs (or spectra) of each set is shown in Tables I and II.

The error is defined as [7]

$$\mathrm{err} = \sigma / \sqrt{n} = \sqrt{\frac{n\sum w_i (x_i - \bar{x})^2}{(n-1)\sum w_i}} \Big/ \sqrt{n} = \sqrt{\frac{\sum w_i (x_i - \bar{x})^2}{(n-1)\sum w_i}} \quad .$$

From Table IV, the biases of the weighted averages are about the same as or may be slightly less than those of the unweighted averages. The biases appear to be somewhat larger than the errors. This is expected since in the error propagation, we did not include the error of the accepted values. Also, in determining the BRs, we found a set of the BRs that works well (but not perfect) with both the empirical and physical efficiency curves. If we are not restricted to a set of BRs satisfying both requirements then two different sets of BRs can be generated, and each would work perfectly with their respective efficiency curve fit equation. This would sure add more precision to the calculated values.

Table IV is arranged into groups for easy comparison. The results from the planar detector are in one group, the results from the coaxial detector analyzed with the low-energy parameter files are in another group, and so on. In general, the results (both the average values and the errors) from a parameter set analyzed with both the empirical and physical models are similar. They both appear to be somewhat better than those analyzed with the current parameter files. For the parameter sets for the low-energy region of the coaxial detector, the results with the new parameter are even much better, about twice better than those using the Coax8k125.3 parameter file. With this new parameter file, the results for the low-energy region of the coaxial detector now appear to be even better than that of the planar detector. For the high-energy region, the new parameter has significantly improved the bias of ^{241}Pu. (With the current ShldCoax4.3 parameter file, it is about 2% low with low-burnup plutonium and about 5% high with high-burnup plutonium.)

The parameter file Pu125_769Cx, which covers the entire energy region, was expected to give the best results due to more data to work with. However, its results are not better than that of the Pu125_451Cx, which works only in the low-energy region. The reason is that the BRs of the peaks used to determine the ^{238}Pu and ^{240}Pu were obtained using the parameter files working in separate energy regions as described in Section V.B. The relative efficiency curve of the whole region is not exactly the same as the combined efficiency curves of the two separate regions. Therefore, even though the BRs of the peaks of ^{238}Pu and ^{240}Pu may be correct in either the low- or high-energy regions, they may not be quite compatible when applied to the whole energy region.

In Table IV, we also included the average results of the analysis using both the Pu125_451Cx and the Pu203_769Cx parameter files. These are called Ave(4k & shld) in the table. To obtain these, each spectrum without the lead absorber of the coaxial detector is analyzed twice, one with the Pu125_451Cx parameter file and one with the Pu203_769Cx parameter file. The results for each spectrum are the weighted average of the two sets of results from the two different analyses. The rest of the calculations are the same as with the others.

These results from the averages of both the Pu125_451Cx and Pu203_769Cx parameters sets are about the same or only slightly better than that from the Pu125_451Cx parameter set alone. It may not be practical to double the analytical time in order to improve the results just a tiny amount.

C. Results from the low-burnup plutonium

In many U.S. facilities where plutonium isotopic analysis is required, most of the measured plutonium samples are of low-burnup plutonium. It is interesting to look at the results of the low-burnup plutonium only. Table V shows these results.

Table V. Weighted averages of the average results from each source divided by the accepted values. These are for the sources with the concentration of ^{239}Pu of 92% or more.

Parameter		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
Widerange6	Ave	1.00662	0.99994	1.00093	0.99742	0.99743	1.00012	1.00092
	Err	0.00575	0.00009	0.00130	0.00122	0.00297	0.00025	0.00129
Pu125_414Pl	Ave	0.99899	1.00032	0.99523	0.99552	0.99106	0.99893	0.99528
(empirical)	Err	0.00562	0.00009	0.00126	0.00136	0.00364	0.00037	0.00125
Pu125_414Pl	Ave	0.99930	1.00020	0.99696	0.99407	0.99228	0.99909	0.99699
(physical)	Err	0.00507	0.00007	0.00105	0.00145	0.00386	0.00032	0.00103
Coax8k125.3	Ave	1.00313	0.99992	1.00177	1.00325	0.98051	0.99910	1.00170
	Err	0.00633	0.00019	0.00353	0.00095	0.00848	0.00051	0.00341
Pu125_451Cx	Ave	0.99397	0.99972	1.00534	0.99863	0.99848	1.00040	1.00517
(empirical)	Err	0.00601	0.00011	0.00228	0.00095	0.00333	0.00039	0.00223
Pu125_451Cx	Ave	0.99010	0.99969	1.00522	1.00024	0.99923	1.00042	1.00504
(physical)	Err	0.00562	0.00011	0.00240	0.00084	0.00303	0.00037	0.00235
ShldCoax4.3	Ave	1.00827	0.99997	1.00170	0.99214	0.99550	0.99936	1.00154
	Err	0.01689	0.00010	0.00150	0.00316	0.00131	0.00056	0.00155
Pu203_769Cx	Ave	1.00565	1.00070	0.98959	1.00038	0.99996	0.99806	0.98971
(empirical)	Err	0.00643	0.00012	0.00226	0.00133	0.00164	0.00045	0.00225
Pu203_769Cx	Ave	1.00906	1.00038	0.99462	1.00207	1.00201	0.99890	0.99467
(physical)	Err	0.00725	0.00012	0.00205	0.00113	0.00140	0.00042	0.00203
Pu125_769Cx	Ave	0.98909	0.99988	1.00247	0.99803	0.99902	0.99996	1.00236
(empirical)	Err	0.00614	0.00009	0.00159	0.00101	0.00209	0.00038	0.00159
Pu125_769Cx	Ave	0.98612	0.99981	1.00314	1.00059	1.00386	1.00020	1.00301
(physical)	Err	0.00333	0.00006	0.00133	0.00088	0.00294	0.00030	0.00131
Ave(4k & shld)	Ave	1.00142	0.99998	1.00086	0.99923	1.00175	1.00031	1.00085
(empirical)	Err	0.00500	0.00006	0.00104	0.00105	0.00228	0.00033	0.00104
Ave(4k & shld)	Ave	1.00282	0.99983	1.00264	1.00058	1.00403	1.00065	1.00259
(physical)	Err	0.00544	0.00009	0.00179	0.00089	0.00199	0.00031	0.00176

The results from this table are not much different than that from Table IV. The overall errors are somewhat larger than in Table IV. This is due to the smaller sets of data. There are two main differences between this table and Table IV: the errors of ^{238}Pu and ^{239}Pu. For low-burnup plutonium, the fraction of ^{238}Pu is very small; therefore, its error is larger. Meanwhile, the fraction of ^{239}Pu becomes larger and so its error is smaller, even with less statistics.

D. Comparison of FRAM's measured errors and the observed errors

FRAM analyzes and reports both the isotopic results and the corresponding errors. It is of interest to see how the reported error of an isotope compared with the error of the same isotope from many runs. Table VI shows the ratios of the average error predicted by FRAM to that of the observed error from multiple runs. The average predicted values are the unweighted average errors of a data set reported by FRAM. The observed values are the standard deviations of the results in a data set. For a data set containing an infinite number of runs, the standard deviation is the true error of a run. The average number of runs in all of our data sets was only about ten or slightly more. Therefore, the observed errors are not the true errors of these data sets. However, they would be close and the ratios shown in Table VI would indicate how well FRAM report its errors.

Table VI. Weighted averages of the average results from each source divided by the accepted values. These are for the sources with the concentration of ^{239}Pu of 92% or more.

Parameter	^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spc Pow	^{240}Pu Eff
Widerange6	1.14	1.03	1.05	0.56	0.62	1.45	1.05
Pu125_414Pl (empirical)	1.14	0.99	1.01	0.54	0.65	1.37	1.00
Pu125_414Pl (physical)	1.28	1.12	1.14	0.63	0.74	1.56	1.13
Coax8k125.3	0.92	0.92	0.92	0.64	1.00	1.26	0.93
Pu125_451Cx (empirical)	0.92	0.89	0.89	0.55	0.79	1.24	0.91
Pu125_451Cx (physical)	1.02	0.95	0.97	0.56	0.83	1.26	0.97
ShldCoax4.3	0.70	0.94	0.95	0.58	0.57	1.15	0.95
Pu203_769Cx (empirical)	0.72	0.98	0.99	0.48	0.76	1.17	0.99
Pu203_769Cx (physical)	0.72	1.04	1.05	0.54	0.87	1.28	1.05
Pu125_769Cx (empirical)	0.86	0.80	0.81	0.45	0.81	1.13	0.81
Pu125_769Cx (physical)	0.89	0.88	0.90	0.45	0.68	1.14	0.90
Ave(4k & shld) (empirical)	0.84	0.83	0.84	0.43	0.69	1.17	0.85
Ave(4k & shld) (physical)	0.89	0.91	0.93	0.47	0.75	1.26	0.93

For all the parameter sets, the reported errors for ^{241}Pu appear to be about half of the observed errors. This is mainly due to determining the error of the 208-keV peak of ^{241}Pu. The 208-keV peak is the most intense peak of ^{241}Pu (and most of the time, of all the isotopes). Due to its weight, the activity of ^{241}Pu is determined mainly from this peak alone. Its peak area can be very accurately determined and the error is normally very small. However, in determining the relative efficiency curve, this peak and other peaks from ^{241}Pu are normalized the peaks of ^{239}Pu. The true error of this peak, relative to the ^{239}Pu, should be much larger than the error from peak area determination. If this true error is used in determining the activity of ^{241}Pu then the reported error should probably be correct. However, the current FRAM codes do not include the errors from the efficiency curve fit in its error propagation. This makes the reported errors appear too small.

The reported errors for ^{241}Am also appear to be too small, about 70% of the observed errors. For the parameters employing the low-energy region, this discrepancy is probably due to the difficulty in obtaining the peak area of the 125.3-keV peak of ^{241}Am and also due to the omission of its error from the efficiency curve fitting. (The difficulty with the 125.3-keV peak was described in Section IV.B.) The 125.3-keV peak is the most or the second most intense ^{241}Am peaks in the low-energy region. With its heavy weight, it can significantly affect the outcome activity and reported error of ^{241}Am.

For the parameters employing the high-energy region, the underestimation of the ^{241}Am error probably arises from ignoring the errors from the efficiency calculations of the 662.5- and 722.0-keV peaks of ^{241}Am. Those two peaks are the strongest for ^{241}Am in the high-energy region.

Similarly, for the ^{238}Pu with the parameters using the high-energy region, the discrepancies between the reported and the observed errors are probably due to ignoring the errors from the efficiency least-squares fit. (The reported errors are about 70% of that of the observed errors.)

As for the specific power, it is a bit too high, about 20% larger than the observe errors. This arises from not treating the correlations in the isotopic fractions in the error propagation.

In general, if the reported errors are somewhat smaller than the observed errors, it is mostly due to the calculations of the efficiency curves. In the error propagation in the FRAM code, the errors from the efficiency curves are ignored. We are correcting this in forthcoming versions of FRAM.

E. Precision as function of plutonium mass

It is of interest to compare the precision of different parameter sets analyzing plutonium in different energy range as a function of plutonium mass. Table VII shows the comparison of the data analyzed with the 125_451Cx and 203_769Cx parameter sets using the physical efficiency model. The table is arranged in the order of the plutonium mass from small to large.

Table VII. Pu-240 precision as function of plutonium mass. The ratio on the last column is the ratio of the precision of the data analyzed with the 125_451Cx parameter file to that analyzed with the 203_769Cx parameter file.

Sample Name	^{240}Pu %	Mass (g)	No runs	Cnt rate (kHz)	Cnt time (hr)	125_ 451Cx	203_ 769Cx	Ratio
PIDIE6-1	5.99	0.4	21	3	1	6.20	5.75	1.08
PIDIE6-2	10.11	0.4	21	3.2	1	4.63	3.90	1.19
PIDIE6-3	14.19	0.4	21	3.2	1	4.67	3.78	1.24
PIDIE6-4	19.89	0.4	21	5	1	1.35	3.08	0.44
PIDIE6-5	21.36	0.4	21	15	1	0.89	2.22	0.40
PIDIE6-6	24.34	0.4	21	28	1	1.27	3.39	0.37
PIDIE6-7	26.20	0.4	21	29	1	1.43	3.51	0.41
2G 118	9.01	2.5	10	30	2	0.54	2.05	0.26
2G 119	11.80	2.5	10	30	2	0.48	1.91	0.25
2G 121	16.53	2.5	10	30	2	0.49	1.74	0.28
STDEUPU7	5.86	5.0	10	30	2	0.74	1.67	0.44
CBNM93	6.31	6.0	10	30	2	1.01	1.46	0.69
CBNM84	14.24	6.0	10	30	2	0.65	1.00	0.65
CBNM70	18.60	6.0	10	30	2	1.43	1.88	0.76
CBNM61	25.93	6.0	10	30	2	1.25	1.78	0.70
STDISO6	6.13	8.5	10	30	2	1.16	1.47	0.79
A1-92	5.26	10.0	10	30	2	0.67	2.02	0.33
A1-86	5.61	10.0	10	30	2	0.65	1.95	0.33
STDISO3	3.56	11.0	10	30	2	1.92	2.13	0.90
STDISO9	6.89	11.9	10	30	2	1.20	1.33	0.90
STDISO15	15.48	12.3	10	30	2	0.83	0.98	0.85
STDISO12	11.84	20.2	10	30	2	1.01	0.99	1.02
STDSGA100	3.56	100.0	10	30	2	0.81	2.76	0.29
STD8	6.30	239.5	11	30	1	1.67	2.17	0.77
CALEX	5.86	398.2	10	30	1	2.68	1.76	1.52
JOO132501	5.90	499.6	11	30	1	2.78	1.67	1.66
LAO225	16.53	868.8	10	30	1	0.96	0.92	1.04
STD40	11.79	869.0	11	30	1	1.46	1.36	1.07
STDPUEU7	5.86	2000.0	11	30	1	2.41	1.69	1.43

Except for the few samples (Pidie6-1, Pidie6-2, Pidie6-3, and STDSGA100), the ratio of the 125_451Cx precision to that of 203_769Cx precision is related to the sample mass. (It is independent of the ^{240}Pu fraction.) The precision of the 125_451Cx parameter set is several times better than that of the 203_769Cx parameter set for small plutonium samples. They are about the same for the sample with mass of about 300 g. For the sample with mass larger than 300 g, the 203_769Cx parameter file is better. The comparisons of the Coax8k125.3/ShieldCoax4.3 and 125_451Cx/203_769Cx pairs analyzed using the empirical model are also similar.

One of the reasons for the mass dependency is that as the sample gets larger, because of the self-absorption, less low-energy gamma rays can get out of the source to enter the detector relative to the high-energy gamma rays. Therefore, the parameter employing the high-energy region gives better results for a large sample.

Another reason is that not all the gamma rays entering the detector come directly from the plutonium decay. Some are scattered by the surrounding plutonium atoms or absorber before getting to the detector. There are more low-energy scattered gamma rays than high-energy ones. These scattered gamma rays contribute to the BG region underneath the peaks in a spectrum. As the sample gets larger, the BG in the low-energy region increases quicker than the BG in the high-energy region. This larger BG at low energy also reduces the precision for the 125_451Cx parameter set.

VII. CONCLUSIONS

We have produced a new set of BRs for use in any energy region above 120 keV for isotopic analysis of plutonium spectra. The results with these new BRs are better than that with the parameter files using the current BRs. The results from the low-energy region of the coaxial detector are much better than before and are even better than that of the planar detector. This should give the users one more reason to use the coaxial detector in measuring plutonium instead of the planar detector. Coupling the coaxial detector with a digital MCA (which collects data at higher count rates and throughput and gives better resolution), one can significantly improve the accuracy and precision of the measurements (for the same amount of data collection time).

In the future, we may stop using the empirical efficiency curve in the isotopic determination. When that happens, we will not be restricted to have a set of BRs that must satisfy both the efficiency modes. This will allow us to construct a perfect set of the BRs for the physical efficiency model. Then, the results will be even better.

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APPENDIX A

RESULTS FOR INDIVIDUAL DATA SETS

The tables in this section show the measured to accepted ratio results for individual data sets. Each result is the average of many runs. These are unweighted averages but they are about the same as the weighted averages because the errors for all the runs in a data set are very similar. The numbers of runs for these data sets are shown in Table I and II. The equation for calculating these averages is

$\bar{x}_i = \sum x_{ij} / n_i$, where $\bar{x}_i$ is the average of data set i, x_{ij} is the result j of data set i and n_i is the number of run in the data set i.

The standard deviation is a measure of how widely the results from a data set are dispersed from the average results and is calculated using

$\sigma_i = \sqrt{\sum \left(x_{ij} - \bar{x}_i\right)^2 / (n_i - 1)}$. They are shown in Appendix B.

The averages of these individual data sets are also shown at the bottoms of the tables. Three different sets of averages and errors are shown: unweighted average, weighted average, and low-burnup weighted average. The unweighted averages were obtained using all the data with the omission of some data points where the results are unexpectedly far from the accepted values. The omitted points are mentioned in the captions of the tables. The weighted averages were obtained using all the data except those from the sources A1-92, A1-86, and Pidie6-1. The low-burnup weighted average were obtained using all the data with the fraction of ^{239}Pu more than 91% (omitting those from A1-92, A1-86, and Pidie6-1).

The equation for the unweighted average is

$\bar{x} = \sum \bar{x}_i / n$, where $\bar{x}$ is the average of all the data sets, $\bar{x}_i$ is the average of data set i, and n is the number of data sets.

The errors are the standard deviations divided by the square root of the number of data sets.

$$\text{err} = \sigma / \sqrt{n} = \sqrt{\sum (\bar{x}_i - \bar{x})^2 / (n-1)} \Big/ \sqrt{n} = \sqrt{\sum (\bar{x}_i - \bar{x})^2 / [n(n-1)]} .$$

The equation for the weighted average is

$\bar{x} = \left(\sum w_i \bar{x}_i\right) / \sum w_i$, where $\bar{x}$ is the weighted average, $\bar{x}_i$ is the average of data set i, w_i = weight of data set i = square inverse of the error of data set i.

The error is defined as

$$\text{err} = \sigma / \sqrt{n} = \sqrt{\frac{n \sum w_i (\bar{x}_i - \bar{x})^2}{(n-1) \sum w_i}} \Bigg/ \sqrt{n} = \sqrt{\frac{\sum w_i (\bar{x}_i - \bar{x})^2}{(n-1) \sum w_i}}$$, where n is the number of data sets.

Table VIII. Results of the data sets obtained with the planar detector and analyzed using the Widerange6 parameter file. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92 and A1-86 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
SRPISO3		1.02831	0.99984	1.00400	1.00517	0.99228	1.00067	1.00406
A1-92		0.87500	1.00003	0.99977	0.99703	0.99353	0.99694	0.99925
A1-86		0.86192	1.00035	0.99443	0.99873	1.03181	0.99881	0.99385
STDR3		0.97953	1.00043	0.99316	0.99740	1.00399	0.99904	0.99313
CALEX		1.07031	0.99993	1.00100	1.00101	0.99453	1.00133	1.00125
PUEU7		1.00757	1.00024	0.99614	1.00005	1.05501	1.00039	0.99628
JOO1325		1.01478	0.99971	1.00459	0.99776	0.98996	1.00037	1.00459
SRPISO6		1.00731	0.99934	1.00999	0.99972	1.01225	1.00190	1.00982
STD117		0.91546	1.00000	1.00040	0.99284	1.00858	0.99763	0.99988
CBNM93		1.01829	0.99965	1.00523	0.99593	0.98087	0.99982	1.00523
STD8		1.00505	1.00043	0.99384	0.99386	0.98969	0.99865	0.99392
STD6		0.99859	0.99991	1.00152	0.99224	0.99345	0.99974	1.00149
SRPISO9		1.00755	1.00036	0.99512	0.99999	1.00060	0.99968	0.99529
STD3		1.01248	0.99970	1.00350	1.00311	1.00300	1.00144	1.00351
STD118		0.98314	1.00013	0.99952	0.98461	1.01137	1.00025	0.99941
PEO382c3		0.94525	0.99916	1.00704	1.01709	0.99212	0.99728	1.00649
STD40		1.00124	0.99981	1.00156	0.99877	1.00494	1.00112	1.00151
STD119		1.01557	0.99915	1.00704	0.98771	0.99518	1.00158	1.00694
SRPISO12		1.00716	1.00019	0.99860	0.99994	1.00202	1.00064	0.99874
CBNM84		1.00272	0.99810	1.01147	0.99661	0.98986	1.00124	1.01091
SRPISO15		1.01800	0.99708	1.01532	1.00057	1.01004	1.00809	1.01431
STD116		0.99233	1.00205	0.99223	0.98785	0.99168	0.99420	0.99299
STD120		0.99572	1.00251	0.98926	0.99017	0.98293	0.99122	0.99063
STD121		1.00597	1.00167	0.99774	0.99165	1.00562	1.00132	0.99789
LAO225		1.01625	0.99930	0.99745	0.99846	1.00202	1.00071	0.99770
CBNM70		1.01711	0.99962	1.00031	1.00196	0.98276	1.00330	1.00171
CBNM61		1.01572	0.99604	1.00881	1.00114	0.97875	1.00345	1.00762
Unweighted	**Ave**	**1.00326**	**0.99980**	**1.00108**	**0.99746**	**0.99996**	**1.00003**	**1.00105**
Average	**Err**	**0.00538**	**0.00025**	**0.00122**	**0.00123**	**0.00307**	**0.00059**	**0.00115**
Weighted	**Ave**	**1.00908**	**0.99986**	**1.00209**	**0.99792**	**0.99505**	**0.99982**	**1.00220**
Average	**Err**	**0.00258**	**0.00013**	**0.00126**	**0.00116**	**0.00210**	**0.00056**	**0.00119**
Low-burnup	**Ave**	**1.00662**	**0.99994**	**1.00093**	**0.99742**	**0.99743**	**1.00012**	**1.00092**
Weighted Ave.	**Err**	**0.00575**	**0.00009**	**0.00130**	**0.00122**	**0.00297**	**0.00025**	**0.00129**

Table IX. Results of the data sets obtained with the planar detector and analyzed using the Pu125_414Pl parameter file with the empirical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92 and A1-86 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
SRPISO3		1.02102	0.99980	1.00524	1.00317	0.96414	1.00018	1.00526
A1-92		0.86917	1.00028	0.99523	0.99424	0.98773	0.99585	0.99474
A1-86		0.85558	1.00067	0.98913	0.99624	1.03057	0.99795	0.98857
STDR3		0.96937	1.00092	0.98519	0.99335	0.98477	0.99621	0.98521
CALEX		1.06254	1.00019	0.99684	0.99951	0.98754	1.00020	0.99712
PUEU7		0.99882	1.00047	0.99255	0.99725	1.04099	0.99946	0.99273
JOO1325		1.00778	1.00002	0.99980	0.99639	0.98975	0.99959	0.99984
SRPISO6		0.99869	0.99979	1.00324	0.99853	0.97977	0.99978	1.00317
STD117		0.90327	1.00074	0.98946	0.98627	0.99652	0.99514	0.98906
CBNM93		1.00764	1.00029	0.99588	0.99145	0.97791	0.99812	0.99597
STD8		0.99838	1.00080	0.98842	0.99178	0.98577	0.99754	0.98854
STD6		0.99165	1.00031	0.99568	0.99083	0.98228	0.99813	0.99569
SRPISO9		1.00132	1.00055	0.99264	1.00055	0.99167	0.99873	0.99283
STD3		1.00477	1.00018	0.99773	1.00227	1.00649	1.00073	0.99782
STD118		0.97126	1.00132	0.98789	0.98065	0.99346	0.99579	0.98800
PEO382c3		0.93986	0.99977	1.00145	1.01777	0.99615	0.99675	1.00102
STD40		0.99711	0.99992	1.00056	1.00114	1.00570	1.00062	1.00050
STD119		1.00204	1.00106	0.99322	0.98293	0.99679	0.99833	0.99345
SRPISO12		1.00321	1.00047	0.99625	1.00356	0.99402	0.99904	0.99644
CBNM84		0.99500	0.99969	1.00208	0.99662	0.99294	0.99889	1.00192
SRPISO15		1.01409	0.99586	1.02151	1.00472	0.99206	1.00696	1.01982
STD116		0.98360	1.00163	0.99472	0.98733	1.00213	0.99507	0.99467
STD120		0.98573	1.00220	0.99147	0.98849	0.99651	0.99393	0.99201
STD121		0.99817	1.00329	0.98974	0.99199	1.00493	0.99865	0.99016
LAO225		1.01710	0.99869	1.00007	1.00575	1.00243	1.00147	1.00021
CBNM70		1.00431	0.99935	1.00300	0.99743	0.98863	0.99925	1.00267
CBNM61		1.00179	0.99813	1.00545	0.99552	0.99228	0.99948	1.00406
Unweighted	**Ave**	**0.995141**	**1.000237**	**0.996831**	**0.996138**	**0.994961**	**0.998586**	**0.996721**
Average	**Err**	**0.005521**	**0.000257**	**0.001439**	**0.001504**	**0.002894**	**0.000491**	**0.001381**
Weighted	**Ave**	**0.998193**	**1.000303**	**0.997607**	**0.997130**	**0.995591**	**0.998605**	**0.997985**
Average	**Err**	**0.002280**	**0.000145**	**0.001168**	**0.001306**	**0.001468**	**0.000380**	**0.001119**
Low-burnup	**Ave**	**0.998988**	**1.000317**	**0.995226**	**0.995516**	**0.991063**	**0.998926**	**0.995284**
Weighted Ave.	**Err**	**0.005625**	**0.000087**	**0.001256**	**0.001355**	**0.003642**	**0.000375**	**0.001255**

