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Development of a Resource for the Improvement of National Nuclear Forensics Gamma Spectrometric Core Capabilities (RINFOR)

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Abstract

The objective of RINFOR was provision of a means of enhancing or establishing core capacities of institutes, agencies or entities with respect to gamma spectrometric responses to situations requiring, or potentially requiring, some measure of nuclear forensic analysis through the generation of a suite of fit-for-purpose materials. For the majority of states, the base capability level in addressing an incident involving nuclear material or requiring nuclear forensic approaches is grounded in high resolution gamma spectrometry using high purity germanium detectors (HPGe) in a number of configurations. Gamma spectrometric procedures, on a technical level, are fully capable of providing accurate information in relation to a number of important parameters pertaining to nuclear materials. RINFOR generated a set of synthetic gamma ray spectra for a variety of typical materials of interest in this context, at various ages since last separation. Spectra were generated for a number of detector types (Plan, LEGe and HPGe) and in a number of different formats.

Key words

Gamma spectrometry, nuclear materials, nuclear forensics

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Final Report from the NKS-B RINFOR (Contract: AFT/B(19)8)

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1. Introduction

The objective of the RINFOR project was to provide a means of enhancing (where they exist) or establishing (where they do not) core capacities of institutes, agencies or entities with respect to gamma spectrometric responses to situations requiring, or potentially requiring, some measure of nuclear forensic analysis through the generation of a suite of fit-for-purpose materials. Responding to incidents involving nuclear or radioactive materials that are outside of regulatory control necessitates countries having a set of core capacities. While specialised capabilities are usually the remit of international entities and advanced capabilities are often provided on the regional or international level, relevant authorities or entities on the national level have a responsibility for establishing and maintaining a set of core capabilities sufficient to conduct an initial analysis in a controlled environment. For the majority of states, this base capability level in addressing an incident involving nuclear material or requiring nuclear forensic approaches is grounded in high resolution gamma spectrometry using high purity germanium detectors (HPGe) in a number of configurations. Gamma spectrometric procedures, on a technical level, are fully capable of providing accurate information in relation to a number of important parameters pertaining to nuclear materials. The extent of awareness or experience of practitioners with these capabilities, procedures or materials is less clear. A number of previous NKS activities (MALRAD, GASMAT etc) have indicated a possible general lack of experience in relation to the application of gamma spectrometry to such problems despite the fact that in handling a real incident, gamma spectrometry will form the basis of most countries' initial response, important decision making with potentially serious consequences being made on the basis of the initial analysis. Previous activities have indicated that difficulty is encountered in obtaining experience for practitioners in analysing materials that are, by their nature, not readily available. There is unlikely to be, in the near future, any means of addressing this lack of actual materials and it is therefore necessary to consider other approaches.

As recent events in Europe and elsewhere have borne witness to, effective response to an incident necessitates the generation of robust, defensible information as to the materials involved. Effective preparedness on a regional level requires that the states of that region have confidence in the ability of each other to adequately characterise materials to a degree that ensures initiation of the correct response actions. This confidence exists with respect to conventional nuclear emergency situations but is possibly lacking regarding situations involving nuclear forensic type actions. This can largely be ascribed to a lack of practice opportunities. RINFOR was intended to address this regional need by making available a set of materials that would otherwise be unavailable which entities can avail of in developing, maintaining or improving their capacities in responding to nuclear forensic type situations. RINFOR focussed on the development, manufacture and testing of a tailored, comprehensive, fit-for-purpose suite of gamma spectrometric materials that could be used for training practitioners and that could be utilised in enhancing the competence of entities or agencies with responsibilities in addressing incidents that may require the core analytical capabilities countries should be in a position to avail of in the event of a nuclear forensic incident.

2. Methods

The spectra constituting the RINFOR compendium were derived using Monte Carlo methods – simulation of the response of the various detectors to the sources as represented by the various

materials. Simulation was conducted using MCNP (X-5 Monte Carlo Team, 2003). Material compositions were compiled from various literature sources as described later in this text.

For each simulation, samples were presented to the detector at a distance of 10 or 5 cm from the detector face. True coincidence summation effects were not included. Sample holders were not included in the simulations. Calibration sources were provided for each detector type, in the same physical geometry as the samples but for an aqueous matrix, necessitating matrix or density corrections. Doppler broadening was included for all simulations. Simulations were run for periods sufficient to ensure that all relevant statistical checks were passed within MCNP. An example of an input deck for MCNP simulation is provided in Appendix 3. Spectra were generated as .cnf, .chn, .n42 and .spec spectra formats.

3. Detectors

Models of five different detectors were utilised in development of the materials comprising the RINFOR data set. Three of these were representative of the types of detectors that may be typically deployed in gamma analysis of such materials or those typically found in the laboratories of the types of organisations that were the target audience of the RINFOR materials. Setups for the detectors with respect to gain and energy range were such that common routines for assaying Pu and U isotopes such as PCFRAM (Vo and Sampson, 2011) would function correctly. The final two detectors consisted of low-resolution scintillation type detectors which may be encountered in field activities.

3.1 Coaxial HPGe Detector (HPGe)

The detector was a standard coaxial p-type HPGe detector (46% relative efficiency), 6.69 cm in height and 6.97 cm in diameter. The endcap was aluminium and of a constant 1 mm thickness on all faces. The dead layer was 0.07 cm over front and side surfaces. Hole diameter was 0.91 cm and the crystal face was 0.4 cm from the inside of the endcap. Spectra for the detector were obtained over 8192 channels with 0.125 keV/ch starting at 0 keV. Samples were positioned at a distance of 10 cm from the detector endcap.

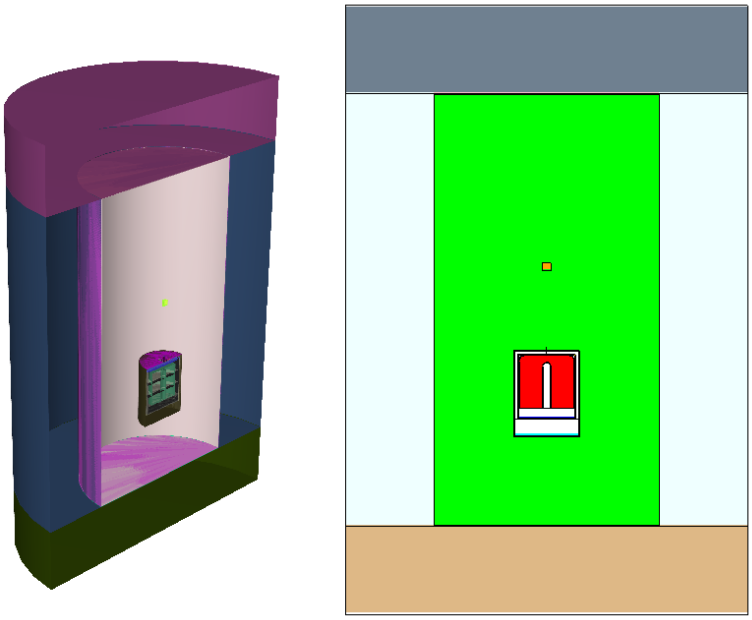

Figure 1. Sectional views of the HPGe detector within its shield.

3.2 Planar Ge Detector (PLAN)

The planar detector (hereafter denoted as PLAN) was 8.2 cm in diameter and 3 cm thick, the endcap being 1 mm thick aluminium with a 0.6 mm thick carbon foil window. The front face of the crystal was 0.5 cm from the window. Spectra for the planar detector were accrued over 8192 channels, 0.125 keV/ch starting at 0 keV. Samples were positioned at a distance of 5 cm from the detector endcap.

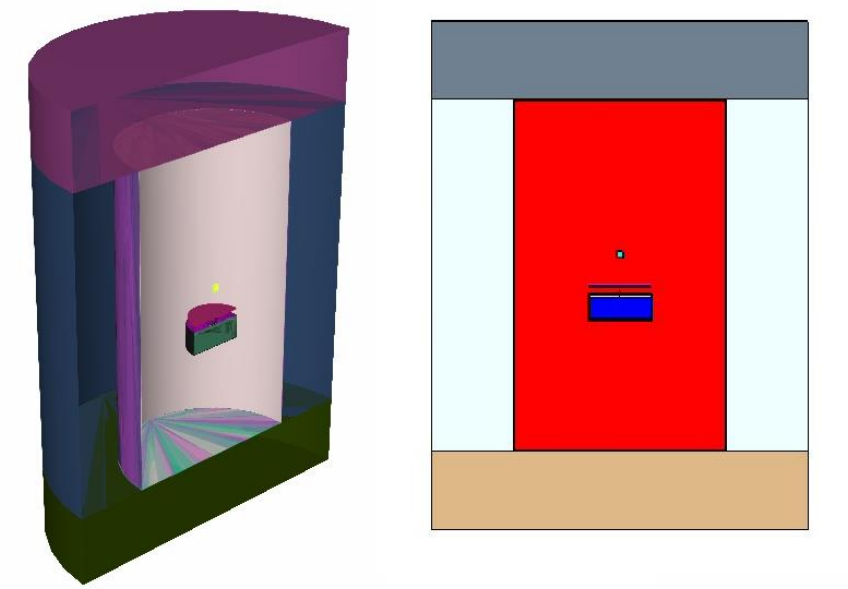

Figure 2. Sectional views of the planar detector within its shield with the tin-cadmium filter in place.

3.3 Low Energy Ge Detector (LEGe)

The low energy detector (hereafter denoted as LEGe) was 2.718 cm in diameter and 1.374 cm thick, the endcap being 1 mm thick aluminium with a 0.20 mm thick beryllium window. The front face of the crystal was 0.5 cm from the window.

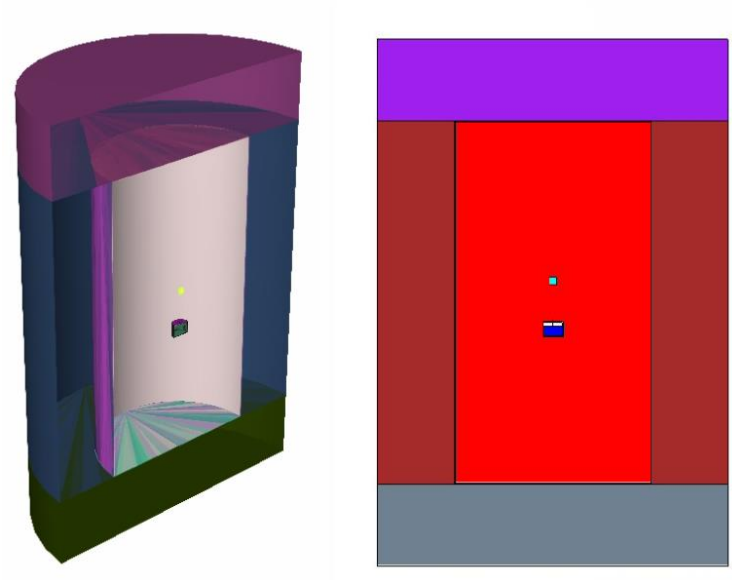

Figure 3. Sectional views of the LEGe detector within its shield.

Spectra for the LEGe were accrued over 8192 channels, 0.075 keV/ch starting at 0 keV. The crystal dead layer was 0.003 cm. All spectra were accrued at a distance of 5 cm from the detector front face.

3.4 Sodium Iodide Detector (NaI:Tl)

The sodium iodide detector (hereafter denoted as NaI:Tl) was 4 inches by 4 inches by 16 inches, the crystal being encapsulated within 0.5 mm of aluminium on all sides. Spectra for the NaI detector were accrued over 2048 channels, 3.90625 keV/ch starting at 0 keV. All spectra were accrued at a distance of 5 cm from the detector front face.

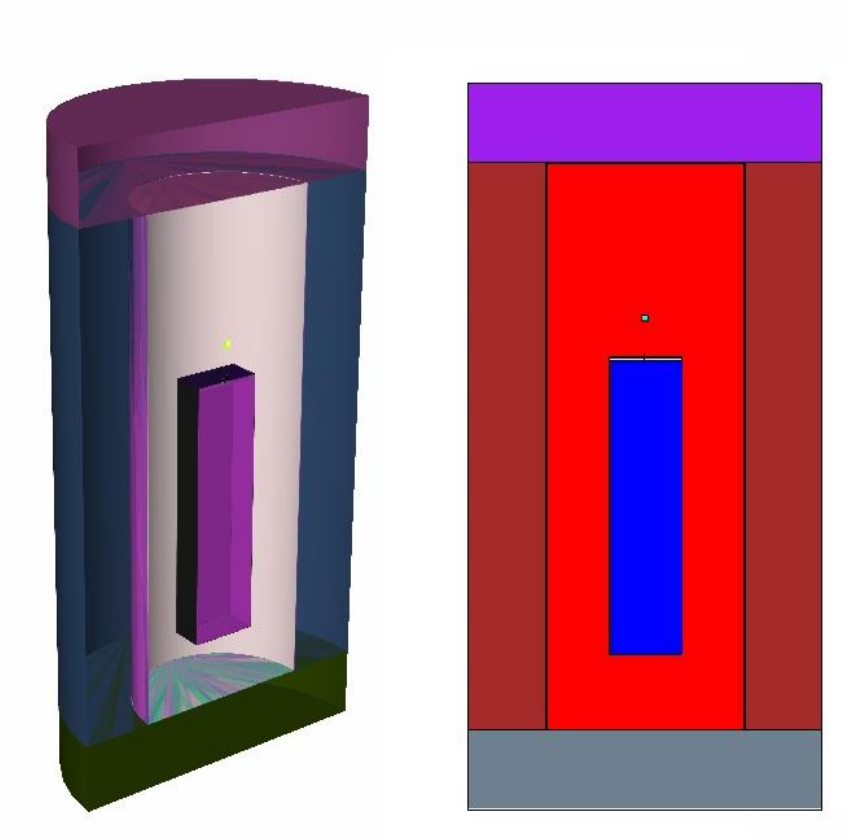

Figure 4. Sectional views of the NaI detector within its shield.

3.5 Lanthanum Bromide Detector ($LaBr_3$)

The lanthanum bromide detector (hereafter denoted as $LaBr_3$) was 5.08 cm in diameter and 5.08 cm long, the crystal being encapsulated within 1 mm of aluminium on all sides. Spectra for the $LaBr_3$ detector were accrued over 2048 channels, 2.441406 keV/ch starting at 0 keV. All spectra

were accrued at a distance of 5 cm from the detector front face. Due to the intrinsic contamination of La with ^{138}La (0.09% of La) 159 Bq of ^{138}La were added to all sources (see Mouhti et al, 2018).

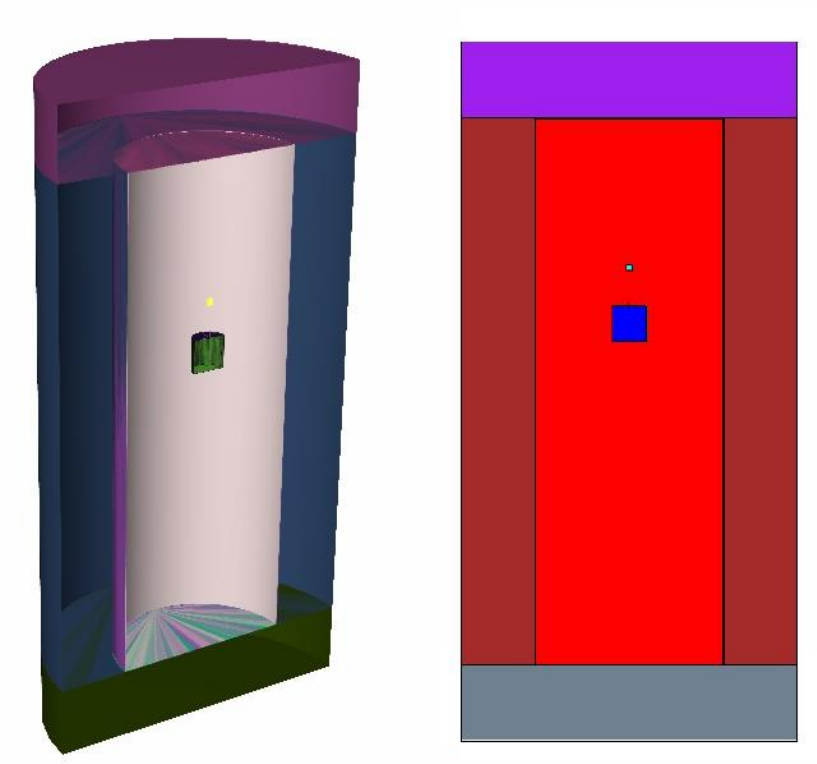

Figure 5. Sectional views of the $LaBr_3$ detector within its shield.

3.6 Shielding

All simulations were conducted within a shield comprised of 10 cm lead with a 1 mm copper liner on all faces.

3.7 Filters

For the spectra containing plutonium, all spectra were accrued using both a filter between the sample and the detector face and no filter present. The filter was used for reduction of the overwhelming ^{241}Am signal at 59 keV which obscured spectrum detail in instances where the ^{241}Am content was appreciable. The filter was composed of 2 mm of cadmium backed by 1 mm of tin.

3.8 Background

Background arising from sources other than the simulated material or interaction of the emissions of that material with the detector, sample matrix, filter or shielding were not included in the simulations.

4. Materials

The following sample materials comprised the basis of the RINFOR compendium of spectra. The materials were selected as being generally typical of the type of materials that may be encountered in situations requiring initial forensic analysis as well as being materials of a type for which actual measurement opportunities are relatively limited. Natural uranium and depleted uranium were included for the purpose of completeness. The list of materials was not intended as being comprehensive but rather as set which features the aspects that are of interest with respect to the deployment of gamma ray spectrometry in the early stages of a nuclear forensics' analysis.

4.1 Depleted uranium

Depleted uranium (metallic) as a cylinder 1 cm tall and 1 cm in diameter, with a density of 19.9512. Total mass of the sample was 15.6696 g. The composition (w/w) of the uranium at the time of last separation (50 years) was:

Table 1. Composition of the depleted uranium material.

Isotope	Composition (w/w)
^{238}U	99.7495 %
^{235}U	0.25 %
^{234}U	0.0005 %

Compositions of the uranium were calculated for 50 years. Full isotope activities are provided in Appendix 1, Table A1. Results as yielded by PCFRAM for the depleted uranium material are provided in Table 2.

Table 2. PCFRAM results for the depleted uranium material for the three different detectors deployed for this material.

Isotope	Composition (w/w ± 1σ) as determined by PCFRAM - HPGe	Composition (w/w ± 1σ) as determined by PCFRAM - Plan	Composition (w/w ± 1σ) as determined by PCFRAM - LEGe
^{238}U	99.72 ± 0.027 %	99.56 ± 0.16 %	99.775 ± 0.0175 %
^{235}U	0.2559 ± 0.0238%	0.240 ± 0.19 %	0.2234 ± 0.0173 %
^{236}U	0.0149 ± 0.0116 %	0.19 ± 0.16 %	0.0005 ± 0.0019 %
^{234}U	0.0005 ± 0.0012 %	0.0005 ± 0.0004 %	0.0012 ± 0.0005 %

4.2 Enriched uranium – commercial grade (2.96 % ^{235}U)

Enriched uranium (metallic) as a cylinder 1 cm tall and 1 cm in diameter, with a density of 18.94449. Total mass of the sample was 14.87897 g. The composition (w/w) of the uranium at the time of last separation was:

Table 3. Composition of the commercial grade enriched uranium at time of last separation.

Isotope	Composition (w/w)
^{238}U	97.01 %
^{235}U	2.96 %
^{234}U	0.03 %

Compositions of the uranium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A2.

Table 4. PCFRAM results for the commercial grade enriched uranium for the two detectors deployed for this material.

Isotope	Age y	Composition (w/w ± 1σ) as determined by PCFRAM - HPGe	Composition (w/w ± 1σ) as determined by PCFRAM - PLAN
^{238}U	1	97.18 ± 0.41 %	97.34 ± 0.18 %
	10	97.24 ± 0.42 %	97.30 ± 0.20 %
	50	97.35 ± 0.36 %	97.28 ± 0.18 %
^{235}U	1	2.78 ± 0.41 %	2.62 ± 0.18 %
	10	2.725 ± 0.41 %	2.656 ± 0.201 %
	50	2.60 ± 0.36 %	2.68 ± 0.17 %
^{236}U	1	0.011 ± 0.004 %	0.009 ± 0.001 %
	10	0.0107 ± 0.004 %	0.0098 ± 0.001 %
	50	0.0119 ± 0.007 %	0.0104 ±0.001 %
^{234}U	1	0.03 ± 0.01 %	0.026 ± 0.003 %
	10	0.0273 ± 0.009 %	0.0265 ± 0.0033 %
	50	0.0292 ± 0.009 %	0.0269 ± 0.003 %

4.3 Highly enriched uranium # 1 (89.8 % ^{235}U)

Highly enriched uranium (metallic) as a cylinder 1 cm tall and 1 cm in diameter, with a density of 18.7328. Total mass of the sample was 14.71275 g. The composition (w/w) of the uranium at the time of last separation was:

Table 5. Composition of the enriched uranium #1 material at time of last separation.

Isotope	Composition (w/w)
^{238}U	8.85 %
^{235}U	89.80 %
^{234}U	0.97 %
^{236}U	0.38 %

Compositions of the uranium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A3.

Table 6. PCFRAM results for the enriched uranium material #1 for the three detectors deployed for this material.

Isotope	Age y	Composition (w/w ± 1σ) as determined by PCFRAM - HPGe	Composition (w/w ± 1σ) as determined by PCFRAM - PLAN	Composition (w/w ± 1σ) as determined by PCFRAM - LEGe
^{238}U	1	10.06 ± 2.45 %	9.62 ± 0.88 %	6.08 ± 10.22 %
	10	11.72 ± 1.8 %	8.95 ± 0.9 %	6.49 ± 10.95 %
	50	13.25 ± 8.4 %	10.51 ±5.9 %	8.91 ± 15.00 %
^{235}U	1	88.53 ± 2.6 %	88.91 ± 0.94 %	92.79 ± 10.1 %
	10	86.90 ± 1.95 %	89.59 ± 1.04 %	92.39 ± 10.8 %
	50	85.40 ± 9.27 %	88.075 ± 6.9 %	89.97 ± 14.9 %
^{236}U	1	0.28 ± 0.08 %	0.28 ± 0.279 %	0.25 ± 0.13 %
	10	0.28 ± 0.05 %	0.27 ± 0.03 %	0.26 ± 0.13 %
	50	0.29 ± 0.29 %	0.28 ± 0.23 %	0.27 ± 0.14 %
^{234}U	1	1.12 ± 0.5 %	1.17 ± 0.18%	0.857 ± 0.09 %
	10	1.08 ± 0.3 %	1.18 ± 0.21 %	0.85 ± 0.10 %
	50	1.04 ± 2.15 %	1.13 ± 2.6 %	0.84 ± 0.14 %

4.4 Highly enriched uranium #2 (93.16 % ^{235}U)

Highly enriched uranium (metallic) as a cylinder of 1 cm tall and 1 cm in diameter, with a density of 18.72476. Total mass of the sample was 14.7063921 g. The composition (w/w) of the uranium at the time of last separation was:

Table 7. Composition of the enriched uranium material #2 at time of last separation.

Isotope	Composition (w/w)
^{238}U	5.42 %
^{235}U	93.16 %
^{234}U	0.98 %
^{236}U	0.45 %

Compositions of the uranium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A4.

Table 8. PCFRAM results for the enriched uranium material #2 for the three detectors deployed for this material.

Isotope	Age y	Composition (w/w ± 1σ) as determined by PCFRAM - HPGe	Composition (w/w ± 1σ) as determined by PCFRAM - PLAN	Composition (w/w ± 1σ) as determined by PCFRAM - LEGe
^{238}U	1	3.9 ± 0.87 %	3.78 ± 1.52 %	4.54 ± 7.59 %
	10	5.48 ± 1.3 %	5.76 ± 0.84 %	4.63 ± 7.8 %
	50	3.91 ± 1.7 %	8.8 ± 10.3 %	4.65 ± 7.87 %
^{235}U	1	94.63 ± 1.08 %	94.73 ± 2.08 %	94.35 ± 7.51 %
	10	93.12 ± 1.51 %	92.802 ± 0.95 %	94.27 ± 7.8 %
	50	94.69 ± 2.19 %	89.7 ± 12.76	94.23 ± 7.8 %
^{236}U	1	0.23 ± 0.05 %	0.23 ± 0.11 %	0.24 ± 0.12 %
	10	0.251 ± 0.07 %	0.254 ± 0.04 %	0.85 ± 0.07 %
	50	0.2334 ± 0.121 %	0.275 ± 0.46 %	0.24 ± 0.12 %
^{234}U	1	1.19 ± 0.41 %	1.24 ± 1.02 %	0.85 ± 0.07 %
	10	1.14 ± 0.46 %	1.18 ± 0.3 %	0.855 ± 0.07 %
	50	1.156 ± 0.97 %	1.12 ± 6.05 %	0.86 ± 0.07 %

4.5 Fuel grade plutonium (12.0 % ^{240}Pu)

Fuel grade plutonium, 10 mg, presented as a cylinder of 1 cm height and 1 cm diameter with an aqueous composition and density. The composition (w/w) of the plutonium at the time of last separation was:

Table 9. Composition of the fuel grade plutonium material at time of last separation.

Isotope	Composition (w/w)
^{238}Pu	0.10 %
^{239}Pu	86.10 %
^{240}Pu	12.00 %
^{241}Pu	1.60 %
^{242}Pu	0.20 %

Compositions of the plutonium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A5.

Table 10. PCFRAM results for the fuel grade plutonium material for the three detectors deployed for this material with filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, with filter	
^{238}Pu	1	0.092 ± 0.003%	0.91 ± 0.14	0.1 ± 0.003 %	1.01 ± 0.06	0.094 ± 0.01 %	0.97 ± 0.17
	10	0.075 ± 0.009 %	9.38 ± 0.40	0.091 ± 0.004 %	10.09 ± 0.17	0.089 ± 0.9 %	10.3 ± 0.32
	50	0.062 ± 0.03 %	52.68 ± 3.1	0.07 ± 0.004 %	50.28 ± 0.54	0.076 ± 0.014 %	51.58 ± 2.8
^{239}Pu	1	86.43 ± 0.43 %		86.40 ± 0.41 %		86.46 ± 1.2 %	
	10	87.52 ± 1.4 %		86.70 ± 0.51 %		88.34 ± 0.9 %	
	50	88.66 ± 4.21 %		88.36 ± 0.58 %		89.497 ± 0.84 %	
^{240}Pu	1	11.74 ± 0.44 %		11.71 ± 0.41 %		11.76 ± 1.2 %	
	10	11.16 ± 1.41 %		11.95 ± 0.52 %		10.37 ± 0.90 %	
	50	10.03 ± 4.3 %		11.20 ± 0.57 %		10.11 ± 0.82 %	
^{241}Pu	1	1.45 ± 0.013 %		1.49 ± 0.015 %		1.401 ± 0.06 %	
	10	1.00 ± 0.03 %		0.97 ± 0.01 %		0.98 ± 0.03 %	
	50	0.134 ± 0.02 %		0.1445 ± 0.004 %		0.12 ± 0.01 %	
^{242}Pu	1	0.27 ± 0.13 %		0.29 ± 0.13 %		0.28 ± 0.04 %	
	10	0.24 ± 0.04 %		0.28 ± 0.015 %		0.23 ± 0.034 %	
	50	0.21 ± 0.104 %		0.224 ± 0.15 %		0.20 ± 0.03 %	

Table 11. PCFRAM results for the fuel grade plutonium material for the three detectors deployed for this material with no filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, no filter	
^{238}Pu	1	0.092 ± 0.005 %	1.12 ± 0.10	0.097 ± 0.004 %	0.91 ± 0.10	0.099 ± 0.003 %	0.98 ± 0.06
	10	0.093 ± 0.04 %	9.93 ± 0.20	0.0896 ± 0.005 %	10.06 ± 1.09	0.093 ± 0.01 %	9.86 ± 0.41
	50	0.064 ± 0.106 %	52.16 ± 6.8	0.07 ± 0.004 %	49.55 ± 0.55	0.076 ± 0.005 %	49.14 ± 0.7
^{239}Pu	1	88.07 ± 1.1 %		86.5 ± 0.89 %		86.23 ± 0.63 %	
	10	86.96 ± 0.73 %		86.79 ± 0.74 %		86.20 ± 1.25 %	
	50	88.29 ± 1.8 %		87.78 ± 0.6 %		87.56 ± 0.83 %	
^{240}Pu	1	10.14 ± 1.1 %		11.62 ± 0.91 %		11.85 ± 0.64 %	
	10	11.7 ± 0.74 %		11.87 ± 0.76 %		12.38 ± 1.3 %	
	50	11.29 ± 1.87 %		11.76 ± 0.58 %		11.96 ± 0.84 %	
^{241}Pu	1	1.47 ± 0.03 %		1.5 ± 0.024 %		1.51 ± 0.02 %	
	10	0.976 ± 0.015 %		0.967 ± 0.016 %		1.02 ± 0.03 %	
	50	0.13 ± 0.008 %		0.15 ± 0.0038 %		0.148 ± 0.005 %	
^{242}Pu	1	0.23 ± 0.04 %		0.284 ± 0.026 %		0.297 ± 0.02 %	
	10	0.2779 ± 0.021 %		0.2777 ± 0.035 %		0.301 ± 0.05 %	
	50	0.216 ± 0.045 %		0.236 ± 0.03 %		0.253 ± 0.022 %	

4.6 Reactor grade plutonium (21.78 % ^{240}Pu)

Reactor grade plutonium, 10 mg, presented as a cylinder of 1 cm height and 1 cm diameter with an aqueous composition and density. The composition (w/w) of the plutonium at the time of last separation was:

Table 12. Composition of the reactor grade plutonium material at time of last separation.