Table X. Results of the data sets obtained with the planar detector and analyzed using the Pu125_414Pl parameter file with the physical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92 and A1-86 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
SRPISO3		1.02113	0.99978	1.00587	1.00313	0.97915	1.00049	1.00589
A1-92		0.87107	1.00020	0.99664	0.99511	0.98622	0.99592	0.99614
A1-86		0.85697	1.00065	0.98939	0.99636	1.02900	0.99787	0.98884
STDR3		0.98211	1.00023	0.99640	0.99485	0.97507	0.99701	0.99636
CALEX		1.06345	1.00024	0.99608	0.99938	0.98879	1.00021	0.99638
PUEU7		0.99976	1.00040	0.99387	0.99418	1.04666	0.99972	0.99402
JOO1325		1.00950	0.99999	1.00024	0.99623	0.99147	0.99978	1.00028
SRPISO6		0.99903	0.99971	1.00457	0.99785	0.98454	1.00010	1.00447
STD117		0.91873	0.99984	1.00323	0.98426	0.99241	0.99720	1.00269
CBNM93		1.00607	1.00032	0.99549	0.98944	0.97992	0.99817	0.99558
STD8		0.99758	1.00076	0.98906	0.99025	0.98784	0.99774	0.98917
STD6		0.99246	1.00026	0.99648	0.98995	0.98390	0.99834	0.99649
SRPISO9		1.00013	1.00057	0.99244	0.99847	0.99488	0.99874	0.99263
STD3		1.00470	1.00014	0.99828	1.00136	1.00806	1.00102	0.99835
STD118		0.98665	1.00010	0.99995	0.98354	0.99209	0.99839	0.99985
PEO382c3		0.93839	0.99986	1.00067	1.01591	0.99766	0.99678	1.00024
STD40		0.99637	1.00006	0.99961	0.99972	1.00634	1.00046	0.99957
STD119		1.01437	0.99963	1.00344	0.98842	0.99513	1.00081	1.00344
SRPISO12		1.00175	1.00075	0.99435	1.00119	0.99569	0.99868	0.99461
CBNM84		0.99281	1.00006	1.00000	0.99411	0.99452	0.99844	0.99992
SRPISO15		1.02717	0.99326	1.03480	1.00946	0.99744	1.01314	1.03217
STD116		0.98486	1.00148	0.99529	0.98790	1.00028	0.99495	0.99522
STD120		0.98641	1.00192	0.99287	0.98853	0.99594	0.99405	0.99324
STD121		1.00456	1.00220	0.99487	0.99529	1.00269	1.00010	0.99513
LAO225		1.01489	0.99888	0.99931	1.00289	1.00304	1.00121	0.99946
CBNM70		1.00212	1.00004	1.00105	0.99449	0.98988	0.99838	1.00098
CBNM61		1.00023	0.99896	1.00395	0.99326	0.99400	0.99897	1.00286
Unweighted	**Ave**	**0.997809**	**1.000011**	**0.999192**	**0.995760**	**0.996023**	**0.999135**	**0.999036**
Average	**Err**	**0.005143**	**0.000295**	**0.001611**	**0.001396**	**0.002822**	**0.000641**	**0.001520**
Weighted	**Ave**	**0.996898**	**1.000193**	**0.998335**	**0.995327**	**0.996149**	**0.998591**	**0.998525**
Average	**Err**	**0.002149**	**0.000108**	**0.000861**	**0.001250**	**0.001432**	**0.000373**	**0.000817**
Low-burnup	**Ave**	**0.999304**	**1.000204**	**0.996963**	**0.994074**	**0.992281**	**0.999092**	**0.996993**
Weighted Ave.	**Err**	**0.005074**	**0.000072**	**0.001054**	**0.001448**	**0.003861**	**0.000318**	**0.001027**

Table XI. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using the Coax8k125.3 parameter file. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, some of the results were omitted in the calculations. For ^{238}Pu, they were A1-92 and A1-86; for ^{240}Pu: JOO132501; for ^{241}Am: JOO132502, Pidie6-1, Pidie6-2, and STD8.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.01318	0.99972	1.00733	1.00652	0.97009	1.00000	1.00729
STDSGA100		1.01977	1.00010	0.99707	1.00443	1.02184	1.00064	0.99719
A1-92		0.86557	1.00083	0.98525	1.00157	0.98539	0.99448	0.98484
A1-86		0.84699	1.00056	0.99087	0.99891	1.01339	0.99686	0.99028
CALEX		0.97547	0.99940	1.00960	1.00250	0.95546	0.99663	1.00938
STDEUPU7		0.98587	1.00068	0.98896	1.00697	1.00454	0.99832	0.98914
SRPSTDPUEU7		1.01235	0.99950	1.00805	0.99904	0.96703	1.00000	1.00792
JOO1325		0.97938	0.99712	1.04592	0.99813	0.92835	0.99951	1.04526
PIDIE6-1		0.97997	0.99873	1.01981	1.00832	0.90330	0.98958	1.01944
STDISO6		1.04253	0.99995	1.00047	1.00354	0.99585	1.00113	1.00069
STD8		0.98575	0.99941	1.00862	1.00550	0.93651	0.99573	1.00848
CBNM93		1.01122	0.99981	1.00281	0.99935	0.97313	0.99857	1.00281
STDISO9		1.01370	1.00000	1.00004	0.99952	0.99565	1.00030	1.00013
2G 118		0.97995	1.00093	0.99067	1.00128	0.99277	0.99652	0.99077
PIDIE6-2		1.00448	0.99740	1.02292	1.00186	0.92237	0.99202	1.02247
STD40		0.99544	1.00048	0.99651	0.99922	1.00674	1.00035	0.99658
2G 119		0.99640	1.00073	0.99451	1.00210	0.99204	0.99724	0.99465
STDISO12		0.99693	1.00016	0.99880	1.00074	1.01278	1.00138	0.99881
PIDIE6-3		1.05360	0.99968	1.00181	0.99845	0.98312	0.99906	1.00215
CBNM84		0.99629	1.00051	0.99685	1.00288	1.00005	0.99899	0.99697
STDISO15		0.99894	1.00080	0.99572	1.00025	1.01845	1.00179	0.99609
2G 121		0.99652	1.00035	0.99796	1.00587	1.00278	0.99988	0.99801
LAO225		0.99090	1.00090	0.99560	0.99909	1.00966	1.00048	0.99571
CBNM70		1.01020	0.99847	1.00402	1.00788	0.99445	1.00310	1.00396
PIDIE6-4		0.98315	1.00393	0.98494	0.99489	1.01811	1.00334	0.98561
PIDIE6-5		0.97904	1.00385	0.98660	0.99593	1.02095	1.00444	0.98720
PIDIE6-6		0.99327	1.00373	0.99057	0.99527	1.02393	1.00743	0.99251
CBNM61		1.00985	0.99476	1.01087	1.00866	0.99205	1.00348	1.00861
PIDIE6-7		1.00190	0.99907	1.00266	0.99698	1.02159	1.00966	1.00202
Unweighted	**Ave**	**1.00022**	**1.00005**	**0.99964**	**1.00157**	**0.99887**	**1.00038**	**1.00121**
Average	**Err**	**0.00347**	**0.00035**	**0.00177**	**0.00073**	**0.00350**	**0.00064**	**0.00231**
Weighted	**Ave**	**0.99778**	**1.00023**	**0.99616**	**1.00248**	**1.00354**	**1.00064**	**0.99670**
Average	**Err**	**0.00150**	**0.00018**	**0.00144**	**0.00065**	**0.00307**	**0.00068**	**0.00133**
Low-burnup	**Ave**	**1.00313**	**0.99992**	**1.00177**	**1.00325**	**0.98051**	**0.99910**	**1.00170**
Weighted Ave.	**Err**	**0.00633**	**0.00019**	**0.00353**	**0.00095**	**0.00848**	**0.00051**	**0.00341**

Table XII. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using the Pu125_451Cx parameter file with the empirical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		0.99489	0.99937	1.01691	1.00325	1.01252	1.00166	1.01668
STDSGA100		1.00866	0.99978	1.00603	0.99967	1.02732	1.00133	1.00599
A1-92		0.85310	1.00064	0.98876	0.99258	0.99833	0.99583	0.98827
A1-86		0.83825	1.00021	0.99691	0.99197	1.02198	0.99821	0.99623
CALEX		0.95514	0.99959	1.00675	0.99704	0.99008	0.99900	1.00650
STDEUPU7		0.97952	1.00026	0.99574	1.00359	1.01128	0.99922	0.99573
SRPSTDPUEU7		0.99002	1.00002	0.99996	0.99224	0.99076	0.99927	0.99991
JOO1325		0.94530	0.99807	1.03113	0.98811	0.99455	1.00204	1.03049
PIDIE6-1		0.97046	0.99952	1.00771	0.99175	0.97815	0.99746	1.00748
STDISO6		1.03130	0.99983	1.00249	0.99984	1.01254	1.00196	1.00261
STD8		0.96427	0.99955	1.00681	0.99813	0.98529	0.99894	1.00661
CBNM93		1.00072	0.99951	1.00730	0.99646	0.99329	1.00045	1.00720
STDISO9		1.00585	0.99969	1.00432	0.99762	1.00472	1.00116	1.00425
2G 118		0.97584	1.00044	0.99582	0.99689	1.00173	0.99845	0.99576
PIDIE6-2		0.99213	0.99739	1.02313	1.00004	0.96753	0.99860	1.02261
STD40		0.99406	0.99955	1.00335	0.99977	1.00301	1.00060	1.00314
2G 119		0.99464	1.00021	0.99845	0.99955	1.00086	0.99957	0.99845
STDISO12		0.99620	0.99937	1.00459	1.00131	1.00749	1.00160	1.00435
PIDIE6-3		1.05649	0.99833	1.00973	1.00239	0.98432	1.00103	1.00983
CBNM84		0.99569	0.99996	1.00012	1.00297	1.00214	0.99994	1.00007
STDISO15		0.99962	1.00024	0.99861	1.00164	1.00883	1.00101	0.99873
2G 121		0.99531	0.99987	1.00046	1.00400	1.01050	1.00196	1.00040
LAO225		0.99506	0.99918	1.00395	1.00252	0.99855	1.00012	1.00374
CBNM70		1.00761	1.00180	0.99130	1.00550	0.99748	1.00176	0.99396
PIDIE6-4		0.99237	1.00010	0.99950	1.00254	1.00153	0.99983	0.99943
PIDIE6-5		0.98657	1.00045	0.99834	1.00232	1.00506	1.00045	0.99826
PIDIE6-6		1.00091	1.00159	0.99512	1.00298	1.00215	1.00085	0.99643
CBNM61		1.00624	1.00087	0.99658	1.00540	1.00106	1.00296	0.99804
PIDIE6-7		1.00671	0.99972	1.00005	1.00191	1.00012	1.00276	1.00058
Unweighted	**Ave**	**0.995044**	**0.999831**	**1.003101**	**0.999448**	**1.000454**	**1.000277**	**1.003163**
Average	**Err**	**0.004007**	**0.000168**	**0.001650**	**0.000837**	**0.002287**	**0.000306**	**0.001597**
Weighted	**Ave**	**1.001004**	**0.999802**	**1.000548**	**1.000348**	**1.002080**	**1.000550**	**1.000336**
Average	**Err**	**0.001384**	**0.000084**	**0.000925**	**0.000574**	**0.001228**	**0.000227**	**0.000827**
Low-burnup	**Ave**	**0.993974**	**0.999716**	**1.005337**	**0.998634**	**0.998483**	**1.000404**	**1.005166**
Weighted Ave.	**Err**	**0.006007**	**0.000111**	**0.002278**	**0.000951**	**0.003328**	**0.000386**	**0.002230**

Table XIII. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using the Pu125_451Cx parameter file with the physical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		0.98418	0.99976	1.00648	1.00733	1.01954	1.00082	1.00633
STDSGA100		1.00915	0.99955	1.01202	1.00046	1.02862	1.00188	1.01191
A1-92		0.85216	1.00035	0.99402	0.99299	1.00028	0.99657	0.99348
A1-86		0.83805	0.99994	1.00151	0.99169	1.02282	0.99882	1.00077
CALEX		0.95414	0.99917	1.01338	0.99950	0.99128	0.99989	1.01304
STDEUPU7		0.97916	1.00000	0.99994	1.00408	1.01268	0.99979	0.99982
SRPSTDPUEU7		0.98983	1.00001	1.00006	0.99601	0.99535	0.99947	1.00000
JOO1325		0.93346	0.99796	1.03276	0.99223	0.99900	1.00231	1.03205
PIDIE6-1		0.96258	0.99898	1.01619	0.99194	0.97861	0.99834	1.01580
STDISO6		1.02481	1.00000	0.99994	1.00156	1.01480	1.00155	1.00007
STD8		0.96138	0.99964	1.00545	1.00039	0.98821	0.99894	1.00525
CBNM93		0.98787	1.00007	0.99912	0.99674	0.99460	0.99916	0.99908
STDISO9		1.00240	0.99967	1.00449	0.99932	1.00571	1.00110	1.00440
2G 118		0.97716	1.00005	0.99971	0.99737	1.00246	0.99922	0.99957
PIDIE6-2		0.99606	0.99769	1.02033	1.00453	0.96951	0.99859	1.01990
STD40		0.99331	0.99921	1.00589	1.00036	1.00266	1.00088	1.00557
2G 119		0.99595	0.99976	1.00184	0.99937	1.00080	1.00024	1.00175
STDISO12		0.99555	0.99922	1.00565	1.00226	1.00764	1.00174	1.00537
PIDIE6-3		1.06070	0.99843	1.00898	1.00495	0.98572	1.00153	1.00913
CBNM84		0.99102	1.00015	0.99922	0.99914	1.00132	0.99912	0.99916
STDISO15		1.00031	0.99993	1.00024	1.00187	1.00845	1.00141	1.00022
2G 121		0.99941	0.99862	1.00670	1.00281	1.00911	1.00334	1.00640
LAO225		0.99563	0.99854	1.00712	1.00317	0.99856	1.00085	1.00678
CBNM70		1.00303	1.00249	0.98970	1.00094	0.99765	0.99968	0.99234
PIDIE6-4		0.99337	0.99936	1.00243	1.00217	1.00000	0.99978	1.00220
PIDIE6-5		0.98726	0.99981	1.00063	1.00189	1.00325	1.00014	1.00042
PIDIE6-6		1.00093	1.00033	0.99875	1.00200	0.99893	0.99974	0.99913
CBNM61		1.00263	1.00249	0.99331	1.00234	1.00346	1.00161	0.99540
PIDIE6-7		1.00614	0.99845	1.00342	1.00032	0.99736	1.00169	1.00290
Unweighted	**Ave**	**0.993264**	**0.999641**	**1.004458**	**0.999991**	**1.001324**	**1.000282**	**1.004422**
Average	**Err**	**0.004258**	**0.000196**	**0.001587**	**0.000738**	**0.002277**	**0.000267**	**0.001520**
Weighted	**Ave**	**1.000248**	**0.999675**	**1.002364**	**1.000306**	**1.000870**	**1.000506**	**1.001906**
Average	**Err**	**0.001388**	**0.000087**	**0.000912**	**0.000414**	**0.001207**	**0.000233**	**0.000828**
Low-burnup	**Ave**	**0.990102**	**0.999689**	**1.005218**	**1.000244**	**0.999232**	**1.000420**	**1.005040**
Weighted Ave.	**Err**	**0.005624**	**0.000107**	**0.002398**	**0.000843**	**0.003028**	**0.000374**	**0.002353**

Table XIV. Results of all the data sets obtained with the coaxial detector and analyzed using the ShldCoax4.3 parameter file. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, Pidie6-1, STDISO3, and STDSGA100 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.12636	1.00035	0.99020	0.99918	0.99560	1.00103	0.99085
STDSGA100		1.12206	1.00024	0.99335	0.99987	0.99878	1.00132	0.99395
A1-92		1.05053	1.00015	0.99723	0.99652	0.99508	1.00019	0.99744
A1-86		0.96737	1.00010	0.99849	0.99379	1.02370	1.00144	0.99836
CALEX		0.95503	1.00015	0.99798	0.99201	0.98941	0.99786	0.99783
CALEX (1/16Pb)		0.95128	1.00005	1.00021	0.96908	0.98645	0.99776	1.00002
STDEUPU7		1.09056	0.99931	1.01075	1.00100	1.00355	1.00444	1.01101
STDPUEU7		0.99749	1.00019	0.99744	0.98630	0.99505	0.99936	0.99748
STDPUEU7(1/16Pb)		0.95131	1.00048	0.99353	0.96690	0.99395	0.99731	0.99340
JOO132501		0.96260	0.99957	1.00727	0.98279	1.00881	1.00065	1.00700
JOO1325 (1/32Pb)		0.96958	1.00020	0.99756	0.96911	0.99274	0.99837	0.99745
JOO1325 (3/32Pb)		0.89819	0.99973	1.00601	0.93075	0.99276	0.99764	1.00547
PIDIE6-1		0.70826	1.00220	0.96609	0.99469	1.00417	0.99009	0.96531
STDISO6		1.08725	0.99966	1.00525	0.99458	1.00004	1.00333	1.00560
STD8		1.08109	1.00057	0.99553	0.99344	0.99837	1.00119	0.98927
STD8 (1/16Pb)		1.01695	1.00057	0.99202	0.96948	0.99172	0.99864	0.99216
CBNM93		1.08552	1.00005	0.99934	0.99043	0.99718	1.00181	0.99971
STDISO9		1.04530	0.99956	1.00609	0.99342	1.00094	1.00288	1.00626
2G 118		0.95827	0.99952	1.00493	1.00112	1.01392	1.00082	1.00451
PIDIE6-2		0.93386	1.00036	0.99704	0.99662	0.98627	0.99475	0.99676
STD40		1.06446	0.99901	1.00662	1.00729	1.00550	1.00846	1.00718
STD40 (1/16Pb)		1.00615	0.99954	1.00304	1.00627	0.99298	0.99966	1.00299
2G 119		0.99752	1.00227	0.98279	1.00859	1.01985	1.00073	0.98330
STDISO12		0.99878	0.99790	1.01505	1.00738	1.00171	1.00289	1.01441
PIDIE6-3		1.01496	0.99977	1.00099	1.00760	1.00359	1.00210	1.00107
CBNM84		1.02274	0.99710	1.01687	1.00507	1.01043	1.00747	1.01626
STDISO15		1.00152	0.99540	1.02377	1.01057	1.00972	1.00625	1.02157
2G 121		1.02159	0.99974	1.00037	1.01588	1.03517	1.00942	1.00054
LAO225 (1/16Pb)		1.04093	0.99848	1.00672	1.01454	0.99882	1.00452	1.00677
LAO225		1.04135	0.99833	1.00753	1.01279	1.00965	1.00715	1.00755
CBNM70		0.98674	0.98724	1.04709	1.02223	0.99281	0.99648	1.03507
PIDIE6-4		1.02554	0.99587	1.01525	1.01430	1.02895	1.01707	1.01468
PIDIE6-5		1.02119	0.99279	1.02486	1.01286	1.03050	1.01954	1.02351
PIDIE6-6		1.00133	0.99183	1.01816	1.03136	1.00705	1.00523	1.01362
CBNM61		0.99204	0.99270	1.01201	1.03414	0.99331	0.99563	1.00800
PIDIE6-7		0.99092	0.99687	1.00040	1.04611	0.98507	0.99053	0.99954
Unweighted	**Ave**	**1.00684**	**0.99855**	**1.00383**	**0.99939**	**1.00260**	**1.00178**	**1.00294**
Average	**Err**	**0.00784**	**0.00052**	**0.00223**	**0.00354**	**0.00210**	**0.00100**	**0.00203**
Weighted	**Ave**	**1.00594**	**0.99969**	**1.00681**	**0.99735**	**0.99877**	**1.00113**	**1.00677**
Average	**Err**	**0.00442**	**0.00020**	**0.00169**	**0.00234**	**0.00164**	**0.00074**	**0.00156**
Low-burnup	**Ave**	**1.00827**	**0.99997**	**1.00170**	**0.99214**	**0.99550**	**0.99936**	**1.00154**
Weighted Ave.	**Err**	**0.01689**	**0.00010**	**0.00150**	**0.00316**	**0.00131**	**0.00056**	**0.00155**