Isotope	Composition (w/w)
^{238}Pu	0.99 %
^{239}Pu	62.38 %
^{240}Pu	21.78 %
^{241}Pu	11.88 %
^{242}Pu	2.97 %

Compositions of the plutonium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A6.

Table 13. PCFRAM results for the reactor grade plutonium material for the three detectors deployed for this material with filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, with filter	
^{238}Pu	1	0.94 ± 0.03 %	1 ± 0.07	1.00 ± 0.30 %	0.95 ± 0.04	0.944 ± 0.056 %	0.98 ± 0.082
	10	0.906 ± 0.09 %	10.6 ± 0.51	0.96 ± 0.04 %	10.18 ± 0.17	0.946 ± 0.042 %	10.86 ± 0.1
	50	0.858 ± 0.09 %	46.96 ± 1.08	0.766 ± 0.04 %	46.86 ± 0.64	0.89 ± 0.23 %	50.42 ± 2.7
^{239}Pu	1	62.10 ± 1.78 %		64.83 ± 1.24 %		57.08 ± 2.528 %	
	10	66.32 ± 4.72 %		65.21 ± 2.12 %		66.62 ± 1.52 %	
	50	69.89 ± 4.3 %		63.4 ± 1.60 %		81.63 ± 9.16 %	
^{240}Pu	1	21.4 ± 2.20 %		18.93 ± 1.5 %		25.388 ± 3.07 %	
	10	21.20 ± 5.44 %		21.86 ± 2.42 %		20.87 ± 1.02 %	
	50	24.07 ± 4.6 %		29.38 ± 1.7 %		14.05 ± 9.4 %	
^{241}Pu	1	11.07 ± 0.33 %		11.4 ± 0.30 %		10.55 ± 0.51 %	
	10	7.60 ± 0.61 %		7.64 ± 0.27 %		7.58 ± 0.33 %	
	50	1.26 ± 0.097 %		1.216 ± 0.0414 %		1.472 ± 0.22 %	
^{242}Pu	1	4.48 ± 0.57 %		3.85 ± 0.52 %		6.03 ± 1.15 %	
	10	3.97 ± 1.40 %		4.32 ± 0.74 %		3.974 ± 0.61 %	
	50	3.92 ± 1.08 %		5.26 ± 0.47 %		1.94 ± 1.54 %	

Table 14. PCFRAM results for the reactor grade plutonium material for the three detectors deployed for this material with no filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, no filter	
^{238}Pu	1	0.99 ± 0.023 %	0.95 ± 0.02	0.989 ± 0.012 %	0.99 ± 0.011	1.018 ± 0.023 %	0.97 ± 0.12
	10	0.947 ± 0.0093 %	10.43 ± 0.106	0.947 ± 0.021 %	10.5 ± 0.087	0.841 ± 0.125 %	10.98 ± 0.86
	50	0.736 ± 0.04 %	51.72 ± 0.61	0.7341 ± 0.02%	50.77 ± 0.34	0.764 ± 0.12 %	50.83 ± 8.2
^{239}Pu	1	63.19 ± 1.24 %		62.3815 ± 0.479 %		60.096 ± 0.86 %	
	10	64.824 ± 0.44 %		65.677 ± 0.87 %		65.17 ± 6.85 %	
	50	70.83 ± 1.69		70.83 ± 0.81 %		71.11 ± 5.74 %	
^{240}Pu	1	20.226 ± 1.51 %		20.893 ± 0.47 %		22.499 ± 1.04 %	
	10	22.341 ± 0.483 %		21.681 ± 0.958 %		22.73 ± 7.8 %	
	50	23.68 ± 1.74 %		23.68 ± 0.84 %		23.36 ± 6.1 %	
^{241}Pu	1	11.34 ± 0.23 %		11.26 ± 0.09 %		11.208 ± 0.187 %	
	10	7.47 ± 0.066 %		7.49 ± 0.115 %		7.07 ± 0.86 %	
	50	1.15 ± 0.04 %		1.17 ± 0.02 %		1.17 ± 0.114 %	
^{242}Pu	1	4.246 ± 0.4 %		4.4745 ± 0.44 %		5.178 ± 0.315 %	
	10	4.413 ± 0.136 %		4.198 ± 0.468 %		4.17 ± 1.94 %	
	50	3.606 ± 0.51 %		3.58 ± 0.18 %		3.58 ± 1.21 %	

4.7 Weapons grade plutonium (5.7 % ^{240}Pu)

Weapons grade plutonium (5.7 %), 10 mg, presented as a cylinder of 1 cm height and 1 cm diameter with an aqueous composition and density. The composition (w/w) of the plutonium at the time of last separation was:

Table 15. Composition of the weapons grade plutonium (5.7 %) material at time of last separation.

Isotope	Composition (w/w)
^{238}Pu	0.03 %
^{239}Pu	93.92 %
^{240}Pu	5.70 %
^{241}Pu	0.32 %
^{242}Pu	0.03 %

Compositions of the plutonium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A7.

Table 16. PCFRAM results for the weapons grade plutonium (5.7 %) material for the three detectors deployed for this material with filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, with filter	
^{238}Pu	1	0.0287 ± 0.0021 %	0.90 ± 0.63	0.03 ± 0.0009 %	0.47 ± 0.20	0.0307 ± 0.003%	1.04 ± 0.22
	10	0.0225 ± 0.0033 %	11.4 ± 0.67	0.0225 ± 0.0024 %	11.32 ± 0.42	0.0246 ± 0.0034 %	9.72 ± 0.68
	50	0.016 ± 0.005 %	50.07 ± 2.4	0.0225 ± 0.0023 %	50.92 ± 1.1	0.0196 ± 0.003 %	49.86 ± 1.26
^{239}Pu	1	93.07 ± 0.39		93.75 ± 0.16 %		94.21 ± 0.51 %	
	10	93.72 ± 0.061 %		93.82 ± 0.34 %		94.24 ± 0.063 %	
	50	94.24 ± 1.25 %		94.060 ± 0.3807 %		95.57 ± 0.606 %	
^{240}Pu	1	6.56 ± 0.39 %		5.87 ± 0.16 %		5.429 ± 0.51 %	
	10	6.03 ± 0.61 %		5.92 ± 0.34 %		5.50 ± 0.63 %	
	50	5.68 ± 1.25 %		5.85 ± 0.381 %		4.35 ± 0.65 %	
^{241}Pu	1	0.289 ± 0.0033 %		0.293 ± 0.002 %		0.29 ± 0.004 %	
	10	0.188 ± 0.0034 %		0.186 ± 0.002 %		0.195 ± 0.004 %	
	50	0.0257 ± 0.0025 %		0.026 ± 0.0008 %		0.286 ± 0.0015 %	
^{242}Pu	1	0.0526 ± 0.004 %		0.0476 ± 0.0016 %		0.0442 ± 0.005 %	
	10	0.043 ± 0.0056 %		0.0445 ± 0.0055 %		0.0402 ± 0.006 %	
	50	0.0326 ± 0.0094 %		0.0404 ± 0.0036 %		0.0275 ± 0.005 %	

Table 17. PCFRAM results for the weapons grade plutonium (5.7 %) material for the three detectors deployed for this material with no filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, no filter	
^{238}Pu	1	0.0299 ± 0.0008 %	0.50± 0.14	0.0303 ± 0.0008 %	0.84 ± 0.05	0.0287 ± 0.0011 %	0.96 ± 0.28
	10	0.0283 ± 0.0027 %	10.46± 0.43	0.0271 ±0.0009 %	10.78 ± 0.21	0.0253 ± 0.0017 %	9.76 ± 0.42
	50	0.0212 ± 0.002 %	50.75 ± 1.0	0.0207 ± 0.0008 %	50.76 ± 0.51	0.0225 ± 0.003 %	50.76 ± 1.96
^{239}Pu	1	93.65 ± 0.17 %		93.86 ± 0.0835 %		94.06 ± 0.28 %	
	10	94.077 ± 0.546		94.136 ± 0.2086 %		93.887 ± 0.42 %	
	50	94.3117 ± 0.438 %		94.13 ± 0.177 %		94.36 ± 0.82 %	
^{240}Pu	1	5.97 ± 0.17 %		5.76 ± 0.0833 %		5.57 ± 0.28 %	
	10	5.69 ± 0.5477 %		5.603 ± 0.21 %		5.85 ± 0.42 %	
	50	5.60 ± 0.43 %		5.78 ± 0.177 %		5.55 ± 0.816 %	
^{241}Pu	1	0.295 ± 0.0018 %		0.2965 ± 0.002 %		0.298 ± 0.0033 %	
	10	0.1887 ± 0.0042 %		0.1907 ± 0.0017 %		0.191 ± 0.004 %	
	50	0.0278 ± 0.0012 %		0.0275 ± 0.0005 %		0.0276 ± 0.0026 %	
^{242}Pu	1	0.0483 ± 0.0017 %		0.0470 ± 0.0048 %		0.0441 ± 0.0025 %	
	10	0.0448 ± 0.0051 %		0.0433 ± 0.0019 %		0.044 ± 0.0036 %	
	50	0.0378 ± 0.0053 %		0.0387 ± 0.0015 %		0.0385 ± 0.0077 %	

4.8 Weapons grade plutonium (11.7 % ^{240}Pu)

Weapons grade plutonium (10 – 13 %), 10 mg, presented as a cylinder of 1 cm height and 1 cm diameter with an aqueous composition and density. The composition (w/w) of the plutonium at the time of last separation was:

Table 18. Composition of the weapons grade plutonium (11.7 %) material at time of last separation.

Isotope	Composition (w/w)
^{238}Pu	0.0892 %
^{239}Pu	86.1901 %
^{240}Pu	11.7081 %
^{241}Pu	1.844 %
^{242}Pu	0.1686 %

Compositions of the plutonium were calculated for 1 year, 10 years and 50 years after last separation. Full isotope activities for the three ages are provided in Appendix 1, Table A8.

Table 19. PCFRAM results for the weapons grade plutonium (11.7 %) material for the three detectors deployed for this material with filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, with filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, with filter	
^{238}Pu	1	0.0875 ± 0.0006 %	0.95± 0.04	0.0881 ± 0.0032 %	0.91 ± 0.07	0.0906 ± 0.009 %	0.98 ± 0.19
	10	0.0736 ± 0.009 %	9.96± 0.36	0.0801 ± 0.003 %	10.18 ± 0.14	0.0763 ± 0.0085 %	10.91 ± 0.40
	50	0.0499 ± 0.0075 %	50.82± 0.97	0.0595 ± 0.0031 %	49.78 ± 0.39	0.0603 ± 0.0109 %	51.72 ± .65
^{239}Pu	1	86.34 ± 0.0936 %		86.41 ± 0.48 %		86.56 ± 1.44 %	
	10	86.364 ± 1.39 %		87.36 ± 0.47 %		86.92 ± 1.45 %	
	50	87.249 ± 1.814 %		88.581 ± 0.432 %		87.3301 ± 2.312 %	
^{240}Pu	1	11.583 ± 0.0873 %		11.51 ± 0.49 %		11.34 ± 1.46 %	
	10	12.16 ± 1.41 %		11.17 ± 0.48 %		11.66 ± 1.47 %	
	50	12.311 ± 1.821 %		10.99 ± 0.43 %		12.212 ± 2.3195 %	
^{241}Pu	1	1.7120 ± 0.0093 %		1.71 ± 0.018		1.732 ± 0.047 %	
	10	1.13 ± 0.03 %		1.1374 ± 0.0106 %		1.082 ± 0.034 %	
	50	0.1682 ± 0.0082 %		0.1657 ± 0.0032 %		0.1577 ± 0.0121 %	
^{242}Pu	1	0.2788 ± 0.0037 %		0.2774 ± 0.031 %		0.2772 ± 0.0435 %	
	10	0.269 ± 0.0397 %		0.2538 ± 0.0134 %		0.26 ± 0.041 %	
	50	0.2216 ± 0.0472 %		0.2072 ± 0.0113%		0.24 ± 0.0583 %	

Table 20. PCFRAM results for the weapons grade plutonium (11.7 %) material for the three detectors deployed for this material with no filter in place.

Isotope	Age (y)	Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – HPGe, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – PLAN, no filter		Composition (w/w ± 1σ) and age (y) as determined by PCFRAM – LEGe, no filter	
^{238}Pu	1	0.086 ± 0.0034 %	1.05± 0.06	0.0862 ± 0.0036 %	1.01 ± 0.05	0.0899 ± 0.0042 %	0.97± 0.06
	10	0.084 ± 0.006 %	9.82± 0.25	0.0825 ± 0.0055 %	10.59 ± 0.26	0.0841 ± 0.0041 %	9.68± 0.12
	50	0.0596 ± 0.0047 %	50.58± 0.62	0.0595 ± 0.0031 %	49.78 ± 0.39	0.0657 ± 0.0046 %	49.32 ±0.51
^{239}Pu	1	86.005 ± 0.8216 %		86.812 ± 0.7103 %		85.7584 ± 0.999 %	
	10	87.557 ± 1.159 %		88.0398 ± 0.773 %		86.995 ± 0.2127 %	
	50	87.709 ± 0.7552 %		88.509 ± 0.4318 %		87.8733 ± 0.2934 %	
^{240}Pu	1	11.874 ± 0.8398 %		11.134 ± 0.725 %		12.0678 ± 1.02 %	
	10	10.958 ± 1.176 %		10.521 ± 0.78 %		11.5136 ± 0.2073 %	
	50	11.839 ± 0.7545 %		10.986 ± 0.4321 %		11.6553 ± 0.2904 %	
^{241}Pu	1	1.7488 ± 0.024		1.704 ± 0.0226 %		1.783 ± 0.039 %	
	10	1.1483 ± 0.027		1.1176 ± 0.0217 %		1.1385 ± 0.014 %	
	50	0.1632 ± 0.0044 %		0.1657 ± 0.0032 %		0.1709 ± 0.0045 %	
^{242}Pu	1	0.287 ± 0.0241 %		0.2634 ± 0.0332 %		0.3008 ± 0.0304 %	
	10	0.2534 ± 0.0322 %		0.2394 ± 0.0324 %		0.2686 ± 0.0098 %	
	50	0.2285 ± 0.0194 %		0.2072 ± 0.0113 %		0.2347 ± 0.0119 %	

4.9 Calibration material

For all simulation setups, the calibration sources, presented in an aqueous matrix (density 1) of the same physical dimensions as the sample materials, was as follows:

Table 21. Isotope activities for the calibration materials.

Isotope	For HPGe, LEGe and PLAN, with filters, kBq	For HPGe, LEGe and PLAN, without filters, kBq	For NaI and LaBr, kBq
^{210}Pb	21000	110.1	11.1
^{241}Am	2000	100.11	1.11
^{57}Co	590	59.2	0.592
^{139}Ce	74	74	0.74
^{203}Hg	22.2	22.2	2.22
^{113}Sn	28.1	28.1	2.81
^{85}Sr	35.5	35.5	3.55
^{137}Cs	25.9	25.9	2.59
^{60}Co			3.03
^{88}Y			5.92

Depictions of the calibration curves for HPGe, LEGe and PLAN and are provided in Figure 6.

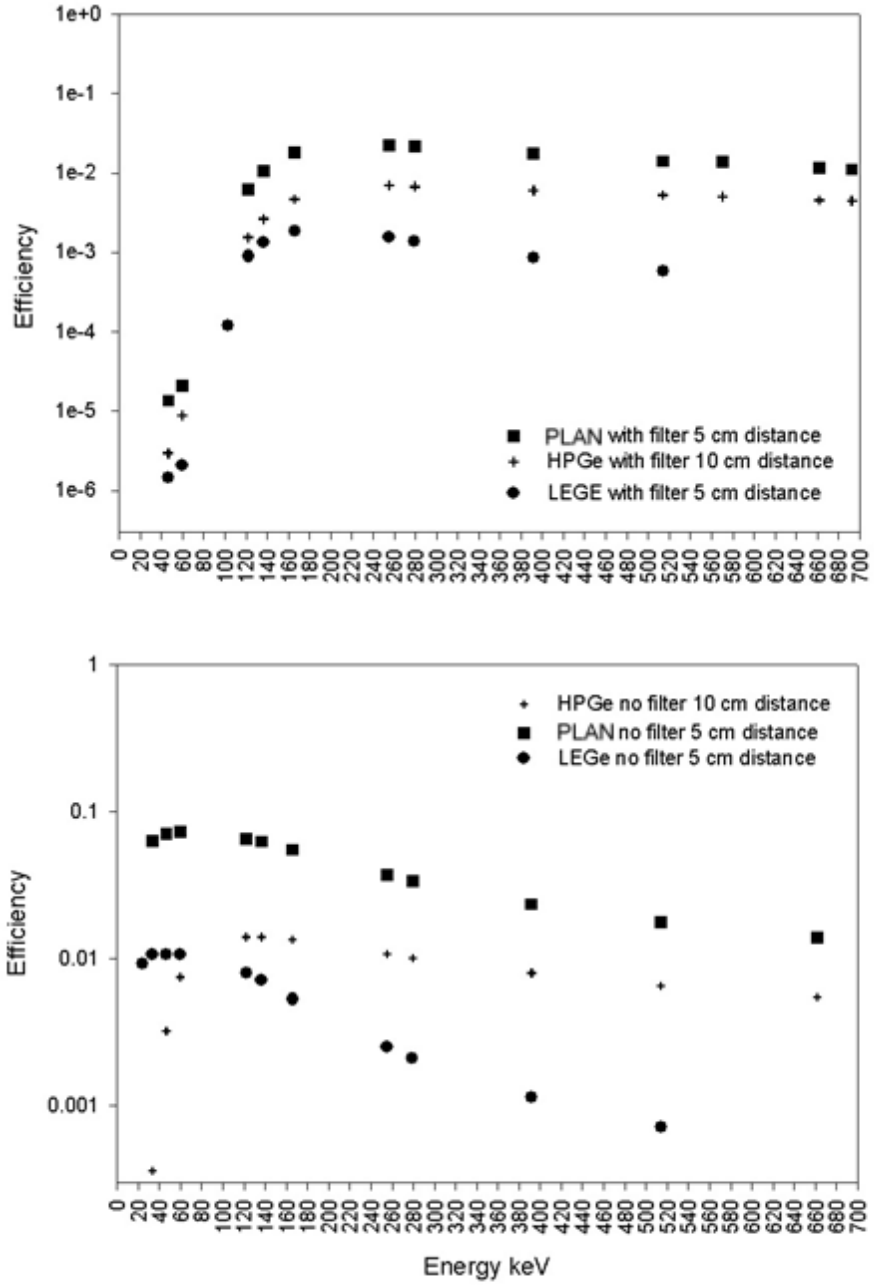

Figure 6. Calibration curves for the three semi-conductor detectors both with and without filters.

5. Data sources

All data pertaining to material and isotope compositions were drawn from McConn et al (2011). Decay/ingrowth calculations were calculated using Eckerman and Sjoreen (2013). Nuclear data

(energies, emission probabilities etc) were drawn from NUDAT 2.6 (www.nndc.bnl.gov) as of 2015.

6. Considerations for use

The spectra comprising the RINFOR set are mathematical simulations of detector responses to models of materials. While a significant effort has been devoted to they're being fit for purpose within the context of the RINFOR objectives, the spectra have limitations and the following should be considered before use.

The spectra are limited to some extent by the nature of the simulations involved. Such simulations are computationally intensive and high numbers of histories necessitate long computational periods. The computational times involved have been as long as the framework of the project allowed. While in most cases the strongest photopeak's in the spectra are well defined statistically, lower intensity peaks may feature relatively large uncertainties. Where such peaks are relied on for any particular analysis sequence, high uncertainties may result.

It is recognised that there are a number of software routines available and commonly used for specialised analysis of materials such as those represented in RINFOR. Some of these software suites require specific conditions to be met with respect to how the spectrum is accrued, detector setup, material parameters, etc. The RINFOR spectra have been simulated according to parameters used for one of the more common commercially available software suites, PCFRAM. The authors can make no assurances as to the RINFOR spectra functioning correctly with other specialised software suites or analytical procedures.

The spectra of the RINFOR project were developed to facilitate users having materials available for training and practice purposes. In particular, the spectra focus on users being able to determine material types, compositions and ages since last separation. The spectra are not intended as quality assurance materials, "reference" or "standard" spectra or as materials for development or testing of analysis routines and should not be used as such under any circumstances. Spectra sets which are possibly more suitable for such applications are available elsewhere.

Users should note that some of the isotopes have half-lives such that compositions of materials may change with time and decay time should be incorporated within analyses. A depiction of how such compositions may change with time over the time-span represented within RINFOR is shown in Figure 7.

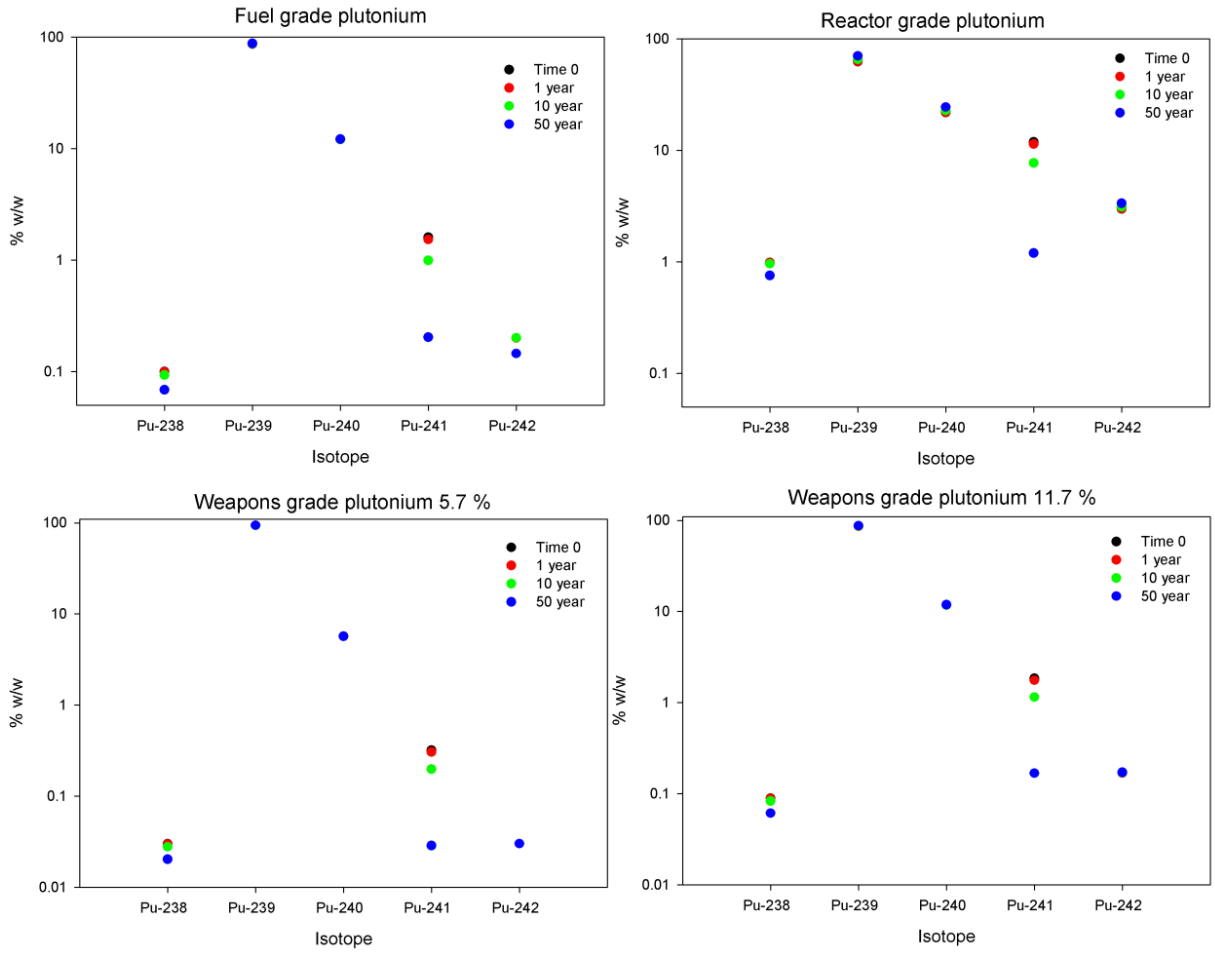

Figure 7. Compositional changes with time for four of the RINFOR materials.

Limitations are imposed by the code employed for the RINFOR project. While later iterations of MCNP, such as that employed in RINFOR, are regarded as relatively robust, mature codes there are limitations intrinsic to the codes and in the way they have been employed in RINFOR that may manifest themselves within the spectra. Differences in peak shapes between gamma (Gaussian) and x-ray (Lorentzian) peaks have not been accounted for.

7. Distribution

The suite of materials are made available for download through the NKS website (www.nks.org) or by contacting the NKS Secretariat by email at nks@nks.org

8. Conclusions

A set of gamma spectra for the purpose of training and practice in the analysis of materials typical for nuclear forensic examinations of nuclear materials were developed and tested. The spectra were intended as being representative of materials that may feature in nuclear forensic type examinations and being amenable to the types of analyses that would be implemented in such circumstances.

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Appendix 1 – Isotope Activities

Table A1. Isotope activities (Bq) of the depleted uranium material (50 years).

Isotope	50 years old
U-238	1.9444E+05
Th-234	1.9444E+05
Pa-234m	1.9444E+05
Pa-234	3.11106E+02
U-234	1.80613E+04
Th-230	8.29550E+00
Ra-226	8.91956E-02
Rn-222	8.91414E-02
Po-218	8.91414E-02
Pb-214	8.91234E-02
At-218	1.78283E-05
Bi-214	8.91414E-02
Rn-218	1.78283E-08
Po-214	8.91234E-02
Tl-210	1.87125E-05
Pb-210	3.27841E-02
Bi-210	3.27480E-02
Hg-206	6.22664E-10
Po-210	3.17916E-02
Tl-206	4.38445E-08
U-235	3.13196E+03
Th-231	3.13196E+03
Pa-231	3.31048E+00
Ac-227	1.65462E+00
Th-227	1.62799E+00
Fr-223	2.28351E-02
Ra-223	1.64835E+00
Rn-219	1.64835E+00
At-219	1.37023E-06
Bi-215	1.32889E-06
Po-215	1.64835E+00
Pb-211	1.64835E+00
Bi-211	1.64835E+00
Tl-207	1.64397E+00
Po-211	4.55074E-03

Table A2. Isotope activities (Bq) of the commercial enriched uranium materials.

Isotope	1 year old	10 years old	50 years old
U-238	1.79559E+05	1.79559E+05	1.79559E+05
Th-234	1.79559E+05	1.79559E+05	1.79559E+05
Pa-234m	1.79559E+05	1.79559E+05	1.79559E+05
Pa-234	2.87295E+02	2.87295E+02	2.87295E+02
U-234	1.04467E+06	1.04467E+06	1.04467E+06
Th-230	9.60572E+00	9.60574E+01	4.80135E+02
Ra-226	2.08098E-03	2.07785E-01	5.16383E+00
Rn-222	2.01830E-03	2.07158E-01	5.16070E+00
Po-218	2.01830E-03	2.07158E-01	5.16070E+00
Pb-214	2.01830E-03	2.07053E-01	5.15965E+00
At-218	4.03660E-07	4.14316E-05	1.03214E-03
Bi-214	2.01830E-03	2.07158E-01	5.16070E+00
Rn-218	4.03660E-10	4.14316E-08	1.03214E-06
Po-214	2.01725E-03	2.07053E-01	5.15965E+00
Tl-210	4.23822E-07	4.35000E-05	1.08333E-03
Pb-210	2.05382E-05	1.99532E-02	1.89817E+00
Bi-210	1.93473E-05	1.98383E-02	1.89608E+00
Hg-206	3.90080E-13	3.79110E-10	3.60517E-08
Po-210	6.24398E-06	1.69759E-02	1.84072E+00
Tl-206	2.59287E-11	2.65659E-08	2.53856E-06
U-235	3.52114E+04	3.52114E+04	3.52114E+04
Th-231	3.52114E+04	3.52114E+04	3.52114E+04
Pa-231	7.41904E-01	7.44721E+00	3.72184E+01
Ac-227	1.16374E-02	1.06867E+00	1.86022E+01
Th-227	9.90848E-03	1.03909E+00	1.83029E+01
Fr-223	1.60564E-04	1.47465E-02	2.56726E-01
Ra-223	9.14087E-03	1.04472E+00	1.85317E+01
Rn-219	9.14087E-03	1.04472E+00	1.85317E+01
At-219	9.63383E-09	8.84862E-07	1.54050E-05
Bi-215	9.34510E-09	8.58101E-07	1.49402E-05
Po-215	9.14087E-03	1.04472E+00	1.85317E+01
Pb-211	9.14087E-03	1.04472E+00	1.85317E+01
Bi-211	9.14087E-03	1.04472E+00	1.85317E+01
Tl-207	9.11270E-03	1.04190E+00	1.84825E+01
Po-211	2.52254E-05	2.88346E-03	5.11621E-02

Table A3. Isotope activities (Bq) of the highly enriched uranium – Russian origin materials.