Table XV. Results of all the data sets obtained with the coaxial detector and analyzed using the Pu203_769Cx parameter file with the empirical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, some of the results were omitted in the calculations. For ^{238}Pu, they were A1-92, A1-86 and Pidie6-1; for ^{240}Pu: A1-92, A1-86, STDISO3, and STDSGA100.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.02224	1.00095	0.97416	1.00702	1.00884	0.99843	0.97459
STDSGA100		1.01781	1.00096	0.97382	1.00428	1.01873	0.99859	0.97422
A1-92		0.88286	1.00145	0.97417	0.99668	0.99840	0.99481	0.97392
A1-86		0.83916	1.00154	0.97452	0.99552	1.02556	0.99602	0.97406
CALEX		0.94961	1.00073	0.98832	1.00002	0.99167	0.99681	0.98827
CALEX (1/16Pb)		0.95811	1.00096	0.98509	0.98703	0.99042	0.99647	0.98511
STDEUPU7		1.02228	0.99962	1.00582	1.00635	1.00912	1.00182	1.00581
STDPUEU7		1.01136	1.00058	0.99085	0.99330	0.99701	0.99909	0.99114
STDPUEU7(1/16Pb)		1.01302	1.00116	0.98182	0.98825	0.99429	0.99788	0.98234
JOO132501		0.98875	1.00055	0.99150	0.99130	1.00946	0.99942	0.99155
JOO1325 (1/32Pb)		1.00716	1.00101	0.98420	0.98395	0.99355	0.99773	0.98443
JOO1325 (3/32Pb)		0.95766	1.00110	0.98313	0.97596	0.99545	0.99654	0.98315
PIDIE6-1		0.69671	1.00211	0.96740	1.00063	0.99531	0.98887	0.96655
STDISO6		1.02896	1.00004	0.99927	1.00169	1.00633	1.00113	0.99944
STD8		1.04892	1.00042	0.99370	0.99881	0.99817	1.00008	0.99395
STD8 (1/16Pb)		0.95715	1.00106	0.98459	0.98317	0.99519	0.99670	0.98459
CBNM93		0.99321	1.00052	0.99238	0.99651	0.99811	0.99869	0.99247
STDISO9		1.02245	0.99988	1.00157	0.99836	1.00343	1.00143	1.00169
2G 118		0.96538	0.99912	1.00892	0.99963	1.00459	1.00042	1.00845
PIDIE6-2		0.87891	1.00141	0.98765	1.00350	0.98198	0.99034	0.98728
STD40		1.05579	1.00007	0.99911	1.00156	1.00291	1.00582	0.99986
STD40 (1/16Pb)		0.99646	1.00034	0.99749	1.00069	0.99750	0.99872	0.99755
2G 119		0.99132	1.00166	0.98758	1.00263	1.00966	0.99920	0.98790
STDISO12		0.99469	0.99897	1.00752	1.00152	0.99979	1.00085	1.00715
PIDIE6-3		0.94648	1.00087	0.99493	1.00084	0.99224	0.99362	0.99470
CBNM84		1.00898	0.99894	1.00634	0.99809	1.00207	1.00254	1.00612
STDISO15		1.00304	0.99806	1.01047	0.99795	1.00263	1.00298	1.00956
2G 121		1.02306	1.00087	0.99535	1.00483	1.01886	1.00495	0.99574
LAO225 (1/16Pb)		1.01813	0.99897	1.00487	1.00424	0.99903	1.00230	1.00481
LAO225		1.02486	1.00008	0.99942	1.00227	1.00223	1.00240	0.99965
CBNM70		0.98821	0.99542	1.01977	0.99576	0.99157	0.99416	1.01420
PIDIE6-4		0.97844	0.99998	0.99995	1.00430	1.00406	0.99963	0.99969
PIDIE6-5		0.96889	0.99981	1.00065	1.00330	1.00913	1.00069	1.00019
PIDIE6-6		0.99528	1.00576	0.98177	1.01676	1.00951	1.00107	0.98609
CBNM61		0.99421	0.99821	1.00449	1.00092	0.99842	0.99724	1.00277
PIDIE6-7		0.99101	1.00942	0.97400	1.02168	1.00667	0.99705	0.98099
Unweighted	**Ave**	**0.994601**	**1.000628**	**0.994685**	**0.999148**	**1.001718**	**0.998736**	**0.992498**
Average	**Err**	**0.005725**	**0.000361**	**0.001894**	**0.001425**	**0.001468**	**0.000599**	**0.001966**
Weighted	**Ave**	**1.000200**	**1.000530**	**0.997246**	**1.000933**	**1.001086**	**0.998985**	**0.997395**
Average	**Err**	**0.002923**	**0.000132**	**0.001665**	**0.000800**	**0.001245**	**0.000422**	**0.001593**
Low-burnup	**Ave**	**1.005645**	**1.000699**	**0.989594**	**1.000379**	**0.999958**	**0.998055**	**0.989710**
Weighted Ave.	**Err**	**0.006430**	**0.000118**	**0.002261**	**0.001335**	**0.001645**	**0.000453**	**0.002252**

Table XVI. Results of all the data sets obtained with the coaxial detector and analyzed using the Pu203_769Cx parameter file with the physical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, some of the results were omitted in the calculations. For ^{238}Pu, they were A1-92, A1-86 and Pidie6-1; for ^{240}Pu: A1-92, A1-86, STDISO3, and STDSGA100.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.04481	1.00089	0.97570	1.01029	1.01140	0.99898	0.97620
STDSGA100		1.00931	1.00086	0.97663	1.00468	1.02144	0.99875	0.97697
A1-92		0.89572	1.00150	0.97318	0.99786	0.99899	0.99499	0.97300
A1-86		0.83133	1.00132	0.97818	0.99534	1.02536	0.99626	0.97764
CALEX		0.95436	1.00019	0.99695	1.00287	0.99496	0.99825	0.99681
CALEX (1/16Pb)		0.95932	1.00055	0.99154	0.99023	0.99342	0.99754	0.99149
STDEUPU7		1.02523	0.99961	1.00595	1.00576	1.00959	1.00194	1.00595
STDPUEU7		1.00007	0.99987	1.00220	0.99813	1.00241	1.00037	1.00215
STDPUEU7(1/16Pb)		1.01738	1.00098	0.98465	0.99129	0.99759	0.99852	0.98512
JOO132501		0.97657	0.99977	1.00372	0.99824	1.01677	1.00119	1.00357
JOO1325 (1/32Pb)		1.01167	1.00086	0.98671	0.98338	0.99614	0.99834	0.98692
JOO1325 (3/32Pb)		0.95868	1.00072	0.98889	0.98763	0.99797	0.99747	0.98884
PIDIE6-1		0.69189	1.00266	0.95893	1.00055	0.99701	0.98798	0.95818
STDISO6		1.04133	1.00021	0.99655	1.00250	1.00430	1.00105	0.99684
STD8		1.05826	1.00065	0.99028	1.00223	0.99774	0.99980	0.99060
STD8 (1/16Pb)		0.93047	1.00057	0.99185	0.98806	0.99901	0.99737	0.99167
CBNM93		1.00769	1.00080	0.98823	0.99719	0.99737	0.99847	0.98844
STDISO9		1.01940	0.99986	1.00179	1.00010	1.00305	1.00131	1.00189
2G 118		0.99241	0.99891	1.01096	0.99929	1.00715	1.00240	1.01063
PIDIE6-2		0.89356	1.00149	0.98682	1.00657	0.98538	0.99130	0.98654
STD40		1.05062	0.99946	1.00362	1.00165	1.00396	1.00629	1.00412
STD40 (1/16Pb)		0.99373	0.99964	1.00252	1.00329	1.00035	0.99989	1.00234
2G 119		0.99263	1.00203	0.98479	1.00361	1.01006	0.99884	0.98520
STDISO12		0.99415	0.99846	1.01120	1.00315	1.00115	1.00167	1.01067
PIDIE6-3		0.97030	1.00034	0.99790	1.00380	0.99768	0.99713	0.99775
CBNM84		1.02670	0.99938	1.00360	0.99911	1.00381	1.00411	1.00371
STDISO15		0.99996	0.99826	1.00931	0.99925	1.00134	1.00192	1.00843
2G 121		1.02948	1.00114	0.99392	1.00591	1.01924	1.00525	0.99443
LAO225 (1/16Pb)		1.01499	0.99736	1.01292	1.00306	1.00323	1.00469	1.01249
LAO225		1.01522	0.99801	1.00971	1.00324	1.00701	1.00488	1.00942
CBNM70		0.99412	0.99613	1.01621	0.99796	0.99084	0.99617	1.01196
PIDIE6-4		0.97355	1.00121	0.99509	1.00481	1.00642	0.99932	0.99505
PIDIE6-5		0.96723	1.00180	0.99347	1.00449	1.01134	1.00025	0.99346
PIDIE6-6		0.98242	1.00903	0.97304	1.01736	1.00610	0.99443	0.97871
CBNM61		0.99342	1.00022	0.99927	1.00262	0.99797	0.99623	0.99894
PIDIE6-7		0.98163	1.01180	0.96856	1.02231	1.00528	0.99227	0.97641
Unweighted	**Ave**	**0.996385**	**1.000737**	**0.995661**	**1.001050**	**1.003410**	**0.999046**	**0.993681**
Average	**Err**	**0.005788**	**0.000458**	**0.002156**	**0.001237**	**0.001407**	**0.000654**	**0.002151**
Weighted	**Ave**	**0.999309**	**1.000131**	**1.001327**	**1.002264**	**1.002696**	**0.999984**	**1.001080**
Average	**Err**	**0.003233**	**0.000167**	**0.001725**	**0.000675**	**0.001115**	**0.000461**	**0.001665**
Low-burnup	**Ave**	**1.009059**	**1.000383**	**0.994623**	**1.002074**	**1.002005**	**0.998895**	**0.994670**
Weighted Ave.	**Err**	**0.007254**	**0.000119**	**0.002051**	**0.001134**	**0.001401**	**0.000420**	**0.002034**

Table XVII. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using the Pu125_769Cx parameter file with the empirical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		0.96919	0.99998	1.00053	1.00322	1.00266	0.99964	1.00039
STDSGA100		1.00261	0.99984	1.00443	0.99971	1.01613	1.00083	1.00438
A1-92		0.85002	1.00079	0.98605	0.99277	0.99872	0.99551	0.98558
A1-86		0.83032	1.00050	0.99204	0.99227	1.02449	0.99773	0.99136
CALEX		0.93116	1.00050	0.99219	0.99728	0.98867	0.99662	0.99202
STDEUPU7		0.97909	1.00027	0.99566	1.00359	1.00691	0.99904	0.99564
SRPSTDPUEU7		0.98097	1.00039	0.99407	0.99198	0.99508	0.99843	0.99410
JOO1325		0.94692	0.99990	1.00191	0.99036	1.00858	0.99961	1.00165
PIDIE6-1		0.71707	1.00100	0.98489	0.99363	0.99546	0.99138	0.98389
STDISO6		1.02089	0.99959	1.00625	0.99807	1.00406	1.00166	1.00624
STD8		0.97390	0.99966	1.00508	0.99805	0.99451	0.99965	1.00493
CBNM93		0.98552	0.99955	1.00681	0.99579	0.99791	1.00035	1.00664
STDISO9		1.01125	0.99955	1.00620	0.99568	1.00060	1.00138	1.00612
2G 118		0.97548	1.00034	0.99682	0.99677	1.00189	0.99860	0.99674
PIDIE6-2		0.88112	0.99977	1.00218	1.00252	0.98186	0.99290	1.00153
STD40		1.03567	1.00031	0.99756	0.99948	0.99772	1.00256	0.99811
2G 119		0.99403	1.00032	0.99768	0.99957	1.00368	0.99996	0.99770
STDISO12		1.00047	0.99931	1.00505	1.00024	0.99887	1.00080	1.00484
PIDIE6-3		0.96218	0.99969	1.00185	1.00300	0.99261	0.99597	1.00150
CBNM84		1.00834	0.99893	1.00618	1.00224	1.00526	1.00297	1.00596
STDISO15		1.01337	0.99919	1.00405	1.00213	1.00435	1.00424	1.00399
2G 121		0.99836	0.99974	1.00110	1.00420	1.01543	1.00341	1.00104
LAO225		1.01339	0.99996	1.00002	1.00313	0.99937	1.00096	1.00013
CBNM70		1.00767	0.99877	1.00326	1.00645	0.99254	1.00137	1.00315
PIDIE6-4		0.98796	1.00024	0.99891	1.00319	1.00233	0.99964	0.99882
PIDIE6-5		0.98313	1.00041	0.99843	1.00304	1.00693	1.00090	0.99830
PIDIE6-6		0.99945	1.00250	0.99247	1.00427	0.99892	0.99871	0.99435
CBNM61		1.00646	0.99877	1.00158	1.00625	0.99708	1.00240	1.00166
PIDIE6-7		1.00411	1.00175	0.99511	1.00282	0.99644	0.99984	0.99690
Unweighted Average	**Ave**	**0.987412**	**1.000052**	**0.999253**	**0.999713**	**1.001002**	**0.999555**	**0.999230**
	Err	**0.005883**	**0.000150**	**0.001091**	**0.000839**	**0.001573**	**0.000544**	**0.001092**
Weighted Average	**Ave**	**1.003749**	**0.999896**	**1.000368**	**1.000131**	**1.001397**	**1.000656**	**1.000142**
	Err	**0.001820**	**0.000078**	**0.000835**	**0.000652**	**0.001236**	**0.000348**	**0.000768**
Low-burnup Weighted Ave.	**Ave**	**0.989091**	**0.999877**	**1.002472**	**0.998033**	**0.999015**	**0.999964**	**1.002363**
	Err	**0.006137**	**0.000087**	**0.001593**	**0.001009**	**0.002091**	**0.000380**	**0.001590**

Table XVIII. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using the Pu125_769Cx parameter file with the physical efficiency method. Each result is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		0.97348	1.00013	0.99631	1.01119	1.00897	0.99953	0.99624
STDSGA100		0.99853	0.99967	1.00896	1.00068	1.01506	1.00111	1.00884
A1-92		0.85136	1.00047	0.99190	0.99308	1.00023	0.99632	0.99138
A1-86		0.83082	1.00012	0.99841	0.99185	1.02455	0.99847	0.99768
CALEX		0.93414	0.99997	1.00061	1.00148	0.99999	0.99873	1.00035
STDEUPU7		0.98313	0.99983	1.00266	1.00382	1.01041	1.00018	1.00249
SRPSTDPUEU7		0.98210	0.99996	1.00082	0.99635	1.00907	0.99990	1.00069
JOO1325		0.96924	0.99951	1.00797	0.99313	1.02453	1.00213	1.00773
PIDIE6-1		0.71957	1.00100	0.98492	0.99400	0.99923	0.99192	0.98393
STDISO6		1.00513	0.99980	1.00293	1.00214	0.99760	1.00040	1.00290
STD8		0.96369	0.99990	1.00149	1.00410	0.98982	0.99861	1.00134
CBNM93		0.98054	1.00017	0.99767	0.99612	0.99939	0.99917	0.99762
STDISO9		0.99050	0.99961	1.00522	1.00034	0.99868	1.00022	1.00503
2G 118		0.97692	0.99998	1.00032	0.99745	1.00442	0.99960	1.00015
PIDIE6-2		0.89717	1.00008	0.99932	1.00576	0.98437	0.99343	0.99880
STD40		1.02426	0.99967	1.00235	1.00001	1.00749	1.00427	1.00256
2G 119		0.99526	0.99992	1.00064	0.99951	1.00506	1.00083	1.00059
STDISO12		1.00578	0.99826	1.01271	1.00221	1.01705	1.00537	1.01224
PIDIE6-3		0.98262	0.99968	1.00164	1.00681	0.99709	0.99844	1.00145
CBNM84		0.99794	0.99992	1.00055	0.99915	1.00373	1.00050	1.00050
STDISO15		0.99362	0.99942	1.00341	0.99639	1.00461	0.99998	1.00294
2G 121		1.00112	0.99885	1.00557	1.00321	1.01505	1.00451	1.00534
LAO225		1.02400	0.99997	0.99985	1.00425	1.00949	1.00405	1.00006
CBNM70		1.00115	0.99989	1.00040	0.99991	0.99389	0.99869	1.00041
PIDIE6-4		0.98880	0.99947	1.00191	1.00348	1.00423	1.00102	1.00167
PIDIE6-5		0.98473	0.99985	1.00041	1.00322	1.00755	1.00167	1.00018
PIDIE6-6		1.00040	1.00132	0.99576	1.00394	0.99678	0.99836	0.99687
CBNM61		1.00188	1.00090	0.99735	1.00188	0.99976	1.00057	0.99825
PIDIE6-7		1.00530	1.00027	0.99867	1.00266	0.99407	0.99965	0.99950
Unweighted	**Ave**	**0.986978**	**0.999917**	**1.000715**	**1.000625**	**1.004213**	**0.999919**	**1.000611**
Average	**Err**	**0.004852**	**0.000108**	**0.000951**	**0.000831**	**0.001738**	**0.000533**	**0.000955**
Weighted	**Ave**	**1.000794**	**0.999785**	**1.001730**	**1.000656**	**1.004660**	**1.000995**	**1.001336**
Average	**Err**	**0.001622**	**0.000062**	**0.000724**	**0.000495**	**0.001511**	**0.000402**	**0.000665**
Low-burnup	**Ave**	**0.986118**	**0.999806**	**1.003144**	**1.000585**	**1.003864**	**1.000196**	**1.003014**
Weighted Ave.	**Err**	**0.003335**	**0.000065**	**0.001327**	**0.000879**	**0.002938**	**0.000305**	**0.001310**

Table XIX. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using both the Pu125_451Cx and 203_769Cx parameter files with the empirical efficiency method. Each spectrum was analyzed twice, one with the Pu125_451Cx parameter file and one with the Pu203_769Cx parameter file. The results of a run from the two analyses were then combined. Each result in this table is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.02107	1.00016	0.99786	1.00528	1.00968	1.00009	0.99792
STDSGA100		1.01574	0.99988	1.00346	1.00109	1.02227	1.00106	1.00345
A1-92		0.85901	1.00071	0.98743	0.99384	0.99836	0.99572	0.98699
A1-86		0.84034	1.00036	0.99465	0.99287	1.02385	0.99798	0.99401
CALEX		0.95690	1.00044	0.99392	0.99893	0.99139	0.99738	0.99379
STDEUPU7		0.99028	1.00017	0.99749	1.00422	1.00983	0.99967	0.99747
SRPSTDPUEU7		1.00942	1.00039	0.99446	0.99291	0.99609	0.99915	0.99461
JOO1325		0.99186	0.99991	1.00242	0.99017	1.00723	1.00002	1.00228
PIDIE6-1		0.85387	1.00098	0.99264	0.99675	0.99097	0.99241	0.99198
STDISO6		1.03099	0.99991	1.00140	1.00066	1.00792	1.00160	1.00153
STD8		1.02243	0.99990	1.00236	0.99845	0.99468	0.99945	1.00233
CBNM93		0.99950	0.99982	1.00255	0.99648	0.99668	0.99983	1.00250
STDISO9		1.01620	0.99977	1.00323	0.99799	1.00376	1.00128	1.00325
2G 118		0.97543	1.00035	0.99672	0.99714	1.00276	0.99858	0.99664
PIDIE6-2		0.92121	0.99985	1.00397	1.00213	0.97810	0.99333	1.00350
STD40		1.03482	0.99983	1.00131	1.00072	1.00295	1.00355	1.00160
2G 119		0.99472	1.00032	0.99783	0.99983	1.00316	0.99955	0.99786
STDISO12		0.99543	0.99917	1.00620	1.00142	1.00225	1.00119	1.00590
PIDIE6-3		0.97669	0.99984	1.00281	1.00142	0.98947	0.99630	1.00260
CBNM84		1.00035	0.99966	1.00203	1.00143	1.00210	1.00076	1.00191
STDISO15		1.00092	0.99930	1.00358	1.00012	1.00510	1.00180	1.00326
2G 121		0.99723	0.99994	1.00011	1.00408	1.01228	1.00219	1.00009
LAO225		1.01607	0.99966	1.00166	1.00239	1.00090	1.00141	1.00169
CBNM70		1.00281	0.99948	1.00211	1.00208	0.99520	0.99950	1.00156
PIDIE6-4		0.99010	1.00008	0.99984	1.00286	1.00209	0.99979	0.99971
PIDIE6-5		0.98376	1.00034	0.99880	1.00246	1.00582	1.00048	0.99865
PIDIE6-6		1.00030	1.00207	0.99405	1.00476	1.00312	1.00084	0.99549
CBNM61		1.00324	0.99999	0.99947	1.00390	1.00011	1.00134	0.99975
PIDIE6-7		1.00470	1.00114	0.99676	1.00494	1.00111	1.00193	0.99801
Unweighted	**Ave**	**0.998160**	**1.000118**	**0.999349**	**1.000045**	**1.002042**	**0.999592**	**0.999321**
Average	**Err**	**0.004351**	**0.000108**	**0.000785**	**0.000733**	**0.001702**	**0.000471**	**0.000780**
Weighted	**Ave**	**1.000991**	**0.999981**	**1.000016**	**1.000588**	**1.002797**	**1.000537**	**0.999853**
Average	**Err**	**0.001394**	**0.000060**	**0.000596**	**0.000590**	**0.001105**	**0.000243**	**0.000542**
Low-burnup	**Ave**	**1.001417**	**0.999975**	**1.000860**	**0.999233**	**1.001749**	**1.000314**	**1.000846**
Weighted Ave.	**Err**	**0.005001**	**0.000061**	**0.001041**	**0.001049**	**0.002285**	**0.000328**	**0.001039**

Table XX. Results of the data sets (without lead absorbers) obtained with the coaxial detector and analyzed using both the Pu125_451Cx and 203_769Cx parameter files with the physical efficiency method. Each spectrum was analyzed twice, one with the Pu125_451Cx parameter file and one with the Pu203_769Cx parameter file. The results of a run from the two analyses were then combined. Each result in this table is the average result from the multiple runs for a sample. The bottom rows (in bold) show the "averages of the averages" and errors using both the unweighted and weighted average methods. For the weighted averages, the values from A1-92, A1-86, and Pidie6-1 were not used. For the unweighted average, the values of ^{238}Pu from A1-92, A1-86, and Pidie6-1 were not used.

Sample Name		^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{241}Am	Spec Pow	^{240}Pu Eff
STDISO3		1.03745	1.00025	0.99277	1.00890	1.01319	0.99992	0.99287
STDSGA100		1.01820	0.99966	1.00926	1.00176	1.02448	1.00160	1.00918
A1-92		0.86024	1.00049	0.99208	0.99433	0.99958	0.99639	0.99159
A1-86		0.83857	1.00010	0.99918	0.99269	1.02414	0.99853	0.99847
CALEX		0.96049	0.99991	1.00191	1.00168	0.99428	0.99869	1.00169
STDEUPU7		0.99043	0.99992	1.00099	1.00447	1.01058	1.00017	1.00088
SRPSTDPUEU7		0.99991	0.99992	1.00206	0.99733	1.00130	1.00011	1.00198
JOO1325		0.97968	0.99929	1.01178	0.99616	1.01399	1.00147	1.01149
PIDIE6-1		0.85910	1.00107	0.98995	0.99685	0.99226	0.99223	0.98935
STDISO6		1.03420	1.00009	0.99872	1.00198	1.00705	1.00135	0.99892
STD8		1.02440	1.00003	1.00008	1.00126	0.99506	0.99930	1.00003
CBNM93		0.99881	1.00031	0.99576	0.99696	0.99655	0.99892	0.99577
STDISO9		1.01275	0.99975	1.00345	0.99970	1.00374	1.00120	1.00342
2G 118		0.97812	0.99998	1.00048	0.99756	1.00412	0.99943	1.00031
PIDIE6-2		0.93461	1.00005	1.00255	1.00584	0.98106	0.99393	1.00215
STD40		1.02899	0.99936	1.00493	1.00107	1.00349	1.00386	1.00504
2G 119		0.99600	0.99988	1.00085	0.99968	1.00317	1.00016	1.00081
STDISO12		0.99488	0.99881	1.00859	1.00271	1.00319	1.00170	1.00817
PIDIE6-3		0.99867	0.99961	1.00404	1.00429	0.99356	0.99875	1.00390
CBNM84		1.00318	0.99992	1.00056	0.99912	1.00263	1.00066	1.00055
STDISO15		1.00024	0.99925	1.00405	1.00078	1.00422	1.00161	1.00365
2G 121		1.00131	0.99883	1.00579	1.00310	1.01123	1.00348	1.00555
LAO225		1.00886	0.99827	1.00852	1.00321	1.00379	1.00305	1.00820
CBNM70		1.00096	1.00029	0.99962	0.99988	0.99510	0.99865	0.99959
PIDIE6-4		0.99098	0.99969	1.00152	1.00267	1.00139	0.99970	1.00130
PIDIE6-5		0.98444	1.00009	0.99971	1.00229	1.00472	1.00015	0.99952
PIDIE6-6		0.99904	1.00148	0.99601	1.00412	0.99996	0.99909	0.99683
CBNM61		1.00035	1.00174	0.99544	1.00244	1.00157	1.00012	0.99665
PIDIE6-7		1.00309	1.00054	0.99883	1.00386	0.99867	1.00034	0.99926
Unweighted Average	**Ave**	**0.999233**	**0.999950**	**1.001016**	**1.000921**	**1.003037**	**0.999811**	**1.000935**
	Err	**0.003618**	**0.000121**	**0.000855**	**0.000590**	**0.001497**	**0.000410**	**0.000842**
Weighted Average	**Ave**	**1.000097**	**0.999789**	**1.001958**	**1.000757**	**1.002942**	**1.000827**	**1.001442**
	Err	**0.001221**	**0.000080**	**0.000840**	**0.000463**	**0.000947**	**0.000280**	**0.000784**
Low-burnup Weighted Ave.	**Ave**	**1.002822**	**0.999834**	**1.002643**	**1.000585**	**1.004031**	**1.000654**	**1.002589**
	Err	**0.005437**	**0.000091**	**0.001792**	**0.000893**	**0.001991**	**0.000312**	**0.001758**

APPENDIX B

FRAM analyzes and reports both the isotopic results and the corresponding errors. It is of interest to see how the reported error of an isotope compared with the error of the same isotope from many runs. The tables in this section show the comparisons. The average predicted values are the unweighted average errors of a data set reported by FRAM. The observed values are the standard deviations of the results in a data set. The equation for the standard deviation is shown at the beginning of the Appendix A. The predicted to observed ratios show how the predicted values compared with the observed values.

Table XXI. Comparison of the average predicted to the observed percent errors. The data were acquired using the planar detector and analyzed with the Widerange6 parameter file.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
SRPISO3	9.25	8.40	1.10	0.10	0.09	1.11	2.57	2.52	1.02	0.19	0.26	0.73	4.60	4.32	1.06	0.35	0.24	1.46	2.54	2.49	1.02
A1-92	3.79	2.58	1.47	0.05	0.04	1.25	0.90	0.64	1.41	0.11	0.15	0.73	0.48	0.68	0.71	0.16	0.09	1.78	0.89	0.63	1.41
A1-86	3.07	2.77	1.11	0.05	0.05	1.00	0.81	0.84	0.96	0.09	16.0	0.01	0.42	0.72	0.58	0.15	0.13	1.15	0.80	0.83	0.96
STDR3	3.21	4.42	0.73	0.06	0.06	1.00	1.01	0.94	1.07	0.12	0.20	0.60	0.46	0.49	0.94	0.19	0.15	1.27	1.00	0.93	1.08
CALEX	8.60	6.41	1.34	0.14	0.10	1.40	2.28	1.60	1.43	0.19	0.29	0.66	1.53	1.64	0.93	0.46	0.26	1.77	2.25	1.59	1.42
PUEU7	3.56	3.06	1.16	0.08	0.07	1.14	1.35	1.12	1.21	0.11	0.16	0.69	4.64	4.02	1.15	0.28	0.12	2.33	1.32	1.09	1.21
JOO1325	6.20	6.68	0.93	0.11	0.09	1.22	1.80	1.50	1.20	0.16	0.22	0.73	1.38	1.99	0.69	0.37	0.27	1.37	1.77	1.49	1.19
SRPISO6	5.68	4.44	1.28	0.13	0.10	1.30	1.93	1.56	1.24	0.17	0.33	0.52	3.13	3.07	1.02	0.42	0.21	2.00	1.89	1.52	1.24
STD117	5.21	5.60	0.93	0.12	0.12	1.00	1.90	1.75	1.09	0.20	0.43	0.47	1.41	1.30	1.08	0.39	0.30	1.30	1.87	1.72	1.09
CBNM93	6.11	3.83	1.60	0.11	0.10	1.10	1.68	1.51	1.11	0.17	0.36	0.47	1.23	1.27	0.97	0.36	0.21	1.71	1.65	1.49	1.11
STD8	3.91	3.44	1.14	0.06	0.10	0.60	0.97	1.52	0.64	0.10	0.18	0.56	0.71	0.51	1.39	0.21	0.22	0.95	0.96	1.50	0.64
STD6	3.24	1.80	1.80	0.05	0.05	1.00	0.81	0.72	1.13	0.09	0.13	0.69	0.61	0.80	0.76	0.17	0.10	1.70	0.80	0.71	1.13
SRPISO9	3.97	4.33	0.92	0.13	0.12	1.08	1.80	1.70	1.06	0.16	0.42	0.38	2.83	2.26	1.25	0.42	0.21	2.00	1.75	1.64	1.07
STD3	1.42	0.99	1.43	0.06	0.06	1.00	0.69	0.78	0.88	0.08	0.21	0.38	0.30	0.43	0.70	0.16	0.16	1.00	0.67	0.77	0.87
STD118	3.48	2.74	1.27	0.16	0.10	1.60	1.60	1.04	1.54	0.21	0.50	0.42	0.89	1.37	0.65	0.42	0.35	1.20	1.55	1.02	1.52
PEO382c3	2.76	1.86	1.48	0.11	0.11	1.00	1.05	1.02	1.03	0.14	0.28	0.50	0.47	0.62	0.76	0.29	0.20	1.45	1.02	1.00	1.02
STD40	1.60	1.59	1.01	0.16	0.16	1.00	1.22	1.16	1.05	0.18	0.30	0.60	0.64	0.37	1.73	0.37	0.28	1.32	1.17	1.11	1.05
STD119	2.44	2.82	0.87	0.16	0.20	0.80	1.19	1.51	0.79	0.19	0.36	0.53	0.64	0.79	0.81	0.37	0.35	1.06	1.16	1.46	0.79
SRPISO12	2.23	2.12	1.05	0.20	0.20	1.00	1.47	1.47	1.00	0.22	0.33	0.67	1.35	1.21	1.12	0.48	0.34	1.41	1.41	1.41	1.00
CBNM84	1.55	1.17	1.32	0.17	0.15	1.13	0.98	0.85	1.15	0.18	0.27	0.67	0.69	0.86	0.80	0.35	0.24	1.46	0.93	0.81	1.15
SRPISO15	0.89	1.15	0.77	0.21	0.28	0.75	1.14	1.46	0.78	0.23	0.54	0.43	1.34	0.74	1.81	0.41	0.47	0.87	1.04	1.34	0.78
STD116	0.58	0.68	0.85	0.25	0.34	0.74	1.37	1.85	0.74	0.27	0.44	0.61	0.39	0.65	0.60	0.31	0.19	1.63	1.16	1.56	0.74
STD120	0.52	0.63	0.83	0.22	0.22	1.00	1.22	1.17	1.04	0.24	0.42	0.57	0.31	0.56	0.55	0.25	0.19	1.32	1.04	1.00	1.04
STD121	1.67	1.26	1.33	0.17	0.22	0.77	0.87	1.07	0.81	0.19	0.38	0.50	0.60	0.79	0.76	0.34	0.26	1.31	0.83	1.03	0.81
LAO225	1.95	1.67	1.17	0.19	0.20	0.95	0.96	0.99	0.97	0.20	0.34	0.59	0.56	0.77	0.73	0.36	0.25	1.44	0.92	0.95	0.97
CBNM70	0.44	0.48	0.92	0.31	0.29	1.07	1.37	1.21	1.13	0.32	0.40	0.80	0.43	0.55	0.78	0.29	0.21	1.38	1.05	0.92	1.14
CBNM61	0.48	0.43	1.12	0.38	0.46	0.83	1.08	1.21	0.89	0.39	0.51	0.76	0.49	0.71	0.69	0.31	0.22	1.41	0.78	0.85	0.92
Average			**1.14**			**1.03**			**1.05**			**0.56**			**0.62**			**1.45**			**1.05**

Table XXII. Comparison of the average predicted to the observed percent errors. The data were acquired using the planar detector and analyzed using the Pu125_414Pl parameter file with the empirical efficiency model.

Sample Name	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
SRPISO3	9.25	8.50	1.09	0.09	0.10	0.86	2.52	2.82	0.89	0.20	0.33	0.60	3.62	6.50	0.56	0.34	0.26	1.30	2.49	2.79	0.89
A1-92	3.79	3.68	1.03	0.05	0.04	1.25	0.89	0.72	1.23	0.11	0.21	0.52	0.40	0.78	0.51	0.16	0.10	1.60	0.88	0.72	1.23
A1-86	3.07	2.76	1.11	0.05	0.05	0.93	0.80	0.91	0.87	0.10	0.20	0.51	0.35	0.80	0.44	0.15	0.14	1.06	0.79	0.91	0.87
STDR3	3.22	4.54	0.71	0.06	0.07	0.88	1.00	1.12	0.89	0.13	0.36	0.36	0.41	1.06	0.39	0.19	0.18	1.02	0.99	1.11	0.89
CALEX	8.60	6.48	1.33	0.14	0.10	1.38	2.25	1.62	1.39	0.19	0.40	0.47	1.11	1.25	0.89	0.45	0.30	1.51	2.22	1.61	1.38
PUEU7	3.56	3.09	1.15	0.08	0.07	1.20	1.33	1.07	1.24	0.11	0.22	0.50	3.50	3.75	0.93	0.28	0.14	2.03	1.30	1.04	1.25
JOO1325	6.20	6.59	0.94	0.11	0.10	1.10	1.77	1.59	1.12	0.16	0.44	0.36	0.93	1.50	0.62	0.36	0.25	1.41	1.75	1.58	1.11
SRPISO6	5.69	4.43	1.28	0.13	0.11	1.19	1.91	1.64	1.17	0.18	0.40	0.45	2.42	3.26	0.74	0.41	0.25	1.61	1.87	1.60	1.17
STD117	5.21	5.79	0.90	0.12	0.12	1.00	1.88	1.85	1.01	0.21	0.50	0.42	1.23	1.93	0.64	0.38	0.33	1.16	1.85	1.82	1.02
CBNM93	6.11	3.78	1.62	0.11	0.11	1.05	1.66	1.57	1.06	0.17	0.41	0.41	0.89	1.42	0.62	0.35	0.23	1.50	1.64	1.54	1.06
STD8	3.91	3.52	1.11	0.06	0.11	0.54	0.96	1.66	0.57	0.11	0.12	0.91	0.59	0.74	0.79	0.20	0.23	0.86	0.95	1.65	0.57
STD6	3.24	1.81	1.79	0.05	0.06	0.86	0.80	0.86	0.93	0.10	0.23	0.44	0.51	1.19	0.43	0.17	0.12	1.38	0.79	0.85	0.92
SRPISO9	3.97	4.25	0.93	0.13	0.14	0.94	1.77	1.89	0.94	0.17	0.46	0.37	2.01	2.32	0.86	0.41	0.20	2.05	1.73	1.83	0.95
STD3	1.42	0.95	1.50	0.06	0.06	0.97	0.68	0.75	0.90	0.08	0.20	0.40	0.26	0.54	0.47	0.15	0.11	1.39	0.66	0.74	0.89
STD118	3.48	2.89	1.20	0.15	0.14	1.06	1.58	1.44	1.10	0.21	0.68	0.31	0.76	1.85	0.41	0.41	0.43	0.97	1.54	1.41	1.09
PEO382c3	2.76	1.73	1.60	0.11	0.10	1.06	1.04	0.97	1.08	0.14	0.40	0.35	0.37	0.67	0.55	0.28	0.17	1.64	1.01	0.94	1.08
STD40	1.60	1.64	0.98	0.16	0.15	1.08	1.20	1.09	1.10	0.18	0.24	0.76	0.45	0.59	0.75	0.36	0.27	1.30	1.15	1.05	1.10
STD119	2.44	2.94	0.83	0.16	0.18	0.89	1.18	1.34	0.88	0.19	0.43	0.45	0.52	0.83	0.63	0.36	0.35	1.04	1.14	1.31	0.87
SRPISO12	2.23	2.20	1.02	0.19	0.20	0.96	1.46	1.49	0.98	0.22	0.38	0.57	0.84	1.23	0.68	0.47	0.39	1.21	1.40	1.43	0.98
CBNM84	1.55	1.25	1.24	0.16	0.16	1.01	0.97	0.93	1.04	0.18	0.31	0.59	0.49	0.61	0.80	0.34	0.26	1.32	0.92	0.89	1.04
SRPISO15	0.89	1.14	0.79	0.21	0.41	0.52	1.12	2.10	0.54	0.23	0.44	0.52	0.86	1.07	0.81	0.39	0.62	0.63	1.02	1.92	0.53
STD116	0.58	0.67	0.87	0.24	0.35	0.68	1.34	1.92	0.70	0.27	0.44	0.62	0.34	0.67	0.51	0.30	0.19	1.59	1.14	1.62	0.70
STD120	0.52	0.56	0.92	0.22	0.18	1.22	1.19	0.99	1.20	0.24	0.38	0.62	0.28	0.50	0.56	0.25	0.21	1.16	1.01	0.84	1.21
STD121	1.67	1.10	1.52	0.17	0.17	1.02	0.86	0.84	1.02	0.20	0.35	0.56	0.48	0.77	0.63	0.33	0.18	1.79	0.82	0.80	1.02
LAO225	1.95	1.69	1.15	0.19	0.16	1.15	0.95	0.82	1.16	0.20	0.27	0.74	0.39	0.52	0.74	0.35	0.23	1.50	0.91	0.79	1.16
CBNM70	0.44	0.44	0.99	0.30	0.27	1.12	1.33	1.14	1.17	0.32	0.36	0.88	0.37	0.46	0.80	0.28	0.21	1.31	1.02	0.86	1.19
CBNM61	0.47	0.38	1.24	0.37	0.44	0.84	1.06	1.15	0.92	0.38	0.40	0.95	0.42	0.53	0.80	0.30	0.19	1.55	0.76	0.81	0.94
Average			**1.14**			**0.99**			**1.01**			**0.54**			**0.65**			**1.37**			**1.00**

Table XXIII. Comparison of the average predicted to the observed percent errors. The data were acquired using the planar detector and analyzed using the Pu125_414Pl parameter file with the physical efficiency model.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
SRPISO3	9.60	8.45	1.14	0.10	0.11	0.94	2.63	2.87	0.92	0.20	0.36	0.56	3.66	6.15	0.59	0.36	0.27	1.35	2.60	2.84	0.92
A1-92	4.01	3.61	1.11	0.05	0.04	1.36	0.94	0.67	1.41	0.12	0.20	0.60	0.42	0.75	0.56	0.17	0.09	1.81	0.93	0.66	1.41
A1-86	3.25	2.77	1.18	0.05	0.05	1.00	0.84	0.85	0.99	0.10	0.21	0.48	0.37	0.78	0.47	0.16	0.14	1.17	0.84	0.84	1.00
STDR3	3.40	4.48	0.76	0.06	0.07	0.88	1.06	1.12	0.95	0.14	0.35	0.40	0.43	1.05	0.41	0.20	0.19	1.08	1.05	1.11	0.94
CALEX	9.15	6.57	1.39	0.15	0.10	1.52	2.39	1.58	1.51	0.20	0.41	0.49	1.16	1.22	0.96	0.48	0.30	1.58	2.36	1.57	1.50
PUEU7	3.77	3.09	1.22	0.09	0.06	1.39	1.42	1.05	1.35	0.11	0.21	0.53	3.64	3.70	0.98	0.29	0.13	2.19	1.38	1.01	1.36
JOO1325	6.59	6.66	0.99	0.12	0.10	1.19	1.89	1.60	1.18	0.17	0.43	0.39	0.98	1.44	0.68	0.38	0.26	1.47	1.86	1.59	1.17
SRPISO6	6.08	4.48	1.36	0.13	0.10	1.30	2.04	1.55	1.32	0.19	0.38	0.49	2.54	3.02	0.84	0.44	0.25	1.78	2.00	1.51	1.32
STD117	5.56	5.76	0.97	0.13	0.12	1.07	2.00	1.85	1.08	0.22	0.41	0.54	1.30	1.94	0.67	0.41	0.32	1.28	1.97	1.81	1.09
CBNM93	6.52	3.72	1.75	0.12	0.11	1.13	1.77	1.59	1.12	0.18	0.37	0.48	0.93	1.41	0.66	0.37	0.23	1.64	1.75	1.56	1.12
STD8	4.18	3.55	1.18	0.07	0.11	0.64	1.02	1.64	0.62	0.12	0.15	0.77	0.62	0.73	0.85	0.22	0.23	0.96	1.01	1.62	0.62
STD6	3.46	1.79	1.94	0.06	0.06	1.08	0.85	0.82	1.04	0.10	0.21	0.47	0.54	1.18	0.45	0.18	0.11	1.61	0.84	0.81	1.03
SRPISO9	4.27	4.26	1.00	0.14	0.14	0.97	1.91	1.97	0.97	0.18	0.39	0.47	2.12	2.32	0.92	0.44	0.22	2.00	1.86	1.91	0.98
STD3	1.55	1.03	1.50	0.06	0.07	0.89	0.74	0.82	0.89	0.09	0.18	0.49	0.27	0.52	0.52	0.17	0.13	1.27	0.72	0.80	0.89
STD118	3.87	2.98	1.30	0.17	0.13	1.28	1.74	1.33	1.31	0.23	0.61	0.38	0.83	1.90	0.44	0.46	0.41	1.13	1.70	1.31	1.30
PEO382c3	3.07	1.69	1.81	0.12	0.10	1.20	1.16	0.95	1.22	0.15	0.36	0.42	0.40	0.66	0.61	0.31	0.15	2.01	1.13	0.92	1.22
STD40	1.83	1.58	1.16	0.18	0.15	1.18	1.38	1.12	1.23	0.20	0.25	0.81	0.50	0.61	0.83	0.41	0.28	1.48	1.32	1.08	1.22
STD119	2.77	2.96	0.94	0.18	0.19	0.96	1.35	1.40	0.97	0.22	0.37	0.61	0.59	0.83	0.71	0.41	0.36	1.16	1.31	1.36	0.96
SRPISO12	2.55	2.25	1.13	0.22	0.19	1.18	1.67	1.41	1.19	0.25	0.35	0.71	0.94	1.20	0.79	0.53	0.37	1.42	1.60	1.35	1.19
CBNM84	1.82	1.23	1.48	0.19	0.15	1.25	1.15	0.90	1.28	0.22	0.27	0.81	0.56	0.61	0.92	0.40	0.25	1.59	1.09	0.86	1.27
SRPISO15	1.09	2.32	0.47	0.26	0.68	0.39	1.37	3.37	0.41	0.28	1.04	0.27	1.03	1.13	0.91	0.48	1.24	0.39	1.24	3.10	0.40
STD116	0.72	0.57	1.26	0.30	0.40	0.75	1.65	2.13	0.77	0.33	0.36	0.92	0.42	0.75	0.56	0.37	0.16	2.30	1.41	1.81	0.78
STD120	0.64	0.57	1.12	0.27	0.19	1.41	1.47	1.03	1.42	0.30	0.32	0.92	0.35	0.51	0.68	0.30	0.22	1.37	1.25	0.88	1.42
STD121	2.03	1.13	1.79	0.20	0.18	1.14	1.04	0.89	1.17	0.24	0.29	0.82	0.58	0.77	0.76	0.40	0.20	1.99	1.00	0.86	1.16
LAO225	2.36	1.68	1.41	0.23	0.16	1.45	1.15	0.79	1.45	0.25	0.36	0.70	0.47	0.53	0.89	0.43	0.22	1.92	1.10	0.76	1.44
CBNM70	0.58	0.42	1.38	0.40	0.28	1.45	1.75	1.18	1.48	0.42	0.38	1.10	0.48	0.44	1.09	0.37	0.20	1.81	1.35	0.89	1.51
CBNM61	0.70	0.39	1.82	0.56	0.46	1.21	1.59	1.22	1.31	0.58	0.42	1.38	0.64	0.55	1.16	0.45	0.20	2.30	1.15	0.86	1.34
Average			**1.28**			**1.12**			**1.14**			**0.63**			**0.74**			**1.56**			**1.13**

Table XXIV. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Coax8k125.3 parameter file.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	7.42	8.51	0.87	0.07	0.06	1.17	1.90	1.70	1.12	0.14	0.18	0.78	2.48	2.70	0.92	0.26	0.18	1.44	1.88	1.66	1.13
STDSGA100	2.86	3.75	0.76	0.03	0.04	0.75	0.81	1.16	0.70	0.08	0.09	0.89	1.06	1.36	0.78	0.11	0.13	0.85	0.80	1.15	0.70
A1-92	3.02	2.36	1.28	0.04	0.05	0.80	0.65	0.90	0.72	0.08	0.09	0.89	0.39	0.38	1.03	0.12	0.13	0.92	0.64	0.90	0.71
A1-86	2.64	2.94	0.90	0.04	0.05	0.80	0.63	0.90	0.70	0.07	0.14	0.50	0.36	0.44	0.82	0.12	0.11	1.09	0.62	0.89	0.70
CALEX	12.43	14.01	0.89	0.16	0.13	1.23	2.58	2.07	1.25	0.20	0.38	0.53	1.62	1.63	0.99	0.53	0.33	1.61	2.55	2.02	1.26
STDEUPU7	1.98	1.80	1.10	0.04	0.06	0.67	0.71	0.96	0.74	0.06	0.16	0.38	1.11	0.87	1.28	0.15	0.11	1.36	0.69	0.93	0.74
SRPSTDPUEU7	6.95	8.70	0.80	0.14	0.17	0.82	2.30	2.69	0.86	0.18	0.36	0.50	3.10	1.78	1.74	0.49	0.35	1.40	2.25	2.61	0.86
JOO1325	11.38	16.61	0.69	0.17	0.15	1.13	2.65	2.33	1.14	0.24	0.40	0.60	2.02	1.33	1.52	0.57	0.61	0.93	2.62	2.35	1.11
PIDIE6-1	29.12	30.30	0.96	0.38	0.44	0.86	5.93	6.70	0.89	0.52	0.80	0.65	4.29	4.69	0.91	1.28	0.98	1.31	5.85	6.64	0.88
STDISO6	3.31	3.92	0.84	0.07	0.08	0.88	1.10	1.25	0.88	0.09	0.20	0.45	1.21	1.15	1.05	0.24	0.18	1.33	1.07	1.21	0.88
STD8	7.59	8.25	0.92	0.11	0.09	1.22	1.59	1.31	1.21	0.17	0.16	1.06	1.27	1.56	0.81	0.35	0.20	1.75	1.58	1.27	1.24
CBNM93	3.72	4.32	0.86	0.07	0.06	1.17	0.96	0.91	1.05	0.09	0.14	0.64	0.81	0.72	1.13	0.21	0.13	1.62	0.95	0.89	1.07
STDISO9	2.63	2.76	0.95	0.08	0.09	0.89	1.12	1.27	0.88	0.10	0.13	0.77	1.09	0.96	1.14	0.26	0.25	1.04	1.10	1.25	0.88
2G 118	1.21	1.03	1.17	0.05	0.07	0.71	0.50	0.73	0.68	0.06	0.14	0.43	0.27	0.52	0.52	0.13	0.14	0.93	0.49	0.72	0.68
PIDIE6-2	16.45	18.87	0.87	0.48	0.52	0.92	4.13	4.56	0.91	0.52	0.92	0.57	4.04	3.29	1.23	1.35	0.90	1.50	4.05	4.43	0.91
STD40	1.88	1.88	1.00	0.17	0.13	1.31	1.29	0.94	1.37	0.18	0.22	0.82	0.60	0.61	0.98	0.38	0.21	1.81	1.24	0.89	1.39
2G 119	0.97	1.31	0.74	0.06	0.06	1.00	0.42	0.48	0.88	0.07	0.15	0.47	0.22	0.17	1.29	0.13	0.12	1.08	0.41	0.47	0.87
STDISO12	1.42	1.47	0.97	0.12	0.10	1.20	0.89	0.78	1.14	0.13	0.23	0.57	0.58	0.55	1.05	0.28	0.18	1.56	0.85	0.74	1.15
PIDIE6-3	10.40	10.89	0.96	0.66	0.78	0.85	3.98	4.70	0.85	0.68	1.01	0.67	2.69	1.91	1.41	1.43	1.13	1.27	3.84	4.55	0.84
CBNM84	0.90	0.71	1.27	0.09	0.12	0.75	0.56	0.72	0.78	0.10	0.14	0.71	0.40	0.39	1.03	0.20	0.15	1.33	0.53	0.68	0.78
STDISO15	0.55	0.47	1.17	0.13	0.12	1.08	0.69	0.63	1.10	0.13	0.27	0.48	0.47	0.36	1.31	0.23	0.15	1.53	0.62	0.57	1.09
2G 121	0.88	0.67	1.31	0.08	0.10	0.80	0.40	0.51	0.78	0.09	0.11	0.82	0.25	0.28	0.89	0.15	0.12	1.25	0.39	0.49	0.80
LAO225	1.82	2.05	0.89	0.16	0.20	0.80	0.80	1.00	0.80	0.16	0.29	0.55	0.49	0.44	1.11	0.30	0.21	1.43	0.76	0.96	0.79
CBNM70	0.35	0.76	0.46	0.25	0.44	0.57	1.08	1.86	0.58	0.25	0.51	0.49	0.34	0.53	0.64	0.23	0.27	0.85	0.83	1.38	0.60
PIDIE6-4	1.78	1.83	0.97	0.26	0.29	0.90	1.07	1.17	0.91	0.28	0.40	0.70	0.44	0.86	0.51	0.36	0.32	1.13	1.01	1.09	0.93
PIDIE6-5	1.05	1.34	0.78	0.18	0.24	0.75	0.69	0.89	0.78	0.19	0.35	0.54	0.30	0.41	0.73	0.24	0.17	1.41	0.65	0.83	0.78
PIDIE6-6	0.40	0.46	0.87	0.28	0.27	1.04	0.89	0.78	1.14	0.29	0.38	0.76	0.33	0.49	0.67	0.23	0.21	1.10	0.66	0.57	1.16
CBNM61	0.36	0.68	0.53	0.29	0.41	0.71	0.82	1.09	0.75	0.30	0.48	0.63	0.36	0.44	0.82	0.23	0.36	0.64	0.59	0.74	0.80
PIDIE6-7	0.43	0.44	0.98	0.34	0.35	0.97	0.95	0.89	1.07	0.35	0.41	0.85	0.39	0.52	0.75	0.26	0.24	1.08	0.67	0.61	1.10
Average			**0.92**			**0.92**			**0.92**			**0.64**			**1.00**			**1.26**			**0.93**