Isotope	1 year old	10 years old	50 years old
U-238	1.62015E+04	1.62015E+04	1.62015E+04
U-236	1.34141E+05	1.34141E+05	1.34141E+05
U-235	1.05630E+06	1.05630E+06	1.05630E+06
U-234	3.27511E+07	3.27511E+07	3.27478E+07
Tl-210	1.32871E-05	1.36375E-03	3.39629E-02
Tl-208	1.46348E-08	6.23756E-06	9.26646E-05
Tl-207	2.73371E-01	3.12560E+01	5.54454E+02
Tl-206	8.12882E-10	8.32860E-07	7.95851E-05
Th-234	1.62015E+04	1.62015E+04	1.62015E+04
Th-232	6.61717E-06	6.61717E-06	3.30926E-04
Th-231	1.05630E+06	1.05630E+06	1.05630E+06
Th-230	3.01146E+02	3.01146E+02	1.50524E+04
Th-228	4.26971E-08	1.74115E-05	2.57953E-04
Th-227	2.97244E-01	3.11715E+01	5.49066E+02
Rn-222	6.32751E-02	6.49454E+00	1.61790E+02
Rn-220	4.09532E-08	1.73578E-05	2.57819E-04
Rn-219	2.74216E-01	3.13405E+01	5.55932E+02
Rn-218	1.26550E-08	1.29891E-06	3.23581E-05
Ra-228	3.83375E-07	2.77269E-05	2.76062E-04
Ra-226	6.52402E-02	6.51419E+00	1.61889E+02
Ra-224	4.09532E-08	1.73578E-05	2.57819E-04
Ra-223	2.74216E-01	3.13405E+01	5.55932E+02
Po-218	6.32751E-02	6.49454E+00	1.61790E+02
Po-216	4.09532E-08	1.73578E-05	2.57819E-04
Po-215	2.74216E-01	3.13405E+01	5.55932E+02
Po-214	6.32423E-02	6.49126E+00	1.61758E+02
Po-212	2.60904E-08	1.11189E-05	1.65128E-04
Po-211	7.56736E-04	8.65007E-02	1.53481E+00
Po-210	1.95753E-04	5.32205E-01	5.77074E+01
Pb-214	6.32751E-02	6.49126E+00	1.61758E+02
Pb-212	4.07520E-08	1.73578E-05	2.57819E-04
Pb-211	2.74216E-01	3.13405E+01	5.55932E+02
Pb-210	6.43886E-04	6.25546E-01	5.95087E+01
Pa-234m	1.62015E+04	1.62015E+04	1.62015E+04
Pa-234	2.59224E+01	2.59224E+01	2.59224E+01
Pa-231	2.22563E+01	2.23408E+02	1.11651E+03
Hg-206	1.22293E-11	1.18854E-08	1.13024E-06
Fr-223	4.81674E-03	4.42380E-01	7.70151E+00
Bi-215	2.80343E-07	2.57421E-05	4.48189E-04
Bi-214	6.32751E-02	6.49454E+00	1.61790E+02
Bi-212	4.07252E-08	1.73578E-05	2.57819E-04
Bi-211	2.74216E-01	3.13405E+01	5.55932E+02
Bi-210	6.06550E-04	6.21943E-01	5.94432E+01
At-219	2.89005E-07	2.65449E-05	4.62133E-04
At-218	1.26550E-05	1.29891E-03	3.23581E-02
Ac-228	3.82570E-07	2.77135E-05	2.76062E-04
Ac-227	3.49108E-01	3.20588E+01	5.58045E+02

Table A4. Isotope activities (Bq) of the highly enriched uranium – American origin materials.

Isotope	1 year old	10 years old	50 years old
U-238	9.90661E+03	9.90661E+03	9.90661E+03
U-236	1.58366E+05	1.58366E+05	1.58366E+05
U-235	1.09529E+06	1.09529E+06	1.09529E+06
U-234	3.31770E+07	3.31770E+07	3.31770E+07
Tl-210	1.34599E-05	1.38149E-03	3.44046E-02
Tl-208	1.72777E-08	7.36401E-06	1.09399E-04
Tl-207	2.83462E-01	3.24098E+01	5.74920E+02
Tl-206	8.23454E-10	8.43692E-07	8.06202E-05
Th-234	9.90661E+03	9.90661E+03	9.90661E+03
Th-232	7.81218E-06	7.81218E-05	3.90688E-04
Th-231	1.09529E+06	1.09529E+06	1.09529E+06
Th-230	3.05063E+02	3.05063E+03	1.52482E+04
Th-228	5.04078E-08	2.05559E-05	3.04537E-04
Th-227	3.08216E-01	3.23221E+01	5.69334E+02
Rn-222	6.40980E-02	6.57901E+00	1.63895E+02
Rn-220	4.83491E-08	2.04925E-05	3.04379E-04
Rn-219	2.84338E-01	3.24974E+01	5.76453E+02
Rn-218	1.28196E-08	1.31580E-06	3.27789E-05
Ra-228	4.52609E-07	3.27342E-05	3.25917E-04
Ra-226	6.60886E-02	6.59891E+00	1.63994E+02
Ra-224	4.83491E-08	2.04925E-05	3.04379E-04
Ra-223	2.84338E-01	3.24974E+01	5.76453E+02
Po-218	6.40980E-02	6.57901E+00	1.63895E+02
Po-216	4.83491E-08	2.04925E-05	3.04379E-04
Po-215	2.84338E-01	3.24974E+01	5.76453E+02
Po-214	6.40648E-02	6.57569E+00	1.63861E+02
Po-212	3.08021E-08	1.31269E-05	1.94948E-04
Po-211	7.84669E-04	8.96936E-02	1.59146E+00
Po-210	1.98299E-04	5.39127E-01	5.84579E+01
Pb-214	6.40980E-02	6.57569E+00	1.63861E+02
Pb-212	4.81115E-08	2.04925E-05	3.04379E-04
Pb-211	2.84338E-01	3.24974E+01	5.76453E+02
Pb-210	6.52260E-04	6.33681E-01	6.02827E+01
Pa-234m	9.90661E+03	9.90661E+03	9.90661E+03
Pa-234	1.58506E+01	1.58506E+01	1.58506E+01
Pa-231	2.30778E+01	2.31655E+02	1.15773E+03
Hg-206	1.23883E-11	1.20399E-08	1.14494E-06
Fr-223	4.99454E-03	4.58709E-01	7.98579E+00
Bi-215	2.90691E-07	2.66923E-05	4.64733E-04
Bi-214	6.40980E-02	6.57901E+00	1.63895E+02
Bi-212	4.80799E-08	2.04925E-05	3.04379E-04
Bi-211	2.84338E-01	3.24974E+01	5.76453E+02
Bi-210	6.14439E-04	6.30032E-01	6.02163E+01
At-219	2.99672E-07	2.75247E-05	4.79191E-04
At-218	1.28196E-05	1.31580E-03	3.27789E-02
Ac-228	4.51659E-07	3.27184E-05	3.25917E-04
Ac-227	3.61995E-01	3.32422E+01	5.78644E+02

Table A5. Isotope activities (Bq) of the fuel grade plutonium materials.

Isotope	1 year old	10 years old	50 years old
Pu-241	5.829612E+08	3.774441E+08	5.466790E+07
Pu-239	1.975995E+07	1.975402E+07	1.973229E+07
U-235m	1.974809E+07	1.974217E+07	1.972043E+07
Pu-240	1.007419E+07	1.006412E+07	1.002180E+07
Pu-238	6.286938E+06	5.855388E+06	4.268603E+06
Am-241	9.569178E+05	7.715302E+06	1.751698E+07
U-237	1.429870E+04	9.257139E+03	1.341153E+03
Pu-242	2.914000E+03	2.914000E+03	2.913709E+03
U-234	1.781964E+01	1.720496E+02	7.388942E+02
U-236	2.981252E-01	2.980244E+00	1.487100E+01
Np-237	1.6060800E-01	1.355226E+01	1.984197E+02
Pa-233	1.3062784E-01	1.328916E+01	1.978079E+02
U-235	1.9453671E-02	1.945169E-01	9.719919E-01
Th-231	1.9372655E-02	1.944379E-01	9.719919E-01

Table A6. Isotope activities (Bq) of the reactor grade plutonium materials.

Isotope	1 year old	10 years old	50 years old
Pu-241	4.328924E+09	2.802805E+09	4.059502E+08
Pu-238	6.224697E+07	5.797420E+07	4.226344E+07
Pu-240	1.828651E+07	1.826822E+07	1.819141E+07
Pu-239	1.431534E+07	1.431104E+07	1.429530E+07
U-235m	1.430675E+07	1.430245E+07	1.428671E+07
Am-241	7.105832E+06	5.729191E+07	1.300767E+08
U-237	1.061786E+05	6.874120E+04	9.959069E+03
Pu-242	4.327727E+04	4.327727E+04	4.327294E+04
U-234	1.764323E+02	1.703463E+03	7.315791E+03
Np-237	1.192635E+00	1.006357E+02	1.473415E+03
Pa-233	9.700097E-01	9.868202E+01	1.468872E+03
U-236	5.411518E-01	5.409690E+00	2.699358E+01
U-235	1.41E-02	1.41E-01	0.704171471
Th-230	0.000812517	0.079369436	1.791930E+00

Table A7. Isotope activities (Bq) of the weapons grade plutonium (5.7 %) materials.

Isotope	1 year old	10 years old	50 years old
Pu-241	116592230.4	75488819.2	10933580.8
Pu-239	21554640	21548173.61	21524463.5
U-235m	21541707.22	21535240.82	21511530.72
Pu-240	4785241.428	4780455.708	4760335.79
Pu-238	1886081.31	1756616.4	1280580.96
Am-241	191383.552	1543060.48	3503395.84
U-237	2859.74016	1851.42784	268.230656
Pu-242	437.1	437.1	437.05629
U-234	5.3458932	51.614865	221.66826
Np-237	0.0321216	2.7104512	39.6839424
Pa-233	0.026125568	2.65783296	39.5615744
U-236	0.141609455	1.415615976	7.0636932
U-235	0.021220543	0.212183876	1.060272742
Th-231	0.021132169	0.212097658	1.060272742

Table A8. Isotope activities (Bq) of the weapons grade plutonium (10 - 13 %) materials.

Isotope	1 year old	10 years old	50 years old
Pu-241	671862727.7	435004320.6	63004759.36
Pu-239	19780627.95	19774693.76	19752935.07
U-235m	19768759.57	19762825.38	19741066.69
Pu-240	9829137.748	9819307.627	9778021.12
Am-241	1102847.718	8891886.016	20188318.53
Pu-238	5607948.428	5223006.096	3807594.054
U-237	16479.25267	10668.85293	1545.679155
Pu-242	2456.502	2456.502	2456.25635
U-234	15.89512245	153.4681986	659.0936264
Np-237	0.18510072	15.61897504	228.6787181
Pa-233	0.150548586	15.31576243	227.9735725
U-236	0.290873273	2.907749721	14.50925824
U-235	0.019474028	0.194720502	0.973009089
Th-231	0.019392928	0.194641379	0.973009089

Appendix 2 – Input peak intensities

Table A2.1 Input peak intensities for the calibration source with no filter between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope	
0.7	9.00E+02	Co-57	X	113.3	2.27E-01	Am-241	X
1.69	9.20E+02	Sr-85	X	114.23	4.30E-01	Am-241	X
3.29	2.42E+03	Sn-113	X	117.46	1.68E-01	Am-241	X
4.47	2.36E+02	Cs-137	X	122.06	5.07E+04	Co-57	
4.65	8.81E+03	Ce-139	X	123.05	1.00E+00	Am-241	
6.39	9.83E+03	Co-57	X	125.3	4.08E+00	Am-241	
6.4	1.95E+04	Co-57	X	129.8	8.52E-02	Sr-85	
7.06	2.32E+03	Co-57	X	136.47	6.32E+03	Co-57	
7.06	1.18E+03	Co-57	X	146.55	4.61E-01	Am-241	
10.3	1.20E+03	Hg-203	X	150.04	7.40E-02	Am-241	
10.8	2.50E+04	Pb-210	X	151.18	4.26E-01	Sr-85	
13.34	6.14E+03	Sr-85	X	164.69	6.67E-02	Am-241	
13.4	1.19E+04	Sr-85	X	165.81	2.32E-02	Am-241	
13.9	3.70E+04	Am-241	X	165.86	5.92E+04	Ce-139	
14.41	5.42E+03	Co-57		169.56	1.73E-01	Am-241	
14.95	8.66E+02	Sr-85	X	175.07	1.82E-02	Am-241	
14.96	1.67E+03	Sr-85	X	191.96	2.16E-02	Am-241	
15.19	2.66E+02	Sr-85	X	208.01	7.91E-01	Am-241	
24	7.87E+03	Sn-113	X	221.46	4.24E-02	Am-241	
24.21	1.46E+04	Sn-113	X	230.4	2.37E-01	Co-57	
26.34	2.27E+03	Am-241		255.13	5.93E+02	Sn-113	
27.24	1.31E+03	Sn-113	X	267.58	2.63E-02	Am-241	
27.28	2.53E+03	Sn-113	X	279.2	1.81E+04	Hg-203	
27.86	6.72E+02	Sn-113	X	283.5	1.50E-01	Cs-137	
31.82	5.15E+02	Cs-137	X	292.77	1.42E-02	Am-241	
32.19	9.43E+02	Cs-137	X	322.52	1.52E-01	Am-241	
33.03	1.67E+04	Ce-139	X	332.35	1.49E-01	Am-241	
33.2	1.26E+02	Am-241		335.37	4.96E-01	Am-241	
33.44	3.03E+04	Ce-139	X	339.69	2.19E+00	Co-57	
36.3	9.01E+01	Cs-137	X	352.33	1.78E+00	Co-57	
36.38	1.74E+02	Cs-137	X	354.06	1.70E-01	Sr-85	
37.26	5.52E+01	Cs-137	X	362.82	4.86E-01	Sr-85	
37.72	2.92E+03	Ce-139	X	366.8	7.10E-01	Co-57	
37.8	5.64E+03	Ce-139	X	368.65	2.17E-01	Am-241	
38.73	1.82E+03	Ce-139	X	370.94	5.23E-02	Am-241	
42.7	5.50E+00	Am-241		376.65	1.38E-01	Am-241	
43.42	7.30E+01	Am-241		382.9	1.69E-02	Sn-113	
46.54	4.68E+03	Pb-210		383.81	2.82E-02	Am-241	
51.01	2.60E-02	Am-241		391.7	1.83E+04	Sn-113	
55.56	1.81E+01	Am-241		419.33	2.87E-02	Am-241	
59.54	3.59E+04	Am-241		426.47	2.46E-02	Am-241	
64.83	1.45E-01	Am-241		514	3.41E+04	Sr-85	
67.45	4.20E-01	Am-241		570.09	9.35E+00	Co-57	
69.76	2.90E+00	Am-241		619.01	5.94E-02	Am-241	
70.83	8.19E+02	Hg-203	X	638.03	2.73E-01	Sn-113	
72.87	1.37E+03	Hg-203	X	653.02	3.77E-02	Am-241	
75.8	5.90E-01	Am-241		661.66	2.20E+04	Cs-137	
82.11	1.66E+02	Hg-203	X	662.4	3.64E-01	Am-241	
82.57	3.18E+02	Hg-203	X	688.72	3.25E-02	Am-241	
84.86	1.16E+02	Hg-203	X	692.41	8.82E+01	Co-57	
97.07	1.14E+00	Am-241	X	706.54	2.96E+00	Co-57	
98.97	2.03E+01	Am-241		716.87	1.10E-01	Sr-85	
101.06	1.81E+00	Am-241	X	722.01	1.96E-01	Am-241	
102.98	1.95E+01	Am-241		868.06	4.26E+00	Sr-85	