Table XXV. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu125_451Cx parameter file with the empirical efficiency model.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	7.42	8.58	0.86	0.07	0.06	1.22	1.85	1.53	1.21	0.14	0.25	0.57	1.21	1.82	0.66	0.25	0.20	1.27	1.83	1.50	1.22
STDSGA100	2.86	3.69	0.78	0.03	0.03	0.98	0.79	0.82	0.96	0.08	0.14	0.57	0.82	1.23	0.66	0.11	0.11	1.03	0.78	0.81	0.96
A1-92	3.02	2.42	1.25	0.03	0.05	0.61	0.64	0.89	0.72	0.08	0.16	0.50	0.25	0.24	1.03	0.11	0.12	0.91	0.63	0.89	0.71
A1-86	2.64	3.01	0.88	0.04	0.05	0.87	0.62	0.78	0.79	0.07	0.22	0.32	0.23	0.38	0.61	0.11	0.12	0.96	0.61	0.77	0.79
CALEX	12.43	13.24	0.94	0.16	0.16	0.96	2.54	2.62	0.97	0.20	0.59	0.33	0.63	0.68	0.91	0.50	0.25	2.00	2.51	2.56	0.98
STDEUPU7	1.98	1.80	1.10	0.04	0.06	0.70	0.70	0.92	0.76	0.06	0.20	0.30	0.63	1.17	0.54	0.14	0.11	1.22	0.68	0.89	0.76
SRPSTDPUEU7	6.95	8.30	0.84	0.14	0.17	0.81	2.28	2.78	0.82	0.17	0.47	0.36	1.21	1.08	1.13	0.47	0.32	1.46	2.22	2.69	0.82
JOO1325	11.41	16.70	0.68	0.17	0.16	1.06	2.62	2.46	1.07	0.23	0.61	0.38	0.73	0.98	0.75	0.54	0.61	0.89	2.58	2.47	1.05
PIDIE6-1	28.93	30.57	0.95	0.38	0.59	0.64	5.94	9.22	0.64	0.51	1.40	0.36	1.25	1.53	0.81	1.16	1.21	0.95	5.86	9.10	0.64
STDISO6	3.30	3.91	0.84	0.07	0.08	0.82	1.08	1.30	0.83	0.09	0.19	0.48	0.57	0.76	0.75	0.23	0.16	1.45	1.06	1.26	0.84
STD8	7.62	8.39	0.91	0.11	0.09	1.16	1.57	1.40	1.13	0.17	1.33	0.13	0.61	1.21	0.50	0.33	0.15	2.20	1.56	1.36	1.14
CBNM93	3.72	4.48	0.83	0.06	0.06	1.01	0.95	0.87	1.09	0.09	0.11	0.83	0.37	0.40	0.91	0.20	0.16	1.26	0.94	0.86	1.09
STDISO9	2.63	2.78	0.95	0.08	0.10	0.80	1.11	1.35	0.83	0.10	0.18	0.56	0.50	0.66	0.76	0.25	0.25	0.99	1.09	1.32	0.82
2G 118	1.21	1.02	1.19	0.05	0.08	0.63	0.49	0.80	0.62	0.06	0.18	0.33	0.18	0.19	0.97	0.13	0.16	0.82	0.48	0.78	0.62
PIDIE6-2	16.51	18.96	0.87	0.47	0.55	0.87	4.11	4.75	0.87	0.51	1.00	0.51	1.04	0.85	1.23	1.21	0.90	1.34	4.02	4.62	0.87
STD40	1.88	1.96	0.96	0.17	0.11	1.57	1.28	0.81	1.59	0.18	0.21	0.84	0.28	0.45	0.63	0.36	0.17	2.14	1.23	0.76	1.62
2G 119	0.96	1.35	0.71	0.06	0.08	0.78	0.42	0.57	0.74	0.07	0.12	0.59	0.15	0.18	0.81	0.12	0.13	0.94	0.41	0.56	0.73
STDISO12	1.42	1.41	1.00	0.12	0.11	1.09	0.88	0.82	1.08	0.13	0.25	0.52	0.27	0.41	0.65	0.27	0.15	1.85	0.85	0.78	1.08
PIDIE6-3	10.40	10.94	0.95	0.66	0.80	0.82	3.96	4.77	0.83	0.68	0.89	0.77	0.85	1.07	0.80	1.26	1.11	1.13	3.82	4.62	0.83
CBNM84	0.90	0.80	1.13	0.09	0.11	0.84	0.55	0.64	0.86	0.10	0.19	0.52	0.20	0.21	0.94	0.19	0.15	1.30	0.53	0.61	0.87
STDISO15	0.55	0.45	1.24	0.13	0.12	1.07	0.69	0.65	1.05	0.13	0.20	0.64	0.24	0.34	0.70	0.22	0.17	1.27	0.62	0.59	1.05
2G 121	0.88	0.67	1.32	0.08	0.10	0.83	0.40	0.48	0.84	0.09	0.12	0.77	0.16	0.22	0.73	0.15	0.14	1.06	0.39	0.46	0.84
LAO225	1.82	1.93	0.94	0.16	0.20	0.80	0.79	1.00	0.79	0.16	0.29	0.57	0.24	0.28	0.85	0.29	0.23	1.29	0.76	0.96	0.79
CBNM70	0.35	0.74	0.47	0.25	0.45	0.56	1.10	1.94	0.57	0.25	0.48	0.52	0.27	0.51	0.53	0.22	0.32	0.69	0.84	1.43	0.59
PIDIE6-4	1.78	1.95	0.91	0.26	0.25	1.05	1.07	1.02	1.05	0.28	0.54	0.52	0.33	0.47	0.70	0.34	0.26	1.31	1.01	0.95	1.06
PIDIE6-5	1.05	1.25	0.84	0.19	0.27	0.70	0.69	0.99	0.69	0.20	0.30	0.65	0.23	0.31	0.75	0.22	0.15	1.46	0.64	0.93	0.69
PIDIE6-6	0.40	0.44	0.92	0.29	0.30	0.97	0.90	0.86	1.05	0.30	0.31	0.95	0.31	0.33	0.91	0.22	0.23	0.97	0.67	0.63	1.06
CBNM61	0.36	0.64	0.56	0.29	0.45	0.65	0.84	1.21	0.69	0.30	0.45	0.66	0.31	0.53	0.58	0.23	0.35	0.64	0.60	0.82	0.73
PIDIE6-7	0.43	0.42	1.01	0.34	0.37	0.93	0.96	0.95	1.01	0.35	0.37	0.95	0.36	0.37	0.97	0.25	0.23	1.10	0.67	0.65	1.04
Average			**0.92**			**0.89**			**0.89**			**0.55**			**0.79**			**1.24**			**0.91**

Table XXVI. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu125_451Cx parameter file with the physical efficiency model.

Sample Name	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	7.52	8.74	0.86	0.07	0.09	0.77	1.92	2.46	0.78	0.14	0.52	0.27	1.22	2.18	0.56	0.26	0.25	1.02	1.90	2.43	0.78
STDSGA100	2.91	3.91	0.74	0.03	0.03	0.94	0.81	0.85	0.95	0.08	0.25	0.31	0.83	1.31	0.63	0.11	0.14	0.77	0.80	0.85	0.94
A1-92	3.06	2.49	1.23	0.04	0.04	0.97	0.67	0.75	0.89	0.08	0.17	0.46	0.26	0.26	1.01	0.12	0.11	1.13	0.66	0.74	0.89
A1-86	2.74	2.92	0.94	0.04	0.05	0.81	0.65	0.83	0.79	0.08	0.26	0.31	0.24	0.43	0.56	0.12	0.12	1.03	0.64	0.82	0.79
CALEX	11.86	13.51	0.88	0.17	0.17	0.99	2.68	2.69	1.00	0.21	0.59	0.36	0.64	0.76	0.84	0.52	0.29	1.80	2.65	2.63	1.01
STDEUPU7	2.07	1.81	1.14	0.05	0.07	0.73	0.74	1.11	0.67	0.06	0.22	0.28	0.65	1.23	0.53	0.15	0.13	1.13	0.72	1.08	0.67
SRPSTDPUEU7	6.74	7.85	0.86	0.15	0.18	0.84	2.41	2.88	0.84	0.18	0.54	0.33	1.25	1.07	1.16	0.48	0.32	1.50	2.36	2.79	0.84
JOO1325	11.23	14.70	0.76	0.18	0.18	1.00	2.78	2.79	1.00	0.24	0.79	0.31	0.76	1.02	0.74	0.56	0.52	1.08	2.75	2.77	0.99
PIDIE6-1	29.54	30.17	0.98	0.40	0.48	0.84	6.20	7.37	0.84	0.54	1.63	0.33	1.31	1.52	0.86	1.21	1.17	1.03	6.12	7.30	0.84
STDISO6	3.44	4.15	0.83	0.08	0.08	0.94	1.16	1.23	0.94	0.10	0.21	0.47	0.59	0.82	0.73	0.24	0.18	1.34	1.13	1.21	0.94
STD8	7.43	7.75	0.96	0.11	0.13	0.83	1.67	1.97	0.85	0.18	1.21	0.15	0.63	1.31	0.48	0.35	0.19	1.87	1.66	1.94	0.86
CBNM93	3.88	4.72	0.82	0.07	0.07	1.02	1.01	1.02	1.00	0.10	0.26	0.37	0.39	0.33	1.18	0.21	0.21	1.02	1.00	1.01	0.99
STDISO9	2.77	3.10	0.89	0.09	0.11	0.79	1.20	1.53	0.78	0.10	0.13	0.82	0.53	0.66	0.80	0.27	0.31	0.87	1.17	1.51	0.77
2G 118	1.31	0.89	1.47	0.05	0.09	0.54	0.54	0.92	0.59	0.07	0.16	0.43	0.20	0.27	0.75	0.14	0.16	0.85	0.53	0.90	0.59
PIDIE6-2	17.70	19.14	0.92	0.53	0.57	0.93	4.63	4.99	0.93	0.58	1.40	0.41	1.15	0.84	1.37	1.34	1.02	1.31	4.54	4.87	0.93
STD40	1.98	2.03	0.97	0.20	0.13	1.54	1.46	0.97	1.50	0.21	0.31	0.67	0.32	0.45	0.71	0.40	0.21	1.91	1.40	0.92	1.52
2G 119	1.07	1.43	0.75	0.06	0.08	0.74	0.48	0.60	0.80	0.07	0.10	0.70	0.17	0.19	0.89	0.14	0.14	1.01	0.46	0.59	0.79
STDISO12	1.58	1.39	1.14	0.14	0.14	0.98	1.01	1.06	0.95	0.14	0.29	0.48	0.30	0.47	0.63	0.30	0.18	1.67	0.97	1.01	0.95
PIDIE6-3	11.66	11.23	1.04	0.78	0.82	0.95	4.67	4.86	0.96	0.80	1.01	0.79	1.00	1.14	0.87	1.46	1.15	1.27	4.51	4.70	0.96
CBNM84	1.04	0.77	1.35	0.11	0.11	0.98	0.65	0.67	0.97	0.11	0.19	0.59	0.23	0.20	1.15	0.22	0.15	1.50	0.62	0.64	0.97
STDISO15	0.65	0.52	1.25	0.15	0.13	1.19	0.83	0.68	1.22	0.16	0.24	0.66	0.28	0.37	0.76	0.26	0.19	1.35	0.75	0.62	1.21
2G 121	1.03	0.68	1.52	0.10	0.13	0.77	0.49	0.65	0.75	0.11	0.21	0.53	0.19	0.31	0.62	0.18	0.16	1.11	0.47	0.63	0.75
LAO225	2.04	2.02	1.01	0.19	0.20	0.96	0.96	0.98	0.98	0.20	0.28	0.72	0.28	0.31	0.90	0.34	0.23	1.51	0.92	0.94	0.98
CBNM70	0.45	0.74	0.61	0.32	0.45	0.70	1.43	1.97	0.73	0.33	0.51	0.64	0.35	0.54	0.64	0.29	0.32	0.89	1.10	1.46	0.75
PIDIE6-4	2.13	1.97	1.08	0.34	0.27	1.26	1.35	1.07	1.26	0.35	0.56	0.63	0.41	0.56	0.73	0.42	0.30	1.38	1.28	1.00	1.27
PIDIE6-5	1.29	1.26	1.02	0.24	0.24	0.98	0.89	0.89	1.00	0.25	0.31	0.80	0.29	0.36	0.80	0.28	0.17	1.63	0.83	0.83	1.01
PIDIE6-6	0.56	0.45	1.23	0.41	0.29	1.42	1.27	0.83	1.54	0.42	0.34	1.22	0.44	0.35	1.23	0.31	0.24	1.27	0.95	0.61	1.56
CBNM61	0.54	0.65	0.82	0.44	0.46	0.96	1.25	1.24	1.01	0.44	0.46	0.97	0.46	0.60	0.77	0.33	0.37	0.91	0.90	0.84	1.07
PIDIE6-7	0.63	0.44	1.42	0.51	0.40	1.28	1.43	1.03	1.39	0.52	0.46	1.15	0.54	0.43	1.25	0.37	0.28	1.34	1.01	0.71	1.42
Average			**1.02**			**0.95**			**0.97**			**0.56**			**0.83**			**1.26**			**0.97**

Table XXVII. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Shldcoax4.3 parameter file.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	5.33	8.58	0.62	0.07	0.08	0.88	1.99	2.23	0.89	0.14	0.25	0.56	0.45	0.51	0.88	0.25	0.23	1.09	1.96	2.20	0.89
STDSGA100	7.43	13.67	0.54	0.09	0.08	1.13	2.57	2.09	1.23	0.12	0.17	0.71	0.59	1.54	0.38	0.33	0.21	1.57	2.54	2.03	1.25
A1-92	5.82	4.37	1.33	0.10	0.11	0.91	1.84	2.04	0.90	0.12	0.10	1.20	0.28	0.31	0.90	0.31	0.24	1.29	1.83	2.03	0.90
A1-86	5.54	9.28	0.60	0.11	0.10	1.10	1.78	1.68	1.06	0.12	0.25	0.48	0.27	0.79	0.34	0.31	0.19	1.63	1.76	1.65	1.07
CALEX	4.92	9.94	0.49	0.10	0.08	1.25	1.61	1.33	1.21	0.15	0.58	0.26	0.26	0.30	0.87	0.29	0.25	1.16	1.59	1.31	1.21
CALEX (1/16Pb)	4.00	4.32	0.93	0.08	0.08	1.00	1.33	1.26	1.06	0.24	0.80	0.30	0.22	0.47	0.47	0.24	0.18	1.33	1.32	1.25	1.06
STDEUPU7	3.40	4.10	0.83	0.10	0.09	1.11	1.54	1.38	1.12	0.11	0.15	0.73	0.43	0.61	0.70	0.30	0.25	1.20	1.51	1.36	1.11
STDPUEU7	3.34	3.61	0.93	0.10	0.14	0.71	1.55	2.23	0.70	0.13	0.31	0.42	0.38	0.62	0.61	0.30	0.37	0.81	1.51	2.19	0.69
STDPUEU7(1/16Pb)	2.65	3.73	0.71	0.08	0.09	0.89	1.22	1.49	0.82	0.22	0.73	0.30	0.30	0.47	0.64	0.23	0.15	1.53	1.19	1.44	0.83
JOO132501	4.00	7.59	0.53	0.10	0.08	1.25	1.53	1.21	1.26	0.18	0.31	0.58	0.27	0.57	0.47	0.29	0.17	1.71	1.51	1.19	1.27
JOO1325 (1/32Pb)	3.29	4.88	0.67	0.08	0.07	1.14	1.31	1.12	1.17	0.24	0.39	0.62	0.23	0.27	0.85	0.24	0.13	1.85	1.29	1.10	1.17
JOO1325 (3/32Pb)	3.29	4.88	0.67	0.08	0.07	1.14	1.31	1.12	1.17	0.24	0.39	0.62	0.23	0.27	0.85	0.24	0.13	1.85	1.29	1.10	1.17
PIDIE6-1	19.20	27.90	0.69	0.32	0.32	1.00	5.27	5.14	1.03	0.45	0.92	0.49	0.74	1.42	0.52	0.91	0.92	0.99	5.21	5.12	1.02
STDISO6	3.08	4.53	0.68	0.09	0.10	0.90	1.36	1.49	0.91	0.10	0.10	1.00	0.31	0.46	0.67	0.27	0.28	0.96	1.33	1.46	0.91
STD8	6.18	9.31	0.66	0.13	0.17	0.76	2.00	2.53	0.79	0.18	0.69	0.26	0.35	0.63	0.56	0.39	0.41	0.95	1.99	2.52	0.79
STD8 (1/16Pb)	5.12	9.05	0.57	0.11	0.14	0.79	1.59	2.03	0.78	0.29	0.47	0.62	0.28	0.49	0.57	0.31	0.33	0.94	1.57	2.01	0.78
CBNM93	3.75	8.01	0.47	0.09	0.12	0.75	1.34	1.76	0.76	0.11	0.16	0.69	0.26	0.28	0.93	0.27	0.34	0.79	1.32	1.74	0.76
STDISO9	2.21	3.10	0.71	0.09	0.06	1.50	1.22	0.85	1.44	0.10	0.19	0.53	0.27	0.23	1.17	0.26	0.22	1.18	1.19	0.84	1.42
2G 118	5.13	4.75	1.08	0.19	0.17	1.12	1.88	1.70	1.11	0.19	0.21	0.90	0.29	0.47	0.62	0.48	0.28	1.71	1.83	1.65	1.11
PIDIE6-2	8.04	13.25	0.61	0.38	0.49	0.78	3.39	4.07	0.83	0.42	0.89	0.47	0.67	1.43	0.47	0.88	0.92	0.96	3.32	3.99	0.83
STD40	1.36	4.84	0.28	0.16	0.14	1.14	1.16	1.05	1.10	0.17	0.28	0.61	0.22	0.66	0.33	0.31	0.50	0.62	1.12	0.99	1.13
STD40 (1/16Pb)	1.04	1.41	0.74	0.12	0.12	1.00	0.89	0.87	1.02	0.15	0.28	0.54	0.17	0.46	0.37	0.24	0.14	1.71	0.85	0.83	1.02
2G 119	4.20	6.77	0.62	0.22	0.20	1.10	1.69	1.55	1.09	0.22	0.26	0.85	0.29	0.81	0.36	0.49	0.61	0.80	1.64	1.52	1.08
STDISO12	1.16	1.71	0.68	0.12	0.16	0.75	0.86	1.21	0.71	0.12	0.27	0.44	0.19	0.56	0.34	0.25	0.18	1.39	0.82	1.15	0.71
PIDIE6-3	5.20	8.81	0.59	0.52	0.64	0.81	3.18	3.84	0.83	0.54	1.02	0.53	0.66	1.84	0.36	0.90	0.62	1.45	3.07	3.68	0.83
CBNM84	1.22	1.27	0.96	0.14	0.21	0.67	0.84	1.25	0.67	0.15	0.35	0.43	0.21	0.42	0.50	0.28	0.19	1.47	0.80	1.17	0.68
STDISO15	0.73	0.95	0.77	0.15	0.17	0.88	0.81	0.92	0.88	0.16	0.33	0.48	0.21	0.56	0.38	0.27	0.30	0.90	0.73	0.83	0.88
2G 121	3.36	4.45	0.76	0.29	0.35	0.83	1.43	1.76	0.81	0.29	0.40	0.73	0.34	0.71	0.48	0.52	0.57	0.91	1.37	1.69	0.81
LAO225 (1/16Pb)	0.92	1.76	0.52	0.12	0.15	0.80	0.61	0.76	0.80	0.14	0.43	0.33	0.15	0.57	0.26	0.20	0.19	1.05	0.59	0.73	0.81
LAO225	1.18	1.39	0.85	0.15	0.11	1.36	0.76	0.56	1.36	0.16	0.31	0.52	0.19	0.54	0.35	0.25	0.21	1.19	0.72	0.53	1.36
CBNM70	0.61	1.00	0.61	0.33	0.47	0.70	1.38	1.88	0.73	0.34	0.59	0.58	0.35	0.46	0.76	0.33	0.53	0.62	1.07	1.47	0.73
PIDIE6-4	3.28	4.85	0.68	0.60	0.77	0.78	2.38	3.02	0.79	0.61	0.99	0.62	0.65	1.61	0.40	0.71	0.80	0.89	2.24	2.83	0.79
PIDIE6-5	2.24	2.62	0.85	0.46	0.54	0.85	1.63	1.92	0.85	0.46	0.65	0.71	0.49	1.00	0.49	0.51	0.45	1.13	1.53	1.79	0.85
PIDIE6-6	1.16	1.66	0.70	0.73	0.92	0.79	2.22	2.68	0.83	0.73	1.26	0.58	0.74	1.26	0.59	0.58	0.93	0.62	1.66	1.95	0.85
CBNM61	0.62	1.11	0.56	0.42	0.67	0.63	1.17	1.76	0.66	0.42	0.61	0.69	0.43	0.83	0.52	0.36	0.61	0.59	0.85	1.20	0.71
PIDIE6-7	1.10	1.94	0.57	0.78	1.18	0.66	2.19	3.09	0.71	0.78	1.23	0.63	0.79	1.71	0.46	0.60	1.24	0.48	1.54	2.09	0.74
Average			**0.70**			**0.94**			**0.95**			**0.58**			**0.57**			**1.15**			**0.95**

Table XXVIII. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu203_769Cx parameter file with the empirical efficiency model.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	5.92	11.90	0.50	0.07	0.07	0.94	2.05	2.08	0.99	0.13	0.35	0.37	0.61	0.55	1.11	0.26	0.25	1.04	2.03	2.05	0.99
STDSGA100	8.35	18.53	0.45	0.10	0.06	1.54	2.66	1.76	1.51	0.12	0.22	0.54	0.67	0.82	0.82	0.33	0.29	1.16	2.62	1.72	1.53
A1-92	6.91	8.31	0.83	0.10	0.15	0.66	1.91	2.79	0.68	0.12	0.26	0.47	0.23	0.31	0.75	0.32	0.33	0.94	1.89	2.78	0.68
A1-86	6.33	10.56	0.60	0.11	0.03	3.33	1.85	0.58	3.20	0.12	0.22	0.56	0.22	0.51	0.43	0.32	0.19	1.68	1.83	0.56	3.27
CALEX	4.95	8.85	0.56	0.10	0.09	1.13	1.66	1.45	1.15	0.15	0.88	0.17	0.29	0.27	1.06	0.30	0.27	1.12	1.64	1.44	1.14
CALEX (1/16Pb)	3.99	3.94	1.01	0.08	0.07	1.10	1.38	1.21	1.14	0.22	1.02	0.21	0.26	0.46	0.56	0.25	0.12	2.02	1.36	1.19	1.15
STDEUPU7	3.60	3.91	0.92	0.10	0.12	0.85	1.57	1.87	0.84	0.11	0.20	0.55	0.42	0.66	0.64	0.31	0.30	1.02	1.53	1.84	0.83
STDPUEU7	3.31	3.06	1.08	0.10	0.14	0.73	1.59	2.22	0.72	0.13	0.50	0.26	0.52	0.57	0.91	0.30	0.31	0.98	1.55	2.17	0.71
STDPUEU7(1/16Pb)	2.52	3.35	0.75	0.08	0.11	0.73	1.27	1.81	0.70	0.20	1.14	0.18	0.45	0.48	0.95	0.24	0.20	1.22	1.24	1.76	0.70
JOO132501	3.92	6.57	0.60	0.10	0.08	1.24	1.57	1.30	1.22	0.17	0.52	0.33	0.31	0.42	0.73	0.29	0.19	1.49	1.55	1.27	1.22
JOO1325 (1/32Pb)	3.19	2.86	1.11	0.08	0.09	0.87	1.34	1.49	0.90	0.22	0.50	0.45	0.28	0.30	0.94	0.24	0.17	1.42	1.32	1.47	0.90
JOO1325 (3/32Pb)	2.88	5.12	0.56	0.07	0.07	0.98	1.21	1.18	1.03	0.50	2.62	0.19	0.27	0.36	0.75	0.22	0.14	1.56	1.20	1.15	1.04
PIDIE6-1	18.98	25.11	0.76	0.33	0.31	1.07	5.35	4.95	1.08	0.44	1.07	0.42	0.72	0.87	0.83	0.92	0.87	1.05	5.28	4.93	1.07
STDISO6	3.24	3.50	0.92	0.09	0.09	1.04	1.38	1.32	1.04	0.10	0.13	0.78	0.33	0.26	1.25	0.27	0.21	1.28	1.35	1.30	1.04
STD8	6.40	9.12	0.70	0.13	0.20	0.66	2.03	3.02	0.67	0.18	1.22	0.15	0.37	0.49	0.76	0.40	0.51	0.78	2.01	3.01	0.67
STD8 (1/16Pb)	5.43	9.26	0.59	0.11	0.13	0.86	1.62	1.93	0.84	0.26	1.01	0.26	0.33	0.47	0.71	0.32	0.27	1.16	1.61	1.91	0.84
CBNM93	4.06	7.95	0.51	0.09	0.12	0.76	1.37	1.77	0.77	0.11	0.18	0.61	0.24	0.35	0.69	0.27	0.32	0.85	1.35	1.75	0.77
STDISO9	2.26	2.88	0.78	0.09	0.08	1.18	1.24	1.02	1.21	0.10	0.19	0.52	0.28	0.16	1.74	0.26	0.23	1.14	1.21	1.00	1.20
2G 118	5.12	3.97	1.29	0.19	0.21	0.92	1.86	2.04	0.91	0.19	0.33	0.57	0.24	0.39	0.62	0.48	0.35	1.38	1.81	2.00	0.91
PIDIE6-2	8.48	15.50	0.55	0.38	0.41	0.95	3.48	3.65	0.95	0.43	0.95	0.45	0.63	0.75	0.85	0.90	0.86	1.04	3.41	3.58	0.95
STD40	1.37	5.20	0.26	0.16	0.27	0.59	1.19	2.02	0.59	0.17	0.30	0.56	0.21	0.73	0.29	0.32	0.53	0.60	1.14	1.92	0.59
STD40 (1/16Pb)	1.05	1.42	0.74	0.12	0.09	1.41	0.91	0.64	1.42	0.15	0.36	0.42	0.17	0.28	0.60	0.24	0.13	1.83	0.88	0.61	1.44
2G 119	4.24	5.24	0.81	0.22	0.19	1.16	1.67	1.44	1.16	0.22	0.28	0.80	0.25	0.42	0.59	0.49	0.36	1.35	1.62	1.40	1.16
STDISO12	1.17	1.70	0.69	0.12	0.18	0.67	0.87	1.33	0.65	0.12	0.32	0.38	0.18	0.34	0.52	0.25	0.19	1.30	0.83	1.26	0.66
PIDIE6-3	5.47	8.39	0.65	0.53	0.56	0.94	3.21	3.42	0.94	0.55	1.08	0.50	0.61	1.08	0.57	0.91	0.47	1.94	3.10	3.28	0.95
CBNM84	1.24	0.96	1.28	0.14	0.21	0.68	0.85	1.22	0.69	0.15	0.36	0.42	0.18	0.31	0.59	0.28	0.24	1.15	0.81	1.16	0.69
STDISO15	0.73	1.27	0.57	0.15	0.17	0.89	0.82	0.90	0.91	0.16	0.31	0.50	0.19	0.28	0.67	0.27	0.35	0.76	0.74	0.82	0.90
2G 121	3.37	3.44	0.98	0.28	0.32	0.87	1.44	1.63	0.88	0.28	0.35	0.82	0.31	0.30	1.03	0.53	0.47	1.11	1.37	1.57	0.88
LAO225 (1/16Pb)	0.94	1.63	0.57	0.12	0.13	0.92	0.62	0.65	0.95	0.14	0.40	0.35	0.15	0.31	0.48	0.21	0.18	1.15	0.59	0.63	0.94
LAO225	1.20	1.61	0.75	0.15	0.15	0.99	0.76	0.76	1.00	0.16	0.28	0.58	0.18	0.39	0.46	0.26	0.20	1.26	0.73	0.73	1.00
CBNM70	0.61	1.14	0.53	0.33	0.49	0.68	1.43	2.04	0.70	0.34	0.61	0.56	0.34	0.35	0.96	0.34	0.48	0.71	1.11	1.57	0.71
PIDIE6-4	3.36	5.85	0.57	0.60	0.62	0.97	2.42	2.47	0.98	0.61	0.97	0.62	0.62	0.69	0.90	0.71	0.54	1.32	2.28	2.31	0.99
PIDIE6-5	2.32	2.90	0.80	0.46	0.43	1.06	1.70	1.59	1.07	0.47	0.58	0.80	0.48	0.52	0.91	0.52	0.30	1.71	1.59	1.48	1.08
PIDIE6-6	1.18	2.58	0.46	0.76	1.36	0.56	2.42	4.17	0.58	0.76	1.52	0.50	0.76	1.51	0.51	0.60	1.18	0.51	1.80	2.95	0.61
CBNM61	0.63	1.35	0.46	0.42	0.68	0.61	1.19	1.83	0.65	0.42	0.69	0.61	0.42	0.74	0.58	0.36	0.67	0.54	0.85	1.25	0.69
PIDIE6-7	1.13	2.08	0.54	0.81	1.10	0.74	2.37	3.00	0.79	0.81	1.13	0.72	0.82	1.21	0.68	0.62	1.07	0.58	1.66	2.01	0.83
Average			**0.72**			**0.98**			**0.99**			**0.48**			**0.76**			**1.17**			**0.99**

Table XXIX. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu203_769Cx parameter file with the physical efficiency model.

Sample Name	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	6.17	17.19	0.36	0.08	0.08	0.96	2.13	2.32	0.92	0.13	0.44	0.30	0.63	0.59	1.08	0.27	0.26	1.01	2.10	2.26	0.93
STDSGA100	8.98	24.23	0.37	0.10	0.09	1.15	2.76	2.43	1.13	0.12	0.28	0.43	0.70	0.85	0.82	0.35	0.37	0.93	2.72	2.36	1.15
A1-92	7.20	9.59	0.75	0.11	0.16	0.71	2.02	2.88	0.70	0.13	0.25	0.52	0.24	0.24	1.01	0.33	0.35	0.95	2.00	2.86	0.70
A1-86	6.77	10.68	0.63	0.11	0.07	1.58	1.95	1.22	1.60	0.13	0.31	0.42	0.23	0.55	0.42	0.34	0.15	2.20	1.93	1.18	1.64
CALEX	5.23	10.04	0.52	0.11	0.08	1.43	1.76	1.25	1.41	0.16	0.95	0.17	0.31	0.38	0.82	0.32	0.25	1.28	1.74	1.23	1.41
CALEX (1/16Pb)	4.24	5.21	0.81	0.09	0.07	1.23	1.47	1.19	1.23	0.23	1.61	0.15	0.28	0.55	0.50	0.26	0.13	2.00	1.45	1.18	1.23
STDEUPU7	3.87	4.52	0.86	0.10	0.09	1.14	1.67	1.44	1.16	0.11	0.15	0.75	0.45	0.57	0.78	0.33	0.24	1.35	1.63	1.41	1.15
STDPUEU7	3.53	4.14	0.85	0.11	0.13	0.81	1.69	2.15	0.79	0.14	0.50	0.28	0.55	0.56	0.98	0.32	0.35	0.92	1.65	2.11	0.78
STDPUEU7(1/16Pb)	2.67	3.78	0.70	0.08	0.12	0.66	1.35	2.00	0.68	0.21	1.39	0.15	0.48	0.43	1.12	0.25	0.21	1.21	1.32	1.94	0.68
JOO132501	4.18	8.33	0.50	0.11	0.08	1.36	1.67	1.28	1.30	0.18	0.74	0.24	0.33	0.46	0.72	0.31	0.21	1.48	1.66	1.26	1.32
JOO1325 (1/32Pb)	3.38	3.91	0.86	0.09	0.12	0.78	1.43	1.87	0.77	0.24	0.73	0.33	0.29	0.35	0.85	0.26	0.21	1.22	1.41	1.84	0.77
JOO1325 (3/32Pb)	3.06	5.33	0.57	0.08	0.08	1.00	1.28	1.25	1.02	0.53	4.17	0.13	0.28	0.35	0.80	0.23	0.16	1.48	1.27	1.23	1.03
PIDIE6-1	20.80	26.00	0.80	0.35	0.36	0.96	5.75	5.93	0.97	0.47	1.02	0.46	0.77	0.96	0.81	0.98	0.92	1.07	5.67	5.89	0.96
STDISO6	3.43	3.42	1.00	0.10	0.08	1.25	1.47	1.21	1.21	0.11	0.18	0.60	0.35	0.24	1.47	0.29	0.21	1.36	1.44	1.19	1.21
STD8	6.78	11.16	0.61	0.14	0.20	0.72	2.17	2.98	0.73	0.19	1.13	0.17	0.40	0.60	0.67	0.42	0.49	0.87	2.15	2.96	0.72
STD8 (1/16Pb)	6.02	12.08	0.50	0.12	0.13	0.88	1.73	1.98	0.87	0.28	1.19	0.24	0.36	0.46	0.77	0.34	0.24	1.43	1.71	1.95	0.88
CBNM93	4.32	8.16	0.53	0.10	0.13	0.76	1.46	1.98	0.74	0.11	0.21	0.55	0.25	0.42	0.61	0.29	0.34	0.85	1.44	1.95	0.74
STDISO9	2.44	2.84	0.86	0.10	0.09	1.13	1.33	1.19	1.12	0.11	0.18	0.60	0.31	0.14	2.22	0.29	0.24	1.20	1.30	1.17	1.11
2G 118	5.63	4.34	1.30	0.21	0.19	1.07	2.05	1.90	1.08	0.21	0.26	0.81	0.27	0.35	0.76	0.53	0.38	1.41	2.00	1.86	1.07
PIDIE6-2	9.43	15.86	0.59	0.43	0.42	1.02	3.90	3.80	1.03	0.48	0.92	0.52	0.70	0.70	1.01	1.00	0.91	1.11	3.82	3.73	1.02
STD40	1.57	5.21	0.30	0.18	0.30	0.59	1.36	2.27	0.60	0.19	0.33	0.58	0.24	0.71	0.34	0.36	0.52	0.70	1.31	2.16	0.61
STD40 (1/16Pb)	1.20	1.68	0.71	0.14	0.08	1.79	1.04	0.59	1.78	0.17	0.43	0.40	0.19	0.30	0.64	0.28	0.14	2.01	1.00	0.56	1.80
2G 119	4.87	4.95	0.98	0.25	0.21	1.19	1.91	1.59	1.20	0.25	0.25	1.03	0.29	0.41	0.71	0.56	0.37	1.51	1.85	1.54	1.20
STDISO12	1.34	1.81	0.74	0.14	0.17	0.79	0.99	1.27	0.78	0.14	0.28	0.49	0.20	0.36	0.55	0.29	0.19	1.49	0.95	1.21	0.79
PIDIE6-3	6.43	9.62	0.67	0.62	0.58	1.07	3.78	3.54	1.07	0.64	1.07	0.60	0.72	1.03	0.70	1.07	0.51	2.11	3.65	3.38	1.08
CBNM84	1.45	1.38	1.05	0.17	0.21	0.82	1.00	1.23	0.81	0.17	0.32	0.53	0.22	0.29	0.76	0.33	0.29	1.13	0.95	1.17	0.81
STDISO15	0.88	1.59	0.55	0.18	0.18	0.98	0.98	0.99	0.99	0.19	0.31	0.60	0.23	0.25	0.90	0.32	0.39	0.81	0.89	0.90	0.99
2G 121	4.08	3.53	1.15	0.34	0.35	0.99	1.74	1.74	1.00	0.34	0.36	0.97	0.37	0.35	1.06	0.63	0.53	1.20	1.66	1.68	0.99
LAO225 (1/16Pb)	1.14	1.80	0.63	0.15	0.12	1.21	0.75	0.62	1.20	0.17	0.45	0.38	0.18	0.26	0.71	0.25	0.18	1.41	0.72	0.60	1.20
LAO225	1.47	1.80	0.81	0.19	0.15	1.20	0.92	0.77	1.20	0.19	0.26	0.72	0.22	0.41	0.54	0.31	0.20	1.59	0.89	0.74	1.20
CBNM70	0.80	1.15	0.70	0.44	0.43	1.03	1.88	1.79	1.05	0.44	0.54	0.82	0.45	0.31	1.45	0.44	0.45	0.99	1.46	1.36	1.07
PIDIE6-4	4.34	7.87	0.55	0.76	0.79	0.96	3.08	3.21	0.96	0.77	1.24	0.62	0.79	0.84	0.94	0.90	0.72	1.25	2.90	3.01	0.96
PIDIE6-5	3.04	3.25	0.93	0.60	0.39	1.53	2.22	1.45	1.54	0.60	0.56	1.07	0.61	0.45	1.35	0.67	0.36	1.85	2.08	1.34	1.54
PIDIE6-6	1.65	2.53	0.65	1.05	1.39	0.75	3.39	4.30	0.79	1.05	1.61	0.65	1.06	1.44	0.74	0.84	1.12	0.74	2.51	3.08	0.82
CBNM61	0.94	1.17	0.80	0.63	0.60	1.04	1.78	1.61	1.11	0.63	0.56	1.11	0.64	0.68	0.93	0.54	0.59	0.91	1.29	1.10	1.17
PIDIE6-7	1.67	2.09	0.80	1.19	1.23	0.97	3.51	3.39	1.04	1.20	1.32	0.90	1.20	1.31	0.92	0.92	1.06	0.86	2.45	2.28	1.08
Average			**0.72**			**1.04**			**1.05**			**0.54**			**0.87**			**1.28**			**1.05**

Table XXX. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu125_769Cx parameter file with the empirical efficiency model.

Sample Name	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	5.17	8.00	0.65	0.05	0.05	0.92	1.33	1.47	0.90	0.13	0.25	0.51	0.78	0.54	1.44	0.18	0.14	1.32	1.31	1.44	0.91
STDSGA100	2.13	4.48	0.47	0.02	0.03	0.71	0.60	0.75	0.80	0.07	0.14	0.51	0.63	0.92	0.68	0.08	0.11	0.73	0.60	0.75	0.80
A1-92	2.22	2.66	0.84	0.03	0.04	0.74	0.49	0.73	0.66	0.08	0.15	0.52	0.20	0.17	1.17	0.09	0.11	0.81	0.48	0.73	0.66
A1-86	1.96	3.32	0.59	0.03	0.04	0.69	0.47	0.74	0.64	0.07	0.22	0.32	0.19	0.43	0.44	0.09	0.11	0.79	0.47	0.73	0.64
CALEX	7.70	7.64	1.01	0.10	0.08	1.32	1.66	1.23	1.35	0.16	0.74	0.21	0.35	0.26	1.34	0.32	0.23	1.37	1.64	1.22	1.34
STDEUPU7	1.46	1.20	1.22	0.03	0.06	0.54	0.53	0.90	0.59	0.05	0.20	0.25	0.47	0.67	0.69	0.11	0.11	1.03	0.51	0.88	0.59
SRPSTDPUEU7	4.41	2.91	1.51	0.09	0.10	0.95	1.51	1.56	0.97	0.13	0.50	0.27	0.66	0.50	1.31	0.30	0.25	1.23	1.47	1.53	0.96
JOO1325	6.72	5.24	1.28	0.11	0.06	1.77	1.67	0.95	1.77	0.19	0.61	0.31	0.39	0.49	0.79	0.33	0.11	2.92	1.65	0.92	1.79
PIDIE6-1	19.55	18.50	1.06	0.26	0.26	0.99	4.14	4.17	0.99	0.42	1.27	0.34	0.83	0.94	0.89	0.77	0.60	1.27	4.09	4.12	0.99
STDISO6	2.34	2.97	0.79	0.05	0.06	0.83	0.79	0.91	0.86	0.08	0.18	0.45	0.39	0.27	1.44	0.16	0.14	1.16	0.77	0.89	0.87
STD8	5.33	5.41	0.99	0.08	0.11	0.76	1.15	1.55	0.74	0.15	1.31	0.12	0.41	0.59	0.70	0.24	0.26	0.94	1.13	1.54	0.74
CBNM93	2.65	5.17	0.51	0.05	0.06	0.85	0.70	0.86	0.81	0.08	0.12	0.65	0.26	0.30	0.87	0.15	0.18	0.84	0.69	0.85	0.81
STDISO9	1.84	1.72	1.06	0.06	0.06	0.98	0.80	0.82	0.97	0.08	0.15	0.55	0.33	0.23	1.44	0.18	0.17	1.07	0.78	0.80	0.97
2G 118	0.95	0.91	1.05	0.04	0.09	0.46	0.39	0.88	0.45	0.05	0.18	0.28	0.15	0.16	0.95	0.10	0.16	0.61	0.38	0.86	0.44
PIDIE6-2	10.88	13.04	0.83	0.32	0.33	0.96	2.84	2.96	0.96	0.38	0.84	0.45	0.69	0.65	1.07	0.80	0.56	1.43	2.78	2.89	0.96
STD40	1.26	3.71	0.34	0.12	0.18	0.68	0.89	1.32	0.68	0.13	0.21	0.63	0.19	0.58	0.33	0.25	0.34	0.74	0.86	1.25	0.69
2G 119	0.76	1.37	0.55	0.04	0.07	0.56	0.34	0.52	0.64	0.06	0.12	0.50	0.12	0.16	0.73	0.10	0.14	0.70	0.33	0.51	0.64
STDISO12	0.98	1.06	0.92	0.08	0.12	0.69	0.62	0.86	0.72	0.09	0.26	0.35	0.18	0.24	0.76	0.19	0.12	1.58	0.60	0.82	0.73
PIDIE6-3	6.80	7.45	0.91	0.45	0.47	0.96	2.71	2.83	0.96	0.47	0.74	0.64	0.58	1.08	0.54	0.83	0.47	1.78	2.62	2.72	0.97
CBNM84	0.66	0.66	1.00	0.07	0.12	0.60	0.41	0.70	0.59	0.08	0.22	0.36	0.15	0.22	0.68	0.14	0.15	0.95	0.39	0.66	0.59
STDISO15	0.40	0.30	1.34	0.09	0.10	0.87	0.50	0.56	0.88	0.10	0.25	0.41	0.17	0.24	0.70	0.16	0.10	1.55	0.45	0.51	0.89
2G 121	0.71	0.71	1.00	0.06	0.10	0.59	0.33	0.52	0.63	0.07	0.12	0.57	0.13	0.23	0.55	0.12	0.17	0.73	0.31	0.50	0.62
LAO225	1.18	1.04	1.13	0.11	0.14	0.77	0.56	0.72	0.77	0.12	0.23	0.53	0.15	0.37	0.41	0.20	0.11	1.89	0.53	0.68	0.78
CBNM70	0.27	0.56	0.47	0.18	0.40	0.45	0.80	1.70	0.47	0.19	0.43	0.44	0.20	0.28	0.71	0.16	0.18	0.91	0.61	1.26	0.49
PIDIE6-4	1.32	1.86	0.71	0.20	0.22	0.91	0.82	0.89	0.92	0.22	0.57	0.39	0.26	0.43	0.60	0.26	0.24	1.08	0.77	0.83	0.92
PIDIE6-5	0.79	1.14	0.69	0.14	0.23	0.61	0.53	0.84	0.63	0.16	0.28	0.56	0.18	0.37	0.48	0.17	0.13	1.28	0.50	0.78	0.64
PIDIE6-6	0.31	0.52	0.60	0.22	0.34	0.66	0.69	1.00	0.70	0.23	0.40	0.58	0.24	0.48	0.50	0.17	0.30	0.56	0.52	0.72	0.72
CBNM61	0.27	0.64	0.43	0.22	0.40	0.55	0.62	1.09	0.57	0.22	0.42	0.53	0.23	0.52	0.44	0.17	0.35	0.48	0.45	0.73	0.61
PIDIE6-7	0.33	0.34	0.97	0.26	0.34	0.77	0.74	0.89	0.83	0.27	0.39	0.70	0.28	0.40	0.71	0.19	0.20	0.98	0.52	0.60	0.86
Average			**0.86**			**0.80**			**0.81**			**0.45**			**0.81**			**1.13**			**0.81**