Table A2.2. Input peak intensities for the calibration source with filter between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope
0.7	8.97E+03	Co-57	X	123.05	2.00E+01	Am-241
1.69	9.20E+02	Sr-85	X	125.3	8.16E+01	Am-241
3.29	2.42E+03	Sn-113	X	136.47	6.30E+04	Co-57
4.47	2.36E+02	Cs-137	X	139.44	1.06E-01	Am-241
4.65	8.81E+03	Ce-139	X	146.55	9.22E+00	Am-241
6.39	9.79E+04	Co-57	X	150.04	1.48E+00	Am-241
6.4	1.94E+05	Co-57	X	151.18	4.26E-01	Sr-85
7.06	2.31E+04	Co-57	X	164.69	1.33E+00	Am-241
7.06	1.18E+04	Co-57	X	165.81	4.64E-01	Am-241
10.3	1.20E+03	Hg-203	X	165.86	5.92E+04	Ce-139
10.8	4.77E+06	Pb-210	X	169.56	3.46E+00	Am-241
13.34	6.14E+03	Sr-85	X	175.07	3.64E-01	Am-241
13.4	1.19E+04	Sr-85	X	191.96	4.32E-01	Am-241
13.9	7.40E+05	Am-241	X	208.01	1.58E+01	Am-241
14.41	5.40E+04	Co-57		221.46	8.48E-01	Am-241
14.95	8.66E+02	Sr-85	X	230.4	2.36E+00	Co-57
14.96	1.67E+03	Sr-85	X	255.13	5.93E+02	Sn-113
15.19	2.66E+02	Sr-85	X	264.89	1.80E-01	Am-241
24	7.87E+03	Sn-113	X	267.58	5.26E-01	Am-241
24.21	1.46E+04	Sn-113	X	275.77	1.32E-01	Am-241
26.34	4.54E+04	Am-241		279.2	1.81E+04	Hg-203
27.24	1.31E+03	Sn-113	X	283.5	1.50E-01	Cs-137
27.28	2.53E+03	Sn-113	X	292.77	2.84E-01	Am-241
27.86	6.72E+02	Sn-113	X	322.52	3.04E+00	Am-241
31.82	5.15E+02	Cs-137	X	332.35	2.98E+00	Am-241
32.19	9.43E+02	Cs-137	X	335.37	9.92E+00	Am-241
33.03	1.67E+04	Ce-139	X	339.69	2.18E+01	Co-57
33.2	2.52E+03	Am-241		352.33	1.77E+01	Co-57
33.44	3.03E+04	Ce-139	X	354.06	1.70E-01	Sr-85
36.3	9.01E+01	Cs-137	X	362.82	4.86E-01	Sr-85
36.38	1.74E+02	Cs-137	X	366.8	7.08E+00	Co-57
37.26	5.52E+01	Cs-137	X	368.65	4.34E+00	Am-241
37.72	2.92E+03	Ce-139	X	370.94	1.05E+00	Am-241
37.8	5.64E+03	Ce-139	X	376.65	2.76E+00	Am-241
38.73	1.82E+03	Ce-139	X	383.81	5.64E-01	Am-241
42.7	1.10E+02	Am-241		391.7	1.83E+04	Sn-113
43.42	1.46E+03	Am-241		419.33	5.74E-01	Am-241
46.54	8.93E+05	Pb-210		426.47	4.92E-01	Am-241
51.01	5.20E-01	Am-241		454.66	1.94E-01	Am-241
55.56	3.62E+02	Am-241		514	3.41E+04	Sr-85
59.54	7.18E+05	Am-241		570.09	9.32E+01	Co-57
64.83	2.90E+00	Am-241		597.48	1.48E-01	Am-241
67.45	8.40E+00	Am-241		619.01	1.19E+00	Am-241
69.76	5.80E+01	Am-241		638.03	2.73E-01	Sn-113
70.83	8.19E+02	Hg-203	X	641.47	1.42E-01	Am-241
72.87	1.37E+03	Hg-203	X	653.02	7.54E-01	Am-241
75.8	1.18E+01	Am-241		661.66	2.20E+04	Cs-137
82.11	1.66E+02	Hg-203	X	662.4	7.28E+00	Am-241
82.57	3.18E+02	Hg-203	X	688.72	6.50E-01	Am-241
84.86	1.16E+02	Hg-203	X	692.41	8.79E+02	Co-57
97.07	2.28E+01	Am-241	X	696.6	1.07E-01	Am-241
98.97	4.06E+02	Am-241		706.54	2.95E+01	Co-57
101.06	3.62E+01	Am-241	X	716.87	1.10E-01	Sr-85
102.98	3.90E+02	Am-241		722.01	3.92E+00	Am-241
113.3	4.54E+00	Am-241	X	737.34	1.60E-01	Am-241
114.23	8.60E+00	Am-241	X	755.9	1.52E-01	Am-241
117.46	3.36E+00	Am-241	X	767	1.00E-01	Am-241
122.06	5.05E+05	Co-57		868.06	4.26E+00	Sr-85

Table A2.3. Input peak intensities for the 50 year old depleted uranium source between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
9.2	1.03E+00	Th-231		94.65	3.89E+01	Pa-234	X	164.94	1.68E-01	Pa-234
10.25	1.57E+00	Th-231		94.65	1.30E+01	Pa-234m	X	165	1.07E-01	Th-231
11.7	3.78E-01	Ra-223	X	95.86	5.43E+01	Th-234	X	165.61	2.36E-01	Pa-234
12.3	6.39E-01	Th-230	X	95.86	1.78E+01	Th-231	X	170.85	1.65E+00	Pa-234
12.7	1.07E+00	Pa-231	X	96.09	2.85E+00	U-235		173.3	1.88E-01	U-235
13.00	1.42E+04	U-238	X	97.17	7.78E-01	Pa-234		174.15	5.57E-01	Th-231
13	1.81E+03	U-234	X	98.43	6.22E+01	Pa-234	X	174.55	5.29E-01	Pa-234
13	8.45E+02	U-235	X	98.43	2.10E+01	Pa-234m	X	179.8	1.43E-01	Pa-234
13.3	1.38E+04	Th-234	X	99.28	4.10E+00	Th-231		182.62	1.22E+01	U-235
13.3	1.85E+03	Th-231	X	99.86	1.03E+01	Pa-234		183.5	1.03E+00	Th-231
13.3	1.05E+02	Pa-234m	X	100.89	4.04E-01	Pa-234		184.7	3.26E+00	Pa-234m
13.6	2.71E+02	Pa-234	X	102.27	1.37E+01	Th-231		185.71	1.78E+03	U-235
13.6	2.64E+01	Pa-234m	X	103.35	6.21E+00	Th-234		186.15	5.75E+00	Pa-234
17.2	7.20E+00	Th-231		103.77	7.78E-01	Pa-234		188.76	1.03E-01	Th-231
19.1	7.51E+00	Th-231		104.82	2.14E+01	U-235	X	193.4	1.40E+00	Pa-234m
19.55	1.97E+03	U-235		104.82	2.64E-01	U-238	X	193.4	1.40E+00	Pa-234m
20.02	9.70E+00	Th-234		105.6	4.10E+01	U-235	X	193.73	1.62E+00	Pa-234
25.64	4.41E+02	Th-231		105.6	5.04E-01	U-238	X	194.94	1.97E+01	U-235
27.36	3.41E-01	Pa-231		105.6	1.76E-01	U-234	X	196.8	2.36E-01	Pa-234
29.49	2.33E+00	Th-234		105.81	2.44E-01	Th-231		198.9	1.13E+00	U-235
31.6	5.32E-01	U-235		106.61	5.51E-01	Th-231		199.9	1.11E+00	Pa-234m
34.7	1.16E+00	U-235		106.68	1.18E-01	Pa-234		199.95	2.36E-01	Pa-234
41.4	9.39E-01	U-235		107.6	6.60E+00	Th-234	X	200.97	2.92E+00	Pa-234
41.96	1.88E+00	U-235		107.6	2.22E+00	Th-231	X	202.12	3.38E+01	U-235
42.86	1.85E+00	Th-231		108.42	1.26E+01	Th-234	X	203.12	4.01E+00	Pa-234
43.49	4.04E-01	Pa-234		108.42	4.23E+00	Th-231	X	203.3	3.30E+00	Pa-234m
49.55	1.24E+02	U-238		108.58	1.57E+01	U-235	X	205.32	1.57E+02	U-235
50.13	1.37E-01	Th-227		108.58	1.92E-01	U-238	X	209.9	2.62E+00	Pa-234m
51.21	1.06E+00	U-235		109.19	5.20E+01	U-235		215.28	9.08E-01	U-235
53.2	2.23E+01	U-234		110.42	7.81E+00	Pa-234	X	217.94	1.24E+00	Th-231
54.25	4.70E-01	U-235		110.42	2.62E+00	Pa-234m	X	220	4.67E-01	Pa-234
58.57	1.45E+01	Th-231		111.3	1.49E+01	Pa-234	X	221.15	1.68E-01	Pa-234
59.19	1.03E-01	Pa-234		111.3	5.04E+00	Pa-234m	X	221.39	3.69E+00	U-235
62.7	4.98E+00	Pa-234		111.49	4.85E+00	Th-234	X	221.83	2.36E-01	Pa-234
62.7	2.33E+00	Pa-234m		111.49	1.63E+00	Th-231	X	226.5	1.37E+01	Pa-234
62.86	3.10E+01	Th-234		112.81	4.07E+02	Th-234		227.25	1.87E+01	Pa-234
63.29	7.18E+03	Th-234		113.5	1.98E+01	U-238		228.78	2.19E-01	U-235
63.86	7.20E-01	Th-231		114.44	5.72E+00	Pa-234	X	232.21	5.60E-01	Pa-234
64.45	4.07E-01	U-235		114.44	1.92E+00	Pa-234m	X	233.5	1.19E+00	U-235
67.25	1.18E-01	Pa-234		115.45	9.39E-01	U-235		235.11	3.70E-01	Pa-234
68.5	1.82E-01	Th-231		116.82	6.95E-01	Th-231		235.9	1.55E-01	Pa-234m
72.7	3.76E+00	U-235		120.35	8.14E-01	U-235		235.96	2.10E-01	Th-227
72.75	7.89E+00	Th-231		120.9	6.34E+00	U-234		236.01	2.88E-01	Th-231
73.92	2.52E+01	Th-234		124.91	1.82E+00	Th-231		240.2	1.68E-01	Pa-234
73.92	2.52E+01	Pa-234m		125.46	2.55E+00	Pa-234		240.88	2.32E+00	U-235
74.94	1.60E+00	U-235		131.3	5.88E+01	Pa-234		245.37	2.46E+00	Pa-234
77.69	1.32E-01	Th-231		134.03	7.83E-01	Th-231		246.83	1.72E+00	U-235
79.84	2.02E-01	Pa-234		134.61	3.70E-01	Pa-234		247.7	4.73E-01	Pa-234m
81.07	2.48E-01	Ra-223	X	135.66	2.47E+00	Th-231		249.22	8.09E+00	Pa-234
81.23	2.82E+01	Th-231		136.55	3.76E-01	U-235		256.23	1.14E-01	Th-227
82.09	1.32E+01	Th-231		136.75	1.38E-01	Th-231		257.2	1.68E-01	Pa-234
83.3	1.16E+02	Th-234		140.1	2.48E+00	Pa-234m		258.23	1.48E+02	Pa-234m
83.79	4.08E-01	Ra-223	X	140.15	1.65E+00	Pa-234		266.45	1.88E-01	U-235
84.21	2.07E+02	Th-231		140.76	6.26E+00	U-235		267.12	5.60E-01	Pa-234
89.95	3.13E+01	Th-231		140.91	9.95E-01	Pa-234		269.46	2.29E-01	Ra-223
89.96	1.07E+02	U-235	X	142.4	1.57E-01	U-235		271.23	1.78E-01	Rn-219
89.96	1.32E+00	U-238	X	143.76	3.43E+02	U-235		272.28	3.51E+00	Pa-234
89.96	4.71E-01	U-234	X	143.78	1.03E+00	Pa-234		275.04	3.02E-01	Pa-234
92.28	3.32E+01	Th-234	X	145.06	1.78E-01	Th-231		275.35	1.60E+00	U-235
92.28	1.10E+01	Th-231	X	145.94	9.92E-01	Th-231		275.49	1.00E+00	U-235
92.38	4.13E+03	Th-234		149.88	2.36E-01	Pa-234		275.5	6.01E-01	Pa-234m
92.8	4.07E+03	Th-234		150.93	2.82E+00	U-235		278.3	1.34E-01	Pa-234
93.02	1.47E+00	Th-231		152.71	1.96E+01	Pa-234		281.42	1.88E-01	U-235
93.35	1.73E+02	U-235	X	159.48	2.12E+00	Pa-234		282.92	1.88E-01	U-235
93.35	2.13E+00	U-238	X	163.1	4.82E+00	Th-231		289.56	2.19E-01	U-235
93.35	7.42E-01	U-234	X	163.36	1.59E+02	U-235		291.65	1.25E+00	U-235
293.79	9.64E+00	Pa-234		559.2	2.36E-01	Pa-234		780.4	2.92E+00	Pa-234
295.91	4.67E-01	Pa-234		562.8	1.18E-01	Pa-234		781.75	1.51E+01	Pa-234m
299	1.26E+00	Pa-234m		565.2	3.36E+00	Pa-234		783.4	9.64E-01	Pa-234
301.7	1.57E-01	U-235		568.9	1.18E+01	Pa-234		786.27	3.89E+00	Pa-234