Table XXXI. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using the Pu125_769Cx parameter file with the physical efficiency model.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	5.24	9.42	0.56	0.05	0.07	0.69	1.38	1.97	0.70	0.13	0.44	0.29	0.79	1.97	0.40	0.18	0.14	1.25	1.36	1.92	0.71
STDSGA100	2.16	4.98	0.43	0.02	0.03	0.74	0.62	0.72	0.87	0.08	0.25	0.32	0.64	0.98	0.65	0.08	0.13	0.60	0.61	0.72	0.85
A1-92	2.27	2.96	0.77	0.03	0.04	0.75	0.51	0.72	0.70	0.08	0.16	0.50	0.21	0.31	0.68	0.09	0.11	0.83	0.51	0.72	0.70
A1-86	2.03	3.48	0.58	0.03	0.05	0.62	0.50	0.81	0.61	0.07	0.26	0.27	0.19	0.47	0.41	0.09	0.11	0.85	0.49	0.80	0.61
CALEX	7.41	8.47	0.88	0.11	0.07	1.65	1.76	1.07	1.65	0.17	0.70	0.24	0.37	0.39	0.95	0.33	0.23	1.46	1.74	1.06	1.64
STDEUPU7	1.52	1.29	1.18	0.03	0.06	0.57	0.56	0.96	0.59	0.06	0.22	0.28	0.48	0.67	0.72	0.11	0.11	1.02	0.55	0.93	0.58
SRPSTDPUEU7	4.33	3.80	1.14	0.10	0.10	1.01	1.60	1.59	1.01	0.14	0.48	0.29	0.69	0.59	1.16	0.32	0.27	1.18	1.56	1.56	1.00
JOO1325	6.66	6.44	1.03	0.11	0.09	1.21	1.78	1.42	1.25	0.20	1.69	0.12	0.40	0.61	0.66	0.35	0.18	1.91	1.76	1.39	1.27
PIDIE6-1	20.04	18.54	1.08	0.27	0.29	0.93	4.34	4.67	0.93	0.45	1.47	0.30	0.88	1.07	0.82	0.80	0.65	1.22	4.29	4.62	0.93
STDISO6	2.44	2.75	0.89	0.05	0.06	0.96	0.84	0.84	1.00	0.08	0.30	0.27	0.41	0.67	0.60	0.17	0.15	1.15	0.82	0.82	1.00
STD8	5.23	6.09	0.86	0.08	0.11	0.76	1.22	1.57	0.77	0.16	1.18	0.14	0.43	0.82	0.52	0.25	0.24	1.05	1.21	1.57	0.77
CBNM93	2.78	5.39	0.52	0.05	0.05	1.02	0.75	0.73	1.03	0.08	0.22	0.37	0.28	0.35	0.79	0.16	0.19	0.83	0.74	0.73	1.01
STDISO9	1.94	1.86	1.04	0.06	0.06	0.96	0.86	0.84	1.02	0.08	0.09	0.86	0.35	1.01	0.35	0.19	0.20	0.95	0.84	0.82	1.01
2G 118	1.03	0.81	1.27	0.04	0.09	0.44	0.43	0.92	0.47	0.06	0.17	0.35	0.16	0.24	0.67	0.11	0.16	0.67	0.42	0.90	0.47
PIDIE6-2	11.67	13.51	0.86	0.36	0.32	1.13	3.19	2.83	1.13	0.42	0.96	0.44	0.77	0.70	1.09	0.89	0.61	1.46	3.13	2.76	1.13
STD40	1.34	3.56	0.38	0.14	0.19	0.72	1.02	1.43	0.71	0.15	0.33	0.46	0.22	0.62	0.35	0.28	0.37	0.76	0.98	1.36	0.72
2G 119	0.85	1.40	0.61	0.05	0.08	0.66	0.38	0.56	0.68	0.06	0.10	0.60	0.14	0.19	0.75	0.11	0.15	0.75	0.37	0.55	0.68
STDISO12	1.10	0.86	1.27	0.10	0.13	0.75	0.71	0.98	0.73	0.11	0.28	0.39	0.20	0.21	0.93	0.21	0.16	1.33	0.68	0.94	0.73
PIDIE6-3	7.65	8.14	0.94	0.53	0.48	1.09	3.19	2.92	1.09	0.56	0.86	0.65	0.68	1.06	0.64	0.97	0.47	2.06	3.08	2.80	1.10
CBNM84	0.76	0.69	1.10	0.08	0.12	0.67	0.49	0.71	0.68	0.09	0.21	0.43	0.17	0.18	0.96	0.16	0.15	1.07	0.46	0.68	0.68
STDISO15	0.48	0.83	0.58	0.11	0.10	1.12	0.60	0.54	1.11	0.12	0.35	0.34	0.20	0.83	0.24	0.19	0.29	0.66	0.54	0.48	1.13
2G 121	0.83	0.61	1.35	0.08	0.13	0.61	0.40	0.65	0.61	0.09	0.21	0.44	0.16	0.31	0.52	0.14	0.14	1.00	0.38	0.63	0.60
LAO225	1.34	1.04	1.28	0.13	0.13	1.03	0.67	0.64	1.06	0.14	0.22	0.64	0.19	0.39	0.48	0.24	0.11	2.14	0.65	0.61	1.07
CBNM70	0.35	0.51	0.68	0.24	0.39	0.62	1.05	1.65	0.63	0.25	0.41	0.60	0.26	0.31	0.84	0.21	0.14	1.56	0.81	1.23	0.65
PIDIE6-4	1.58	1.89	0.84	0.26	0.26	0.99	1.03	1.06	0.98	0.28	0.61	0.46	0.33	0.51	0.65	0.32	0.28	1.14	0.97	0.99	0.98
PIDIE6-5	0.97	1.21	0.81	0.19	0.22	0.87	0.69	0.80	0.87	0.20	0.30	0.66	0.23	0.38	0.60	0.22	0.16	1.40	0.64	0.74	0.87
PIDIE6-6	0.44	0.55	0.80	0.32	0.33	0.97	0.98	0.97	1.01	0.33	0.44	0.75	0.34	0.50	0.69	0.24	0.32	0.76	0.73	0.70	1.04
CBNM61	0.41	0.60	0.68	0.32	0.40	0.80	0.93	1.09	0.85	0.33	0.40	0.82	0.35	0.63	0.55	0.25	0.36	0.70	0.67	0.74	0.90
PIDIE6-7	0.49	0.36	1.37	0.40	0.37	1.08	1.11	0.95	1.16	0.41	0.46	0.88	0.42	0.43	0.97	0.29	0.23	1.24	0.78	0.66	1.19
Average			**0.89**			**0.88**			**0.90**			**0.45**			**0.68**			**1.14**			**0.90**

Table XXXII. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using both the Pu125_451Cx and Pu203_769Cx parameter files with the empirical efficiency model. Each spectrum was analyzed twice, one with the Pu125_451Cx parameter file and one with the Pu203_769Cx parameter file. The results of a run from the two analyses were then combined.

	238Pu			**239Pu**			**240Pu**			**241Pu**			**241Am**			**Spec Pow**			**240Pu Eff**		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	4.59	7.55	0.61	0.05	0.05	0.91	1.38	1.44	0.95	0.10	0.27	0.35	0.55	0.65	0.85	0.18	0.15	1.21	1.36	1.42	0.96
STDSGA100	2.70	4.74	0.57	0.03	0.03	0.99	0.76	0.79	0.96	0.07	0.16	0.42	0.52	0.80	0.65	0.10	0.10	1.00	0.75	0.77	0.96
A1-92	2.76	2.89	0.96	0.03	0.04	0.65	0.60	0.78	0.77	0.07	0.16	0.41	0.17	0.24	0.71	0.10	0.12	0.88	0.60	0.78	0.76
A1-86	2.43	3.02	0.81	0.04	0.04	0.87	0.59	0.74	0.79	0.06	0.21	0.28	0.16	0.39	0.41	0.11	0.11	0.97	0.58	0.73	0.79
CALEX	4.57	7.40	0.62	0.08	0.08	1.08	1.39	1.23	1.13	0.12	0.77	0.15	0.26	0.28	0.93	0.26	0.23	1.12	1.37	1.23	1.12
STDEUPU7	1.74	1.08	1.60	0.04	0.06	0.65	0.64	0.94	0.68	0.05	0.20	0.27	0.35	0.75	0.47	0.13	0.11	1.11	0.62	0.92	0.68
SRPSTDPUEU7	2.98	2.95	1.01	0.08	0.10	0.85	1.30	1.59	0.82	0.10	0.47	0.22	0.48	0.52	0.92	0.25	0.23	1.11	1.27	1.54	0.82
JOO1325	3.69	5.27	0.70	0.09	0.06	1.33	1.35	1.07	1.26	0.14	0.52	0.26	0.29	0.46	0.63	0.26	0.15	1.74	1.33	1.06	1.26
PIDIE6-1	14.90	16.55	0.90	0.25	0.27	0.93	3.95	4.11	0.96	0.33	1.04	0.32	0.63	0.89	0.70	0.72	0.53	1.36	3.89	4.07	0.96
STDISO6	2.31	2.86	0.81	0.06	0.06	0.88	0.85	0.97	0.88	0.07	0.14	0.47	0.29	0.28	1.02	0.18	0.12	1.42	0.84	0.94	0.89
STD8	4.87	5.79	0.84	0.08	0.11	0.75	1.24	1.62	0.77	0.12	1.27	0.10	0.32	0.59	0.54	0.26	0.24	1.08	1.23	1.60	0.77
CBNM93	2.74	5.29	0.52	0.05	0.06	0.86	0.78	0.86	0.91	0.07	0.11	0.65	0.20	0.34	0.60	0.16	0.17	0.93	0.77	0.85	0.91
STDISO9	1.71	1.82	0.94	0.06	0.06	0.96	0.83	0.83	0.99	0.07	0.16	0.43	0.24	0.21	1.17	0.18	0.17	1.10	0.81	0.82	0.99
2G 118	1.18	0.95	1.24	0.05	0.09	0.56	0.48	0.87	0.55	0.06	0.19	0.30	0.14	0.21	0.68	0.13	0.17	0.75	0.47	0.85	0.55
PIDIE6-2	7.45	12.84	0.58	0.30	0.34	0.89	2.65	3.01	0.88	0.33	0.82	0.40	0.54	0.66	0.82	0.72	0.54	1.34	2.60	2.93	0.89
STD40	1.11	3.87	0.29	0.12	0.17	0.69	0.87	1.27	0.69	0.12	0.23	0.54	0.17	0.57	0.30	0.24	0.33	0.71	0.84	1.20	0.70
2G 119	0.94	1.37	0.68	0.06	0.07	0.85	0.41	0.51	0.80	0.07	0.12	0.54	0.13	0.14	0.93	0.12	0.12	0.98	0.40	0.50	0.79
STDISO12	0.90	1.22	0.74	0.08	0.11	0.76	0.62	0.84	0.74	0.09	0.27	0.33	0.15	0.26	0.58	0.18	0.11	1.66	0.59	0.80	0.74
PIDIE6-3	4.82	6.73	0.72	0.41	0.48	0.86	2.49	2.83	0.88	0.43	0.86	0.50	0.50	0.94	0.53	0.74	0.45	1.65	2.40	2.72	0.88
CBNM84	0.73	0.59	1.24	0.08	0.11	0.67	0.46	0.68	0.68	0.08	0.24	0.35	0.13	0.25	0.54	0.16	0.14	1.14	0.44	0.65	0.68
STDISO15	0.44	0.37	1.20	0.10	0.11	0.91	0.53	0.57	0.92	0.10	0.23	0.43	0.15	0.20	0.73	0.17	0.14	1.23	0.48	0.52	0.92
2G 121	0.85	0.67	1.27	0.08	0.10	0.76	0.39	0.51	0.77	0.09	0.12	0.70	0.14	0.21	0.68	0.14	0.14	1.00	0.37	0.49	0.77
LAO225	1.00	1.00	1.01	0.11	0.14	0.79	0.55	0.70	0.79	0.11	0.25	0.47	0.14	0.31	0.46	0.19	0.10	1.83	0.53	0.66	0.79
CBNM70	0.30	0.58	0.52	0.20	0.39	0.51	0.87	1.67	0.52	0.20	0.47	0.43	0.21	0.36	0.59	0.18	0.20	0.93	0.67	1.25	0.54
PIDIE6-4	1.57	1.84	0.85	0.24	0.22	1.11	0.98	0.87	1.12	0.25	0.57	0.45	0.29	0.42	0.69	0.30	0.21	1.47	0.92	0.81	1.13
PIDIE6-5	0.96	1.13	0.84	0.18	0.23	0.77	0.64	0.84	0.76	0.18	0.29	0.63	0.21	0.29	0.72	0.20	0.12	1.73	0.60	0.78	0.76
PIDIE6-6	0.38	0.52	0.73	0.27	0.34	0.80	0.84	0.99	0.85	0.28	0.41	0.67	0.28	0.39	0.72	0.21	0.28	0.75	0.62	0.72	0.87
CBNM61	0.31	0.64	0.49	0.24	0.41	0.59	0.68	1.10	0.62	0.24	0.41	0.59	0.25	0.49	0.51	0.19	0.34	0.56	0.49	0.75	0.66
PIDIE6-7	0.40	0.36	1.10	0.31	0.33	0.94	0.89	0.87	1.03	0.32	0.36	0.90	0.33	0.34	0.96	0.23	0.20	1.18	0.62	0.59	1.06
Average			**0.84**			**0.83**			**0.84**			**0.43**			**0.69**			**1.17**			**0.85**

Table XXXIII. Comparison of the average predicted to the observed percent errors. The data were acquired using the coaxial detector and analyzed using both the Pu125_451Cx and Pu203_769Cx parameter files with the physical efficiency model. Each spectrum was analyzed twice, one with the Pu125_451Cx parameter file and one with the Pu203_769Cx parameter file. The results of a run from the two analyses were then combined.

	238Pu			239Pu			240Pu			241Pu			241Am			Spec Pow			240Pu Eff		
Sample Name	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs	Ave Pred	Obsv	Pre/ Obs
STDISO3	4.69	9.79	0.48	0.05	0.08	0.65	1.43	2.23	0.64	0.10	0.44	0.22	0.56	0.75	0.75	0.19	0.19	0.97	1.41	2.19	0.64
STDSGA100	2.75	5.39	0.51	0.03	0.03	0.98	0.78	0.78	1.00	0.07	0.25	0.27	0.53	0.93	0.57	0.10	0.14	0.76	0.77	0.78	0.99
A1-92	2.82	3.31	0.85	0.04	0.04	0.90	0.63	0.73	0.87	0.07	0.18	0.39	0.18	0.21	0.83	0.11	0.12	0.96	0.63	0.73	0.86
A1-86	2.53	3.29	0.77	0.04	0.05	0.79	0.62	0.81	0.77	0.07	0.27	0.26	0.17	0.40	0.42	0.11	0.10	1.12	0.61	0.79	0.77
CALEX	4.76	8.72	0.55	0.09	0.08	1.17	1.47	1.26	1.17	0.13	0.81	0.16	0.28	0.41	0.69	0.27	0.24	1.14	1.45	1.25	1.17
STDEUPU7	1.82	1.35	1.36	0.04	0.06	0.71	0.68	1.03	0.66	0.05	0.20	0.27	0.37	0.69	0.54	0.14	0.12	1.14	0.66	1.00	0.66
SRPSTDPUEU7	3.13	3.88	0.81	0.09	0.09	0.93	1.38	1.54	0.90	0.11	0.46	0.24	0.51	0.54	0.94	0.27	0.25	1.07	1.35	1.50	0.90
JOO1325	3.90	6.49	0.60	0.09	0.07	1.27	1.43	1.17	1.23	0.14	0.71	0.20	0.30	0.47	0.64	0.27	0.13	2.11	1.42	1.14	1.24
PIDIE6-1	15.86	16.95	0.94	0.26	0.29	0.91	4.20	4.67	0.90	0.35	1.12	0.32	0.66	1.02	0.65	0.76	0.62	1.23	4.15	4.61	0.90
STDISO6	2.43	2.76	0.88	0.06	0.06	0.93	0.91	0.97	0.94	0.07	0.19	0.40	0.30	0.24	1.24	0.18	0.13	1.41	0.89	0.95	0.94
STD8	4.97	6.95	0.72	0.09	0.14	0.65	1.32	2.00	0.66	0.13	1.16	0.11	0.34	0.71	0.48	0.27	0.27	1.00	1.31	1.98	0.66
CBNM93	2.88	5.70	0.51	0.06	0.06	1.02	0.83	0.83	1.01	0.07	0.18	0.41	0.21	0.36	0.59	0.17	0.20	0.84	0.82	0.83	0.99
STDISO9	1.83	1.87	0.98	0.07	0.07	1.00	0.89	0.90	0.99	0.08	0.11	0.66	0.27	0.20	1.36	0.20	0.18	1.09	0.87	0.89	0.98
2G 118	1.27	0.85	1.50	0.05	0.09	0.51	0.52	0.96	0.55	0.07	0.17	0.40	0.16	0.28	0.58	0.14	0.17	0.79	0.51	0.94	0.55
PIDIE6-2	8.22	13.23	0.62	0.33	0.31	1.08	2.98	2.78	1.07	0.37	0.84	0.44	0.60	0.67	0.89	0.80	0.53	1.51	2.92	2.69	1.08
STD40	1.23	3.68	0.33	0.13	0.19	0.70	0.99	1.40	0.71	0.14	0.30	0.47	0.19	0.55	0.35	0.27	0.31	0.88	0.95	1.32	0.72
2G 119	1.04	1.45	0.72	0.06	0.08	0.77	0.47	0.56	0.84	0.07	0.10	0.66	0.15	0.12	1.23	0.14	0.13	1.01	0.45	0.54	0.82
STDISO12	1.02	1.31	0.78	0.10	0.12	0.80	0.71	0.90	0.79	0.10	0.27	0.37	0.17	0.27	0.60	0.21	0.14	1.51	0.68	0.85	0.79
PIDIE6-3	5.60	7.46	0.75	0.49	0.49	0.99	2.93	2.94	1.00	0.50	0.89	0.56	0.58	0.89	0.66	0.87	0.46	1.88	2.83	2.82	1.00
CBNM84	0.85	0.74	1.14	0.09	0.11	0.81	0.54	0.69	0.79	0.09	0.22	0.43	0.16	0.21	0.75	0.18	0.14	1.35	0.52	0.65	0.79
STDISO15	0.52	0.34	1.55	0.12	0.12	0.94	0.63	0.66	0.96	0.12	0.26	0.47	0.18	0.23	0.77	0.20	0.12	1.74	0.57	0.60	0.96
2G 121	1.00	0.67	1.48	0.10	0.13	0.73	0.47	0.65	0.72	0.10	0.20	0.53	0.17	0.28	0.61	0.17	0.16	1.10	0.45	0.63	0.72
LAO225	1.19	1.12	1.06	0.13	0.13	0.99	0.67	0.67	0.99	0.14	0.23	0.61	0.17	0.32	0.54	0.23	0.10	2.24	0.64	0.64	1.00
CBNM70	0.39	0.57	0.70	0.26	0.37	0.70	1.14	1.56	0.73	0.26	0.44	0.60	0.28	0.39	0.71	0.24	0.20	1.20	0.88	1.16	0.75
PIDIE6-4	1.91	1.89	1.01	0.31	0.26	1.19	1.24	1.03	1.20	0.32	0.62	0.52	0.37	0.47	0.77	0.38	0.26	1.47	1.17	0.96	1.21
PIDIE6-5	1.18	1.22	0.97	0.22	0.21	1.05	0.83	0.78	1.06	0.23	0.30	0.78	0.26	0.31	0.84	0.26	0.14	1.88	0.77	0.72	1.07
PIDIE6-6	0.53	0.55	0.96	0.38	0.32	1.17	1.19	0.94	1.26	0.39	0.47	0.83	0.40	0.44	0.92	0.29	0.31	0.95	0.88	0.68	1.30
CBNM61	0.46	0.63	0.74	0.36	0.41	0.88	1.02	1.09	0.94	0.36	0.39	0.93	0.37	0.54	0.68	0.28	0.35	0.81	0.74	0.74	0.99
PIDIE6-7	0.59	0.37	1.59	0.47	0.37	1.28	1.33	0.93	1.43	0.48	0.44	1.09	0.49	0.40	1.24	0.34	0.23	1.52	0.93	0.64	1.46
Average			**0.89**			**0.91**			**0.93**			**0.47**			**0.75**			**1.26**			**0.93**

APPENDIX C

This section shows two parameter files, one for the coaxial detector in the energy range of 125 to 769 keV and one for the planar detector in the energy range of 125 to 414 keV. The parameter file for the planar detector is similar to that of the coaxial detector within the energy range except that the energy regions are different due to different energy resolution of the two types of detectors. The parameter file for the coaxial detector in the energy range of 125 to 451 keV is exactly the same as that of the 125_769Cx parameter file within the energy range. The parameter file for the coaxial detector in the energy range of 203 to 769 keV is also exactly the same as that of the 125_769Cx parameter file within the energy range with one exception. Because of the unavailability of the low-energy peaks, the peaks that are dependent of the 125.3-keV peak are now dependent of the 662.5-keV peak.

Also, in these files, the check for the presence of ^{237}Np is permanently removed. Neptunium-237 is the decay product of both ^{241}Pu and ^{241}Am. It always shows up in the aged plutonium so it is included into the isotope list.