310.2	2.36E-01	Pa-234	569.5	2.68E+01	Pa-234	786.28	1.06E+02	Pa-234m
311	1.63E-01	Pa-234m	572	1.68E+00	Pa-234m	792.8	1.43E-01	Pa-234
313.5	3.36E-01	Pa-234	581.19	1.59E-01	Pa-234m	794.9	2.18E+00	Pa-234
316.7	3.69E-01	Pa-234m	584.1	5.60E-01	Pa-234	796.1	8.40E+00	Pa-234
316.7	3.36E-01	Pa-234	586.3	2.36E-01	Pa-234	804.1	2.02E+00	Pa-234
320.4	1.68E-01	Pa-234	590.3	1.18E-01	Pa-234	805.75	1.15E+01	Pa-234m
330.4	1.52E+00	Pa-234	595.4	3.02E-01	Pa-234	805.8	8.09E+00	Pa-234
330.4	9.95E-01	Pa-234	596.9	6.53E-01	Pa-234	808.2	5.39E+00	Pa-234m
331.4	2.36E-01	Pa-234	602.6	1.74E+00	Pa-234	808.4	1.18E-01	Pa-234
338.1	2.13E+00	Pa-234m	604.6	1.68E-01	Pa-234	811.5	4.04E-01	Pa-234
340.2	1.36E-01	Pa-234m	612	1.24E+00	Pa-234	814.2	9.95E-01	Pa-234
340.2	1.31E-01	Pa-234	617	1.68E-01	Pa-234	818.2	1.94E+00	Pa-234m
343.8	1.12E-01	Pa-234	619	1.18E-01	Pa-234	819.2	6.16E+00	Pa-234
345.92	1.25E+00	U-235	624.2	1.15E+00	Pa-234	825.1	6.16E+00	Pa-234
351.07	2.15E-01	Bi-211	624.6	2.23E-01	Pa-234m	825.6	1.28E+01	Pa-234m
351.9	1.34E+00	Pa-234	628.1	7.78E-01	Pa-234	829.3	1.18E+00	Pa-234
356.03	1.57E-01	U-235	629.4	1.15E+00	Pa-234	831.5	1.34E+01	Pa-234
357.5	1.55E+00	Pa-234m	632.6	1.18E-01	Pa-234	844.1	2.13E+00	Pa-234m
357.9	1.18E-01	Pa-234	634.3	4.35E-01	Pa-234	844.1	1.37E+00	Pa-234
362.8	1.32E+00	Pa-234m	646.5	3.70E-01	Pa-234	851.58	1.34E+01	Pa-234m
369.5	8.09E+00	Pa-234	649	1.94E+00	Pa-234m	851.8	2.36E-01	Pa-234
372	3.95E+00	Pa-234	653.7	1.52E+00	Pa-234	857.7	1.18E-01	Pa-234
379.1	1.34E-01	Pa-234	655.2	4.35E-01	Pa-234	863.2	2.36E-01	Pa-234
385.4	1.34E-01	Pa-234	655.3	2.68E+00	Pa-234m	866.8	2.21E+00	Pa-234m
387.6	1.80E+00	Pa-234m	657.4	1.28E+00	Pa-234	869.7	6.53E-01	Pa-234
387.6	9.08E-01	Pa-234m	663.9	1.74E+00	Pa-234	874	1.18E-01	Pa-234
387.84	1.25E+00	U-235	666.5	3.79E+00	Pa-234	876	8.24E+00	Pa-234
394.1	3.02E-01	Pa-234	669.7	3.23E+00	Pa-234	880.5	2.02E+01	Pa-234
401.81	1.09E-01	Rn-219	670.8	7.18E-01	Pa-234m	880.5	1.37E+01	Pa-234
409.8	1.12E+00	Pa-234	673.9	1.26E+00	Pa-234m	880.9	7.76E+00	Pa-234m
416.1	1.18E-01	Pa-234	675.1	3.27E-01	Pa-234	883.22	6.79E+00	Pa-234m
426.95	1.49E+00	Pa-234	683.4	1.11E+00	Pa-234m	883.24	3.11E+01	Pa-234
433.1	3.02E-01	Pa-234	683.9	4.98E-01	Pa-234	898.67	1.06E+01	Pa-234
446.6	3.70E-01	Pa-234	685.1	4.67E-01	Pa-234	904.2	1.12E+00	Pa-234
450.97	6.03E+00	Pa-234m	691	1.73E+01	Pa-234m	918.4	3.23E-01	Pa-234
453.58	4.13E+00	Pa-234m	692.6	4.04E+00	Pa-234	921.72	2.48E+01	Pa-234m
456.7	1.40E+00	Pa-234m	695.5	3.14E+00	Pa-234m	925	2.55E+01	Pa-234
458.68	3.70E+00	Pa-234	699.02	1.11E+01	Pa-234m	926	5.60E+00	Pa-234
461.5	1.12E-01	Pa-234	699.03	1.18E+01	Pa-234	926.61	2.41E+00	Pa-234m
468	7.15E-01	Pa-234	702	1.41E+01	Pa-234m	926.72	2.36E+01	Pa-234
468.43	4.44E+00	Pa-234m	705.9	7.40E+00	Pa-234	935.8	2.15E-01	Pa-234
472.3	1.18E+00	Pa-234	705.94	1.09E+01	Pa-234m	936.3	2.13E+00	Pa-234m
474.2	1.18E-01	Pa-234	708.2	1.31E+00	Pa-234m	941.96	4.89E+00	Pa-234m
475.74	4.64E+00	Pa-234m	713.7	4.67E-01	Pa-234	942	1.49E-01	Pa-234
478.6	4.04E-01	Pa-234	727.8	3.70E-01	Pa-234	945.94	1.96E+01	Pa-234m
481	9.95E-01	Pa-234	730.9	2.05E+00	Pa-234	946	4.35E+01	Pa-234
498	2.02E-01	Pa-234	732.5	2.52E+00	Pa-234m	947.7	5.29E+00	Pa-234
506.75	4.20E+00	Pa-234	733.39	2.24E+01	Pa-234	952.7	2.68E-01	Pa-234
507.5	3.05E+00	Pa-234m	738	3.76E+00	Pa-234	960	1.55E+00	Pa-234m
509.2	4.07E+00	Pa-234m	740.1	2.12E+01	Pa-234m	960	2.36E-01	Pa-234
513.4	2.46E+00	Pa-234	742.81	2.07E+02	Pa-234m	965.8	1.56E+00	Pa-234
513.4	1.24E+00	Pa-234	742.81	6.72E+00	Pa-234	978.2	2.92E-01	Pa-234
519.6	1.28E+00	Pa-234	745.9	1.03E+00	Pa-234	980.3	8.71E+00	Pa-234
521.4	2.43E+00	Pa-234	748.1	3.36E-01	Pa-234	980.3	5.72E+00	Pa-234
527.9	1.28E+00	Pa-234	755	3.95E+00	Pa-234	981.6	2.36E+00	Pa-234
529.1	3.11E-01	Pa-234	758.9	8.09E-01	Pa-234	984.2	5.29E+00	Pa-234
534.1	2.68E-01	Pa-234	761	2.36E-01	Pa-234	989.5	3.36E-01	Pa-234
537.2	2.68E-01	Pa-234	764.8	6.53E-01	Pa-234	994.6	2.02E-01	Pa-234
543.8	4.35E-01	Pa-234	766.4	2.49E-01	Pa-234	996.1	1.09E+01	Pa-234m
543.98	7.12E+00	Pa-234m	766.42	6.15E+02	Pa-234m	997.7	1.49E-01	Pa-234
553.7	1.43E-01	Pa-234	769.1	6.03E-01	Pa-234	1001.03	1.63E+03	Pa-234m
558	3.02E-01	Pa-234	772.4	2.36E-01	Pa-234			

Table A2.4. Input peak intensities for the 1 year old commercial enriched uranium between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope	keV	Photons/s	isotope
9.2	1.16E+01	Th-231		174.15	6.27E+00	Th-231	569.5	2.47E+01	Pa-234
10.25	1.77E+01	Th-231		174.55	4.88E-01	Pa-234	572	1.56E+00	Pa-234m
12.3	7.40E-01	Th-230	X	179.8	1.32E-01	Pa-234	581.19	1.48E-01	Pa-234m
12.7	2.40E-01	Pa-231	X	182.62	1.37E+02	U-235	581.7	1.25E-01	U-234
13	1.04E+05	U-234	X	183.5	1.16E+01	Th-231	584.1	5.17E-01	Pa-234
13	1.31E+04	U-238	X	184.7	3.02E+00	Pa-234m	586.3	2.18E-01	Pa-234
13	9.50E+03	U-235	X	185.71	2.01E+04	U-235	590.3	1.09E-01	Pa-234
13.3	2.08E+04	Th-231	X	186.15	5.31E+00	Pa-234	595.4	2.78E-01	Pa-234
13.3	1.28E+04	Th-234	X	188.76	1.16E+00	Th-231	596.9	6.03E-01	Pa-234
13.3	9.72E+01	Pa-234m	X	193.4	1.30E+00	Pa-234m	602.6	1.61E+00	Pa-234
13.6	2.50E+02	Pa-234	X	193.4	1.30E+00	Pa-234m	604.6	1.55E-01	Pa-234
13.6	2.45E+01	Pa-234m	X	193.73	1.49E+00	Pa-234	612	1.15E+00	Pa-234
17.2	8.10E+01	Th-231		194.94	2.22E+02	U-235	617	1.55E-01	Pa-234
19.1	8.45E+01	Th-231		196.8	2.18E-01	Pa-234	619	1.09E-01	Pa-234
19.55	2.22E+04	U-235		198.9	1.27E+01	U-235	624.2	1.06E+00	Pa-234
20.02	9.00E+00	Th-234		199.9	1.03E+00	Pa-234m	624.6	2.07E-01	Pa-234m
25.64	4.96E+03	Th-231		199.95	2.18E-01	Pa-234	628.1	7.18E-01	Pa-234
29.49	2.16E+00	Th-234		200.97	2.70E+00	Pa-234	629.4	1.06E+00	Pa-234
31.6	5.98E+00	U-235		202.12	3.80E+02	U-235	632.6	1.09E-01	Pa-234
34.7	1.30E+01	U-235		203.12	3.70E+00	Pa-234	634.3	4.02E-01	Pa-234
41.4	1.06E+01	U-235		203.3	3.06E+00	Pa-234m	646.5	3.42E-01	Pa-234
41.96	2.11E+01	U-235		205.32	1.77E+03	U-235	649	1.80E+00	Pa-234m
42.86	2.08E+01	Th-231		209.9	2.43E+00	Pa-234m	653.7	1.41E+00	Pa-234
43.49	3.73E-01	Pa-234		215.28	1.02E+01	U-235	655.2	4.02E-01	Pa-234
44.08	2.46E-01	Th-231		217.94	1.39E+01	Th-231	655.3	2.48E+00	Pa-234m
49.55	1.15E+02	U-238		220	4.31E-01	Pa-234	657.4	1.18E+00	Pa-234
51.21	1.20E+01	U-235		221.15	1.55E-01	Pa-234	663.9	1.61E+00	Pa-234
53.2	1.28E+03	U-234		221.39	4.15E+01	U-235	666.5	3.50E+00	Pa-234
54.1	1.76E-01	U-235		221.83	2.18E-01	Pa-234	669.7	2.99E+00	Pa-234
54.25	5.28E+00	U-235		226.5	1.26E+01	Pa-234	670.8	6.66E-01	Pa-234m
58.57	1.63E+02	Th-231		227.25	1.72E+01	Pa-234	673.9	1.17E+00	Pa-234m
62.7	4.59E+00	Pa-234		228.78	2.46E+00	U-235	675.1	3.01E-01	Pa-234
62.7	2.16E+00	Pa-234m		232.21	5.17E-01	Pa-234	683.4	1.03E+00	Pa-234m
62.86	2.88E+01	Th-234		233.5	1.34E+01	U-235	683.9	4.59E-01	Pa-234
63.29	6.66E+03	Th-234		235.11	3.42E-01	Pa-234	685.1	4.31E-01	Pa-234
63.86	8.10E+00	Th-231		235.9	1.44E-01	Pa-234m	691	1.61E+01	Pa-234m
64.45	4.58E+00	U-235		236.01	3.24E+00	Th-231	692.6	3.73E+00	Pa-234
67.25	1.09E-01	Pa-234		240.2	1.55E-01	Pa-234	695.5	2.92E+00	Pa-234m
68.5	2.04E+00	Th-231		240.27	1.02E-01	Th-231	699.02	1.03E+01	Pa-234m
72.7	4.22E+01	U-235		240.88	2.61E+01	U-235	699.03	1.09E+01	Pa-234
72.75	8.87E+01	Th-231		242.5	2.92E-01	Th-231	702	1.30E+01	Pa-234m
73.92	2.34E+01	Th-234		245.37	2.27E+00	Pa-234	705.9	6.83E+00	Pa-234
73.92	2.34E+01	Pa-234m		246.83	1.94E+01	U-235	705.94	1.01E+01	Pa-234m
74.94	1.80E+01	U-235		247.7	4.39E-01	Pa-234m	708.2	1.21E+00	Pa-234m
77.69	1.48E+00	Th-231		249.22	7.46E+00	Pa-234	713.7	4.31E-01	Pa-234
79.84	1.87E-01	Pa-234		249.6	2.78E-01	Th-231	727.8	3.42E-01	Pa-234
81.23	3.17E+02	Th-231		250.45	2.32E-01	Th-231	730.9	1.89E+00	Pa-234
82.09	1.48E+02	Th-231		257.2	1.55E-01	Pa-234	732.5	2.34E+00	Pa-234m
83.3	1.08E+02	Th-234		258.23	1.38E+02	Pa-234m	733.39	2.07E+01	Pa-234
84.21	2.32E+03	Th-231		266.45	2.11E+00	U-235	738	3.47E+00	Pa-234
89.95	3.52E+02	Th-231		267.12	5.17E-01	Pa-234	740.1	1.96E+01	Pa-234m
89.96	1.21E+03	U-235	X	267.62	4.40E-01	Th-231	742.81	1.92E+02	Pa-234m
89.96	2.70E+01	U-234	X	272.28	3.24E+00	Pa-234	742.81	6.20E+00	Pa-234
89.96	1.22E+00	U-238	X	275.04	2.78E-01	Pa-234	745.9	9.47E-01	Pa-234
92.28	1.23E+02	Th-231	X	275.35	1.80E+01	U-235	748.1	3.10E-01	Pa-234
92.28	3.08E+01	Th-234	X	275.49	1.13E+01	U-235	755	3.65E+00	Pa-234
92.38	3.83E+03	Th-234		275.5	5.58E-01	Pa-234m	758.9	7.46E-01	Pa-234
92.8	3.78E+03	Th-234		278.3	1.23E-01	Pa-234	761	2.18E-01	Pa-234
93.02	1.65E+01	Th-231		281.42	2.11E+00	U-235	764.8	6.03E-01	Pa-234
93.35	1.95E+03	U-235	X	282.92	2.11E+00	U-235	766.4	2.30E-01	Pa-234
93.35	4.26E+01	U-234	X	289.56	2.46E+00	U-235	766.42	5.71E+02	Pa-234m
93.35	1.98E+00	U-238	X	291.65	1.41E+01	U-235	769.1	5.57E-01	Pa-234
94.65	3.59E+01	Pa-234	X	293.79	8.90E+00	Pa-234	772.4	2.18E-01	Pa-234
94.65	1.21E+01	Pa-234m	X	295.91	4.31E-01	Pa-234	780.4	2.70E+00	Pa-234
95.86	2.01E+02	Th-231	X	299	1.17E+00	Pa-234m	781.75	1.40E+01	Pa-234m
95.86	5.04E+01	Th-234	X	301.7	1.76E+00	U-235	783.4	8.90E-01	Pa-234
96.09	3.20E+01	U-235		308.78	1.27E-01	Th-231	786.27	3.59E+00	Pa-234
97.17	7.18E-01	Pa-234		310.2	2.18E-01	Pa-234	786.28	9.79E+01	Pa-234m
98.43	5.74E+01	Pa-234	X	311	1.09E+00	Th-231	792.8	1.32E-01	Pa-234
98.43	1.94E+01	Pa-234m	X	311	1.51E-01	Pa-234m	794.9	2.01E+00	Pa-234
99.28	4.61E+01	Th-231		313.5	3.10E-01	Pa-234	796.1	7.75E+00	Pa-234
99.86	9.47E+00	Pa-234		316.7	3.42E-01	Pa-234m	804.1	1.87E+00	Pa-234
100.89	3.73E-01	Pa-234		316.7	3.10E-01	Pa-234	805.75	1.06E+01	Pa-234m