Pu125_769Cx parameter file

```
// fit information
name: Pu125_769Cx
desc: "Coax .125 kev/ch, Homo. Am/Pu, Equ., 3-25% Pu240,<800 keV "
date: "2000.04.20 15:18"
ecal: 1.250000e-001 5.000000e-003
fix-ecal: N
fcal: 1.650000e-001 2.600000e-003 4.390000e+001
fix-fcal: N
scal: -4.200000e+000 3.000000e-003 2.700000e-001 0.000000e+000
fix-scal: Y
// peak information
num_peaks: 97
  1 "Pu239"  124.490    0.000 6.720000e-007 0.000000e+000   0   0 N N N N N 2
  2 "Pu239"  125.190    0.000 6.466000e-007 0.000000e+000   4   0 N N N N N 2
  3 "Am241"  125.292    0.000 4.198000e-005 0.000000e+000   0   0 N Y N N N 2
  4 "Pu239"  129.294    0.000 6.257000e-005 0.000000e+000   0   0 Y Y Y Y Y 1
  5 "Pu239"  141.657    0.000 3.390000e-007 0.000000e+000   7   0 N N N N N 3
  6 "Pu239"  143.350    0.000 1.830000e-007 0.000000e+000   7   0 N N N N N 3
  7 "Pu239"  144.211    0.000 2.940000e-006 0.000000e+000   0   0 N N N N N 3
  8 "Pu239"  146.077    0.000 1.210000e-006 0.000000e+000   7   0 N N N N N 3
  9 "Am241"  146.557    0.000 4.824000e-006 0.000000e+000   0   0 N N N N N 3
 10 "Pu241"  148.567    0.000 1.800000e-006 0.000000e+000   0   0 Y Y Y Y N 3
 11 "Am241"  150.040    0.000 7.532000e-007 0.000000e+000   9   0 N N N N N 3
 12 "Pu238"  152.720    0.000 8.869000e-006 0.000000e+000   0   0 N Y N N N 4
 13 "Pu241"  159.969    0.000 6.210000e-008 0.000000e+000  10   0 N N N N N 6
 14 "Pu239"  160.180    0.000 5.200000e-008 0.000000e+000  16   0 N N N N N 6
 15 "Pu240"  160.308    0.000 3.831000e-006 0.000000e+000   0   0 N Y N N N 6
 16 "Pu239"  161.482    0.000 1.152000e-006 0.000000e+000   0   0 N Y N N N 6
 17 "Pu241"  164.597    0.000 4.376000e-007 0.000000e+000   0   0 Y Y Y Y Y 5
 18 "Am241"  164.597    0.000 6.449000e-007 0.000000e+000   3   0 N N N N N 5
 19 "Am241"  165.930    0.000 2.119000e-007 0.000000e+000   0   0 N N N N N 5
 20 "Am241"  169.567    0.000 1.584000e-006 0.000000e+000   0   0 N Y N N N 7
 21 "Pu239"  171.372    0.000 1.047000e-006 0.000000e+000   0   0 N Y N N N 7
 22 "Pu239"  203.545    0.000 5.474000e-006 0.000000e+000   0   0 Y Y N N N 8
 23 "Pu241"  208.000    0.000 5.174000e-006 0.000000e+000   0   0 Y Y Y Y Y 9
 24 "Am241"  208.000    0.000 7.625000e-006 0.000000e+000   3   0 N N N N N 9
 25 "Pu239"  255.380    0.000 7.804000e-007 0.000000e+000   0   0 Y Y N N N 10
 26 "Pu239"  263.930    0.000 2.568000e-007 0.000000e+000   0   0 N N N N N 11
 27 "     "  264.850    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 11
 28 "Pu239"  265.700    0.000 1.550000e-008 0.000000e+000  26   0 N N N N N 11
 29 "Pu241"  267.540    0.000 1.764000e-007 0.000000e+000   0   0 Y Y Y N N 11
 30 "Am241"  267.540    0.000 2.600000e-007 0.000000e+000   3   0 N N N N N 11
 31 "Pu239"  311.700    0.000 2.574000e-007 0.000000e+000  46   0 N N N N N 12
 32 "Np237"  311.900    0.000 3.860000e-001 0.000000e+000   0   0 N Y N N N 12
 33 "Pu239"  319.700    0.000 4.800000e-008 0.000000e+000   0   0 N N N N N 13
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 34 "Pu239"  320.860    0.000 5.298000e-007 0.000000e+000   0   0 N N N N N 13
 35 "Am241"  322.525    0.000 1.486000e-006 0.000000e+000   0   0 N Y N N N 13
 36 "Pu239"  323.822    0.000 5.430000e-007 0.000000e+000   0   0 N N N N N 13
 37 "Pu241"  332.387    0.000 2.974000e-007 0.000000e+000   0   0 Y Y N N N 15
 38 "Am241"  332.387    0.000 1.433000e-006 0.000000e+000  41   0 N N N N N 15
 39 "Pu239"  332.845    0.000 4.907000e-006 0.000000e+000  46   0 N N N N N 15
 40 "Pu241"  335.422    0.000 2.399000e-008 0.000000e+000  23   0 N N N N N 15
 41 "Am241"  335.422    0.000 4.822000e-006 0.000000e+000   0   0 N Y N N N 15
 42 "Pu239"  336.110    0.000 1.145000e-006 0.000000e+000  46   0 N N N N N 15
 43 "     "  337.720    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 15
 44 "     "  340.450    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 14
 45 "Pu239"  341.495    0.000 6.584000e-007 0.000000e+000  46   0 N N N N N 14
 46 "Pu239"  345.011    0.000 5.530000e-006 0.000000e+000   0   0 Y Y Y Y Y 14
 47 "Pu239"  367.036    0.000 8.572000e-007 0.000000e+000   0   0 N Y N N N 16
 48 "Pu239"  368.536    0.000 9.048000e-007 0.000000e+000  47   0 N N N N N 16
 49 "Pu241"  368.605    0.000 1.043000e-008 0.000000e+000  23   0 N N N N N 16
 50 "Am241"  368.605    0.000 2.097000e-006 0.000000e+000   0   0 N Y N N N 16
 51 "Pu241"  370.934    0.000 2.729000e-008 0.000000e+000   0   0 N Y N N N 16
 52 "Am241"  370.934    0.000 5.002000e-007 0.000000e+000  51   0 N N N N N 16
 53 "     "  372.450    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 16
 54 "Pu239"  375.042    0.000 1.553000e-005 0.000000e+000   0   0 Y Y Y N N 17
 55 "Np237"  375.300    0.000 6.790000e-003 0.000000e+000  32   0 N N N N N 17
 56 "Am241"  376.610    0.000 1.436000e-006 0.000000e+000   0   0 N N N N N 17
 57 "Pu239"  380.170    0.000 3.055000e-006 0.000000e+000   0   0 N Y N N N 17
 58 "Pu239"  382.743    0.000 2.582000e-006 0.000000e+000   0   0 N Y N N N 17
 59 "Am241"  383.740    0.000 2.800000e-007 0.000000e+000   0   0 N N N N N 17
 60 "Am241"  390.540    0.000 4.856000e-008 0.000000e+000   0   0 N N N N N 18
 61 "Pu239"  392.525    0.000 2.029000e-006 0.000000e+000  62   0 N N N N N 18
 62 "Pu239"  393.120    0.000 3.447000e-006 0.000000e+000   0   0 N Y N N N 18
 63 "Pu239"  411.000    0.000 4.000000e-008 0.000000e+000  65   0 N N N N N 19
 64 "     "  411.800    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 19
 65 "Pu239"  413.712    0.000 1.475000e-005 0.000000e+000   0   0 Y Y Y Y N 19
 66 "Pu241"  414.600    0.000 1.000000e-009 0.000000e+000  68   0 N N N N N 19
 67 "Np237"  415.760    0.000 1.745000e-002 0.000000e+000  32   0 N N N N N 19
 68 "Pu241"  415.800    0.000 1.000000e-009 0.000000e+000   0   0 N N N N N 19
 69 "Am241"  419.270    0.000 2.736000e-007 0.000000e+000   0   0 N N N N N 0
 70 "Pu239"  451.474    0.000 1.903000e-006 0.000000e+000   0   0 Y Y Y Y Y 20
 71 "Am241"  452.450    0.000 2.396000e-008 0.000000e+000  41   0 N N N N N 20
 72 "Pu239"  637.790    0.000 2.458000e-008 0.000000e+000   0   0 N N N N N 22
 73 "Pu239"  640.050    0.000 8.123000e-008 0.000000e+000   0   0 N N N N N 22
 74 "Am241"  641.470    0.000 7.114000e-008 0.000000e+000  83   0 N N N N N 22
 75 "Pu240"  642.490    0.000 1.255000e-007 0.000000e+000   0   0 N Y N N N 22
 76 "Pu239"  645.940    0.000 1.487000e-007 0.000000e+000   0   0 Y Y N N N 22
 77 "Pu239"  649.321    0.000 6.903000e-009 0.000000e+000  79   0 N N N N N 0
 78 "Pu239"  650.529    0.000 2.662000e-009 0.000000e+000  79   0 N N N N N 0
 79 "Pu239"  652.052    0.000 6.509000e-008 0.000000e+000   0   0 N N N N N 0
 80 "Am241"  652.990    0.000 3.716000e-007 0.000000e+000  83   0 N N N N N 0
 81 "Pu239"  654.890    0.000 2.270000e-008 0.000000e+000   0   0 N N N N N 0
 82 "Pu239"  658.919    0.000 1.016000e-007 0.000000e+000   0   0 N N N N N 21
 83 "Am241"  662.456    0.000 3.627000e-006 0.000000e+000   0   0 Y Y Y Y N 21
 84 "Pu239"  664.587    0.000 2.651000e-008 0.000000e+000   0   0 N N N N N 21
 85 "Pu239"  717.650    0.000 2.807000e-008 0.000000e+000   0   0 N N N N N 23
 86 "Pu239"  720.300    0.000 2.857000e-010 0.000000e+000  85   0 N N N N N 23
 87 "Am241"  721.990    0.000 1.926000e-006 0.000000e+000   0   0 Y Y Y Y N 23
 88 "     "  724.200    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 23
 89 "Am241"  763.300    0.000 1.434000e-008 0.000000e+000   0   0 N N N N N 24
 90 "     "  765.000    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 24
 91 "Pu238"  766.410    0.000 2.185000e-007 0.000000e+000   0   0 N Y N N N 24
 92 "Pu239"  766.500    0.000 3.206000e-009 0.000000e+000  95   0 N N N N N 24
 93 "Am241"  766.900    0.000 5.053000e-008 0.000000e+000  87   0 N N N N N 24
 94 "Pu239"  767.520    0.000 3.500000e-009 0.000000e+000   0   0 N N N N N 24
 95 "Pu239"  769.250    0.000 1.137000e-007 0.000000e+000   0   0 Y Y N N N 24
 96 "Am241"  770.540    0.000 4.535000e-008 0.000000e+000  87   0 N N N N N 24
 97 "Am241"  772.130    0.000 2.697000e-008 0.000000e+000   0   0 N N N N N 24
// region information
num_regions: 24
 1  127.80 131.00 126.70 127.30 127.20 127.80 131.80 132.40 132.80 133.400 7 "bilinear step"
 2  124.20 126.65 126.70 127.30 127.20 127.80   0.00   0.00   0.00   0.000 2 "linear"
 3  140.80 151.00 138.00 139.00 139.50 140.50 150.90 151.40   0.00   0.000 7 "bilinear step"
 4  151.60 154.00 151.00 151.30 154.20 154.80   0.00   0.00   0.00   0.000 2 "linear"
 5  163.10 166.90 162.60 163.10 167.00 167.50   0.00   0.00   0.00   0.000 2 "linear"
```

```
 6  158.70 162.50 157.40 158.80 162.60 162.90 167.00 168.20   0.00   0.000 3 "quadratic"
 7  168.50 172.70 167.70 168.30 173.00 173.60   0.00   0.00   0.00   0.000 2 "linear"
 8  201.80 205.10 201.10 201.70 205.10 205.70   0.00   0.00   0.00   0.000 2 "linear"
 9  205.80 210.80 205.10 205.70 211.80 212.40 212.80 213.40   0.00   0.000 6 "linear step"
10  253.90 256.90 252.70 253.20 253.30 253.80 257.30 257.80 258.10 258.600 6 "linear step"
11  262.60 269.50 260.60 261.20 261.50 262.10 270.00 270.60 271.00 271.600 2 "linear"
12  310.10 313.70 309.20 309.70 313.90 314.40   0.00   0.00   0.00   0.000 2 "linear"
13  318.70 325.20 317.50 318.00 318.00 318.50 325.40 325.90 326.10 326.600 5 "flat step"
14  339.30 347.30 328.80 329.40 329.50 330.10 347.80 348.40 348.80 349.400 5 "flat step"
15  330.30 339.00 328.80 329.40 329.50 330.10 347.80 348.40 348.80 349.400 5 "flat step"
16  365.30 372.90 363.80 364.40 364.50 365.10 385.50 386.10 386.20 386.800 5 "flat step"
17  372.10 385.80 363.80 364.40 364.50 365.10 385.50 386.10 386.20 386.800 5 "flat step"
18  389.40 396.30 387.60 388.20 388.60 389.20 401.50 402.10 402.80 403.400 5 "flat step"
19  409.20 417.20 404.20 404.80 405.10 405.70 432.20 432.80 433.00 433.600 5 "flat step"
20  449.00 453.50 448.20 448.80 455.90 456.50   0.00   0.00   0.00   0.000 5 "flat step"
21  656.60 666.60 628.50 629.90 634.80 635.80 671.40 672.20 682.40 683.600 6 "linear step"
22  635.90 647.80 628.50 629.90 634.80 635.80 671.40 672.20 682.40 683.600 6 "linear step"
23  715.80 726.10 711.60 712.20 713.60 714.20 733.20 733.80 734.00 734.600 5 "flat step"
24  762.20 774.20 761.10 761.70 777.60 778.20   0.00   0.00   0.00   0.000 5 "flat step"
// isotope information
num_isotopes: 7
 1 "Pu239" 2.411900e+004 years  239.05220    1.92880  0.0000 1
 2 "Pu241" 1.434800e+001 years  241.05690    3.41120  0.0000 1
 3 "Am241" 4.336000e+002 years  241.05679  114.20000  0.0000 1
 4 "Pu238" 8.774000e+001 years  238.04961  567.57000  2.5200 1
 5 "Pu240" 6.564000e+003 years  240.05380    7.08240  1.0000 1
 6 "Pu242" 3.763000e+005 years  242.05874    0.11590  1.6800 1
 7 "Np237" 2.140000e+006 years  237.04817    0.00000  0.0000 1
// appcon information
num_appcons: 40
 1 "pu242_correlation" ".994"
 2 "pu238_exponent" "0."
 3 "pu239_exponent" "-2.0"
 4 "pu240_exponent" "1.0"
 5 "pu241_exponent" "1.0"
 6 "FRAM_SUMMARY_TYPE" "PLUTONIUM"
 7 "num_ecal" "2"
 8 "ecal_energy[1]" "208.00"
 9 "ecal_channel[1]" "1664.00"
10 "ecal_limit[1]" ".50"
11 "ecal_energy[2]" "662.456"
12 "ecal_channel[2]" "5299.40"
13 "ecal_limit[2]" "1.5"
14 "num_fwhmcal" "1"
15 "fcal_energy[1]" "413.714"
16 "fcal_limit[1]" "1500."
17 "num_tailfract" "1"
18 "scal_energy[1]" "413.714"
19 "scal_limit[1]" "5.0"
20 "num_intf" "2"
21 "intf_1st_energy[1]" "185.720"
22 "intf_2nd_energy[1]" "203.545"
23 "intf_limit[1]" ".050"
24 "intf_msg[1]" "** possible presence of U235 **"
25 "intf_1st_energy[2]" "228.140"
26 "intf_2nd_energy[2]" "203.545"
27 "intf_limit[2]" ".025"
28 "intf_msg[2]" "** possible presence of Np239 **"
29 "num_samptype" "2"
30 "type_1st_peak[1]" "10"
31 "type_2nd_peak[1]" "17"
32 "type_lower_limit[1]" ".95"
33 "type_upper_limit[1]" "1.05"
34 "type_msg[1]" "Possible non-equilibrium or heterogeneous sample."
35 "type_1st_peak[2]" "3"
36 "type_2nd_peak[2]" "83"
37 "type_lower_limit[2]" ".93"
38 "type_upper_limit[2]" "1.07"
39 "type_msg[2]" "Possible heterogeneous (Am/Pu) sample."
40 "fix_bad_bkg" "TRUE"
// end
```

Pu125_414Pl parameter file

```
// fit information
name: Pu125_414Pl
desc: "Planar .1 kev/ch, Homo. Am/Pu, Equ., 3-25% Pu240,<414 keV "
date: "2000.04.27 17:30"
ecal: 1.000200e-001 9.985000e+000
fix-ecal: N
fcal: 2.241700e+000 1.900000e-002 3.307000e+003
fix-fcal: N
scal: -3.508100e+000 3.740000e-003 2.200300e-001 0.000000e+000
fix-scal: N
// peak information
num_peaks: 68
  1 "Pu239"  124.490    0.000 6.720000e-007 0.000000e+000   0   0 N N N N N 2
  2 "Pu239"  125.190    0.000 6.466000e-007 0.000000e+000   4   0 N N N N N 2
  3 "Am241"  125.292    0.000 4.198000e-005 0.000000e+000   0   0 N Y N N N 2
  4 "Pu239"  129.294    0.000 6.257000e-005 0.000000e+000   0   0 Y Y Y Y Y 1
  5 "Pu239"  141.657    0.000 3.390000e-007 0.000000e+000   7   0 N N N N N 3
  6 "Pu239"  143.350    0.000 1.830000e-007 0.000000e+000   7   0 N N N N N 3
  7 "Pu239"  144.211    0.000 2.940000e-006 0.000000e+000   0   0 N N N N N 3
  8 "Pu239"  146.077    0.000 1.210000e-006 0.000000e+000   7   0 N N N N N 3
  9 "Am241"  146.557    0.000 4.824000e-006 0.000000e+000   0   0 N N N N N 3
 10 "Pu241"  148.567    0.000 1.800000e-006 0.000000e+000   0   0 Y Y Y Y N 3
 11 "Am241"  150.040    0.000 7.532000e-007 0.000000e+000   9   0 N N N N N 3
 12 "Pu238"  152.720    0.000 8.869000e-006 0.000000e+000   0   0 N Y N N N 4
 13 "Pu241"  159.969    0.000 6.210000e-008 0.000000e+000  10   0 N N N N N 6
 14 "Pu239"  160.180    0.000 5.200000e-008 0.000000e+000  16   0 N N N N N 6
 15 "Pu240"  160.308    0.000 3.831000e-006 0.000000e+000   0   0 N Y N N N 6
 16 "Pu239"  161.482    0.000 1.152000e-006 0.000000e+000   0   0 N Y N N N 6
 17 "Pu241"  164.597    0.000 4.376000e-007 0.000000e+000   0   0 Y Y Y Y Y 5
 18 "Am241"  164.597    0.000 6.449000e-007 0.000000e+000   3   0 N N N N N 5
 19 "Am241"  165.930    0.000 2.119000e-007 0.000000e+000   0   0 N N N N N 5
 20 "Am241"  169.567    0.000 1.584000e-006 0.000000e+000   0   0 N Y N N N 7
 21 "Pu239"  171.372    0.000 1.047000e-006 0.000000e+000   0   0 N Y N N N 7
 22 "Pu239"  203.545    0.000 5.474000e-006 0.000000e+000   0   0 Y Y N N N 8
 23 "Pu241"  208.000    0.000 5.174000e-006 0.000000e+000   0   0 Y Y Y Y Y 9
 24 "Am241"  208.000    0.000 7.625000e-006 0.000000e+000   3   0 N N N N N 9
 25 "Pu239"  255.380    0.000 7.804000e-007 0.000000e+000   0   0 Y Y N N N 10
 26 "Pu239"  263.930    0.000 2.568000e-007 0.000000e+000   0   0 N N N N N 11
 27 "      " 264.850    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 11
 28 "Pu239"  265.700    0.000 1.550000e-008 0.000000e+000  26   0 N N N N N 11
 29 "Pu241"  267.540    0.000 1.764000e-007 0.000000e+000   0   0 Y Y Y Y N 11
 30 "Am241"  267.540    0.000 2.600000e-007 0.000000e+000   3   0 N N N N N 11
 31 "Pu239"  311.700    0.000 2.574000e-007 0.000000e+000  46   0 N N N N N 12
 32 "Np237"  311.900    0.000 3.860000e-001 0.000000e+000   0   0 N Y N N N 12
 33 "Pu239"  319.700    0.000 4.800000e-008 0.000000e+000   0   0 N N N N N 13
 34 "Pu239"  320.860    0.000 5.298000e-007 0.000000e+000   0   0 N N N N N 13
 35 "Am241"  322.525    0.000 1.486000e-006 0.000000e+000   0   0 N Y N N N 13
 36 "Pu239"  323.822    0.000 5.430000e-007 0.000000e+000   0   0 N N N N N 13
 37 "Pu241"  332.387    0.000 2.974000e-007 0.000000e+000   0   0 Y Y N N N 15
 38 "Am241"  332.387    0.000 1.433000e-006 0.000000e+000  41   0 N N N N N 15
 39 "Pu239"  332.845    0.000 4.907000e-006 0.000000e+000  46   0 N N N N N 15
 40 "Pu241"  335.422    0.000 2.399000e-008 0.000000e+000  23   0 N N N N N 15
 41 "Am241"  335.422    0.000 4.822000e-006 0.000000e+000   0   0 N Y N N N 15
 42 "Pu239"  336.110    0.000 1.145000e-006 0.000000e+000  46   0 N N N N N 15
 43 "      " 337.720    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 15
 44 "      " 340.450    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 14
 45 "Pu239"  341.495    0.000 6.584000e-007 0.000000e+000  46   0 N N N N N 14
 46 "Pu239"  345.011    0.000 5.530000e-006 0.000000e+000   0   0 Y Y Y Y Y 14
 47 "Pu239"  367.036    0.000 8.572000e-007 0.000000e+000   0   0 N Y N N N 16
 48 "Pu239"  368.536    0.000 9.048000e-007 0.000000e+000  47   0 N N N N N 16
 49 "Pu241"  368.605    0.000 1.043000e-008 0.000000e+000  23   0 N N N N N 16
 50 "Am241"  368.605    0.000 2.097000e-006 0.000000e+000   0   0 N Y N N N 16
 51 "Pu241"  370.934    0.000 2.729000e-008 0.000000e+000   0   0 N N N N N 16
 52 "Am241"  370.934    0.000 5.002000e-007 0.000000e+000  51   0 N N N N N 16
 53 "      " 372.450    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 17
 54 "Pu239"  375.042    0.000 1.553000e-005 0.000000e+000   0   0 Y Y Y Y N 17
 55 "Np237"  375.300    0.000 6.790000e-003 0.000000e+000  32   0 N N N N N 17
 56 "Am241"  376.610    0.000 1.436000e-006 0.000000e+000   0   0 N N N N N 17
 57 "Pu239"  380.170    0.000 3.055000e-006 0.000000e+000   0   0 N Y N N N 18
```

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 58 "Pu239"  382.743    0.000 2.582000e-006 0.000000e+000   0   0 N Y N N N 18
 59 "Am241"  383.740    0.000 2.800000e-007 0.000000e+000   0   0 N N N N N 18
 60 "Am241"  390.540    0.000 4.856000e-008 0.000000e+000   0   0 N N N N N 19
 61 "Pu239"  392.525    0.000 2.029000e-006 0.000000e+000  62   0 N N N N N 19
 62 "Pu239"  393.120    0.000 3.447000e-006 0.000000e+000   0   0 N Y N N N 19
 63 "Pu239"  411.000    0.000 4.000000e-008 0.000000e+000  65   0 N N N N N 20
 64 "     "  411.800    0.000 0.000000e+000 0.000000e+000   0   0 N N N N N 20
 65 "Pu239"  413.712    0.000 1.475000e-005 0.000000e+000   0   0 Y Y Y Y Y 20
 66 "Pu241"  414.600    0.000 1.000000e-009 0.000000e+000  68   0 N N N N N 20
 67 "Np237"  415.760    0.000 1.745000e-002 0.000000e+000  32   0 N N N N N 20
 68 "Pu241"  415.800    0.000 1.000000e-009 0.000000e+000   0   0 N N N N N 20
// region information
num_regions: 20
 1  127.90 130.30 126.60 127.10 127.20 127.80 130.90 131.40 132.70 133.200 6 "linear step"
 2  124.20 126.50 126.60 127.10 127.20 127.80   0.00   0.00   0.00   0.000 2 "linear"
 3  141.00 150.80 139.80 140.20 140.40 140.80 142.30 142.70 150.90 151.300 6 "linear step"
 4  151.80 153.60 151.20 151.70 153.80 154.30   0.00   0.00   0.00   0.000 2 "linear"
 5  163.30 166.60 162.40 162.80 166.60 167.00 167.00 167.40   0.00   0.000 6 "linear step"
 6  159.00 162.20 158.70 159.20 162.40 162.90   0.00   0.00   0.00   0.000 2 "linear"
 7  168.80 172.20 168.20 168.70 172.30 172.80   0.00   0.00   0.00   0.000 2 "linear"
 8  202.00 204.70 201.80 202.20 204.70 205.10   0.00   0.00   0.00   0.000 2 "linear"
 9  206.70 209.30 204.90 205.60 209.90 210.60 211.60 212.30   0.00   0.000 6 "linear step"
10  254.20 256.50 252.70 253.10 253.70 254.10 256.70 257.10   0.00   0.000 6 "linear step"
11  262.70 269.00 261.20 261.50 262.20 262.50 269.10 269.40 270.10 271.400 6 "linear step"
12  310.40 313.10 309.30 309.80 313.80 314.30   0.00   0.00   0.00   0.000 2 "linear"
13  318.70 325.20 317.50 318.00 318.00 318.50 325.40 325.90 326.10 326.600 5 "flat step"
14  339.60 346.60 327.70 328.20 328.60 329.10 347.50 348.00 348.70 349.200 5 "flat step"
15  330.20 338.60 327.70 328.20 328.60 329.10 347.50 348.00 348.70 349.200 5 "flat step"
16  365.60 372.00 363.20 363.70 364.00 364.50 385.20 385.70 385.90 386.400 5 "flat step"
17  372.10 377.80 363.20 363.70 364.00 364.50 385.20 385.70 385.90 386.400 5 "flat step"
18  378.40 384.20 363.20 363.70 364.00 364.50 385.20 385.70 385.90 386.400 5 "flat step"
19  389.50 394.70 387.50 387.90 388.40 388.80 396.50 396.90 397.30 397.700 5 "flat step"
20  409.90 417.00 408.10 408.80 409.00 409.70 417.50 418.20   0.00   0.000 5 "flat step"
// isotope information
num_isotopes: 7
 1 "Pu239" 2.411900e+004 years  239.05220    1.92880  0.0000 1
 2 "Pu241" 1.434800e+001 years  241.05690    3.41120  0.0000 1
 3 "Am241" 4.336000e+002 years  241.05679  114.20000  0.0000 1
 4 "Pu238" 8.774000e+001 years  238.04961  567.57000  2.5200 1
 5 "Pu240" 6.564000e+003 years  240.05380    7.08240  1.0000 1
 6 "Pu242" 3.763000e+005 years  242.05874    0.11590  1.6800 1
 7 "Np237" 2.140000e+006 years  237.04817    0.00000  0.0000 1
// appcon information
num_appcons: 40
 1 "pu242_correlation" ".994"
 2 "pu238_exponent" "0."
 3 "pu239_exponent" "-2.0"
 4 "pu240_exponent" "1.0"
 5 "pu241_exponent" "1.0"
 6 "FRAM_SUMMARY_TYPE" "PLUTONIUM"
 7 "num_ecal" "2"
 8 "ecal_energy[1]" "208.00"
 9 "ecal_channel[1]" "1980.00"
10 "ecal_limit[1]" ".50"
11 "ecal_energy[2]" "413.712"
12 "ecal_channel[2]" "4037.00"
13 "ecal_limit[2]" "1.5"
14 "num_fwhmcal" "1"
15 "fcal_energy[1]" "413.714"
16 "fcal_limit[1]" "1500."
17 "num_tailfract" "1"
18 "scal_energy[1]" "413.714"
19 "scal_limit[1]" "5.0"
20 "num_intf" "2"
21 "intf_1st_energy[1]" "185.720"
22 "intf_2nd_energy[1]" "203.545"
23 "intf_limit[1]" ".050"
24 "intf_msg[1]" "** possible presence of U235 **"
25 "intf_1st_energy[2]" "228.140"
26 "intf_2nd_energy[2]" "203.545"
27 "intf_limit[2]" ".025"
```

```
28 "intf_msg[2]" "** possible presence of Np239 **"
29 "num_samptype" "2"
30 "type_1st_peak[1]" "10"
31 "type_2nd_peak[1]" "17"
32 "type_lower_limit[1]" ".95"
33 "type_upper_limit[1]" "1.05"
34 "type_msg[1]" "Possible non-equilibrium or heterogeneous sample."
35 "type_1st_peak[2]" "3"
36 "type_2nd_peak[2]" "41"
37 "type_lower_limit[2]" ".93"
38 "type_upper_limit[2]" "1.07"
39 "type_msg[2]" "Possible heterogeneous (Am/Pu) sample."
40 "fix_bad_bkg" "TRUE"
// end
```

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