102.27	1.54E+02	Th-231		317.1	3.52E-01	U-235	805.8	7.46E+00	Pa-234
103.35	5.76E+00	Th-234		320.4	1.55E-01	Pa-234	808.2	5.00E+00	Pa-234m
103.77	7.18E-01	Pa-234		330.4	1.41E+00	Pa-234	808.4	1.09E-01	Pa-234
104.82	2.41E+02	U-235	X	330.4	9.18E-01	Pa-234	811.5	3.73E-01	Pa-234
104.82	5.30E+00	U-234	X	331.4	2.18E-01	Pa-234	814.2	9.18E-01	Pa-234
104.82	2.45E-01	U-238	X	338.1	1.98E+00	Pa-234m	818.2	1.80E+00	Pa-234m
105.6	4.61E+02	U-235	X	340.2	1.26E-01	Pa-234m	819.2	5.68E+00	Pa-234
105.6	1.01E+01	U-234	X	340.2	1.21E-01	Pa-234	825.1	5.68E+00	Pa-234
105.6	4.68E-01	U-238	X	343.5	1.06E+00	U-235	825.6	1.19E+01	Pa-234m
105.81	2.75E+00	Th-231		343.8	1.03E-01	Pa-234	829.3	1.09E+00	Pa-234
106.61	6.20E+00	Th-231		345.92	1.41E+01	U-235	831.5	1.23E+01	Pa-234
106.68	1.09E-01	Pa-234		351.9	1.23E+00	Pa-234	844.1	1.98E+00	Pa-234m
107.6	2.50E+01	Th-231	X	356.03	1.76E+00	U-235	844.1	1.26E+00	Pa-234
107.6	6.12E+00	Th-234	X	357.5	1.44E+00	Pa-234m	851.58	1.24E+01	Pa-234m
108.42	4.75E+01	Th-231	X	357.9	1.09E-01	Pa-234	851.8	2.18E-01	Pa-234
108.42	1.17E+01	Th-234	X	362.8	1.22E+00	Pa-234m	857.7	1.09E-01	Pa-234
108.58	1.76E+02	U-235	X	369.5	7.46E+00	Pa-234	863.2	2.18E-01	Pa-234
108.58	3.85E+00	U-234	X	372	3.65E+00	Pa-234	866.8	2.05E+00	Pa-234m
108.58	1.78E-01	U-238	X	379.1	1.23E-01	Pa-234	869.7	6.03E-01	Pa-234
109.19	5.84E+02	U-235		385.4	1.23E-01	Pa-234	874	1.09E-01	Pa-234
110.42	7.20E+00	Pa-234	X	387.6	1.67E+00	Pa-234m	876	7.61E+00	Pa-234
110.42	2.43E+00	Pa-234m	X	387.6	8.42E-01	Pa-234m	880.5	1.87E+01	Pa-234
111.3	1.38E+01	Pa-234	X	387.84	1.41E+01	U-235	880.5	1.26E+01	Pa-234
111.3	4.68E+00	Pa-234m	X	394.1	2.78E-01	Pa-234	880.9	7.20E+00	Pa-234m
111.49	1.83E+01	Th-231	X	409.8	1.03E+00	Pa-234	883.22	6.30E+00	Pa-234m
111.49	4.50E+00	Th-234	X	410.29	1.06E+00	U-235	883.24	2.87E+01	Pa-234
112.81	3.78E+02	Th-234		416.1	1.09E-01	Pa-234	898.67	9.76E+00	Pa-234
113.5	1.84E+01	U-238		426.95	1.38E+00	Pa-234	904.2	1.03E+00	Pa-234
114.44	5.28E+00	Pa-234	X	433.1	2.78E-01	Pa-234	918.4	2.99E-01	Pa-234
114.44	1.78E+00	Pa-234m	X	446.6	3.42E-01	Pa-234	921.72	2.30E+01	Pa-234m
115.45	1.06E+01	U-235		448.4	3.52E-01	U-235	925	2.35E+01	Pa-234
115.63	3.73E-01	Th-231		450.97	5.60E+00	Pa-234m	926	5.17E+00	Pa-234
116.82	7.81E+00	Th-231		453.58	3.83E+00	Pa-234m	926.61	2.23E+00	Pa-234m
120.35	9.15E+00	U-235		454.95	2.60E-01	U-234	926.72	2.18E+01	Pa-234
120.9	3.64E+02	U-234		456.7	1.30E+00	Pa-234m	935.8	1.98E-01	Pa-234
124.91	2.04E+01	Th-231		458.68	3.42E+00	Pa-234	936.3	1.98E+00	Pa-234m
125.46	2.35E+00	Pa-234		461.5	1.03E-01	Pa-234	941.96	4.54E+00	Pa-234m
131.3	5.42E+01	Pa-234		468	6.60E-01	Pa-234	942	1.38E-01	Pa-234
134.03	8.80E+00	Th-231		468.43	4.12E+00	Pa-234m	945.94	1.82E+01	Pa-234m
134.61	3.42E-01	Pa-234		472.3	1.09E+00	Pa-234	946	4.02E+01	Pa-234
135.66	2.78E+01	Th-231		474.2	1.09E-01	Pa-234	947.7	4.88E+00	Pa-234
136.55	4.22E+00	U-235		475.74	4.30E+00	Pa-234m	952.7	2.47E-01	Pa-234
136.75	1.55E+00	Th-231		478.6	3.73E-01	Pa-234	960	1.44E+00	Pa-234m
140.1	2.30E+00	Pa-234m		481	9.18E-01	Pa-234	960	2.18E-01	Pa-234
140.15	1.52E+00	Pa-234		498	1.87E-01	Pa-234	965.8	1.44E+00	Pa-234
140.54	2.57E-01	Th-231		506.75	3.88E+00	Pa-234	978.2	2.70E-01	Pa-234
140.76	7.04E+01	U-235		507.5	2.83E+00	Pa-234m	980.3	8.04E+00	Pa-234
140.91	9.18E-01	Pa-234		508.2	1.56E-01	U-234	980.3	5.28E+00	Pa-234
142.4	1.76E+00	U-235		509.2	3.78E+00	Pa-234m	981.6	2.18E+00	Pa-234
143.76	3.86E+03	U-235		513.4	2.27E+00	Pa-234	984.2	4.88E+00	Pa-234
143.78	9.47E-01	Pa-234		513.4	1.15E+00	Pa-234	989.5	3.10E-01	Pa-234
145.06	2.01E+00	Th-231		519.6	1.18E+00	Pa-234	994.6	1.87E-01	Pa-234
145.94	1.12E+01	Th-231		521.4	2.24E+00	Pa-234	996.1	1.01E+01	Pa-234m
149.88	2.18E-01	Pa-234		527.9	1.18E+00	Pa-234	997.7	1.38E-01	Pa-234
150.93	3.17E+01	U-235		529.1	2.87E-01	Pa-234	1001.03	1.52E+03	Pa-234m
152.71	1.81E+01	Pa-234		534.1	2.47E-01	Pa-234	1009.9	1.98E-01	Pa-234
159.48	1.95E+00	Pa-234		537.2	2.47E-01	Pa-234	1021.8	4.31E-01	Pa-234
163.1	5.42E+01	Th-231		543.8	4.02E-01	Pa-234	1028.7	1.69E+00	Pa-234
163.36	1.79E+03	U-235		543.98	6.61E+00	Pa-234m	1041.7	2.23E+00	Pa-234m
164.94	1.55E-01	Pa-234		553.7	1.32E-01	Pa-234	1051.4	1.87E-01	Pa-234
165	1.21E+00	Th-231		558	2.78E-01	Pa-234	1059.4	4.10E+00	Pa-234m
165.61	2.18E-01	Pa-234		559.2	2.18E-01	Pa-234	1061.86	3.85E+00	Pa-234m
169.66	4.65E-01	Th-231		562.8	1.09E-01	Pa-234	1073.6	3.10E-01	Pa-234
170.85	1.52E+00	Pa-234		565.2	3.10E+00	Pa-234	1081.9	1.62E+00	Pa-234m
173.3	2.11E+00	U-235		568.9	1.09E+01	Pa-234	1083.2	1.52E+00	Pa-234

Table A2.5. Input peak intensities for the 10 year old commercial enriched uranium between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope	keV	Photons/s	isotope
9.2	1.16E+01	Th-231		173.3	2.11E+00	U-235	559.2	2.18E-01	Pa-234
10.25	1.77E+01	Th-231		174.15	6.27E+00	Th-231	562.8	1.09E-01	Pa-234
11.7	2.38E-01	Ra-223	X	174.55	4.88E-01	Pa-234	565.2	3.10E+00	Pa-234
12.3	7.40E+00	Th-230	X	179.8	1.32E-01	Pa-234	568.9	1.09E+01	Pa-234
12.7	2.41E+00	Pa-231	X	182.62	1.37E+02	U-235	569.5	2.47E+01	Pa-234
13	1.04E+05	U-234	X	183.5	1.16E+01	Th-231	572	1.56E+00	Pa-234m
13	1.31E+04	U-238	X	184.7	3.02E+00	Pa-234m	581.19	1.48E-01	Pa-234m
13	9.50E+03	U-235	X	185.71	2.01E+04	U-235	581.7	1.25E-01	U-234
13.3	2.08E+04	Th-231	X	186.15	5.31E+00	Pa-234	584.1	5.17E-01	Pa-234
13.3	1.28E+04	Th-234	X	188.76	1.16E+00	Th-231	586.3	2.18E-01	Pa-234
13.3	9.72E+01	Pa-234m	X	193.4	1.30E+00	Pa-234m	590.3	1.09E-01	Pa-234
13.6	2.50E+02	Pa-234	X	193.4	1.30E+00	Pa-234m	595.4	2.78E-01	Pa-234
13.6	2.45E+01	Pa-234m	X	193.73	1.49E+00	Pa-234	596.9	6.03E-01	Pa-234
17.2	8.10E+01	Th-231		194.94	2.22E+02	U-235	602.6	1.61E+00	Pa-234
19.1	8.45E+01	Th-231		196.8	2.18E-01	Pa-234	604.6	1.55E-01	Pa-234
19.55	2.22E+04	U-235		198.9	1.27E+01	U-235	612	1.15E+00	Pa-234
20.02	9.00E+00	Th-234		199.9	1.03E+00	Pa-234m	617	1.55E-01	Pa-234
25.64	4.96E+03	Th-231		199.95	2.18E-01	Pa-234	619	1.09E-01	Pa-234
27.36	7.67E-01	Pa-231		200.97	2.70E+00	Pa-234	624.2	1.06E+00	Pa-234
29.49	2.16E+00	Th-234		202.12	3.80E+02	U-235	624.6	2.07E-01	Pa-234m
31.6	5.98E+00	U-235		203.12	3.70E+00	Pa-234	628.1	7.18E-01	Pa-234
34.7	1.30E+01	U-235		203.3	3.06E+00	Pa-234m	629.4	1.06E+00	Pa-234
41.4	1.06E+01	U-235		205.32	1.77E+03	U-235	632.6	1.09E-01	Pa-234
41.96	2.11E+01	U-235		209.9	2.43E+00	Pa-234m	634.3	4.02E-01	Pa-234
42.86	2.08E+01	Th-231		215.28	1.02E+01	U-235	646.5	3.42E-01	Pa-234
43.49	3.73E-01	Pa-234		217.94	1.39E+01	Th-231	649	1.80E+00	Pa-234m
44.08	2.46E-01	Th-231		220	4.31E-01	Pa-234	653.7	1.41E+00	Pa-234
49.55	1.15E+02	U-238		221.15	1.55E-01	Pa-234	655.2	4.02E-01	Pa-234
51.21	1.20E+01	U-235		221.39	4.15E+01	U-235	655.3	2.48E+00	Pa-234m
53.2	1.28E+03	U-234		221.83	2.18E-01	Pa-234	657.4	1.18E+00	Pa-234
54.1	1.76E-01	U-235		226.5	1.26E+01	Pa-234	663.9	1.61E+00	Pa-234
54.25	5.28E+00	U-235		227.25	1.72E+01	Pa-234	666.5	3.50E+00	Pa-234
58.57	1.63E+02	Th-231		228.78	2.46E+00	U-235	669.7	2.99E+00	Pa-234
59.19	9.47E-02	Pa-234		232.21	5.17E-01	Pa-234	670.8	6.66E-01	Pa-234m
62.7	4.59E+00	Pa-234		233.5	1.34E+01	U-235	673.9	1.17E+00	Pa-234m
62.7	2.16E+00	Pa-234m		235.11	3.42E-01	Pa-234	675.1	3.01E-01	Pa-234
62.86	2.88E+01	Th-234		235.9	1.44E-01	Pa-234m	683.4	1.03E+00	Pa-234m
63.29	6.66E+03	Th-234		235.96	1.34E-01	Th-227	683.9	4.59E-01	Pa-234
63.86	8.10E+00	Th-231		236.01	3.24E+00	Th-231	685.1	4.31E-01	Pa-234
64.45	4.58E+00	U-235		240.2	1.55E-01	Pa-234	691	1.61E+01	Pa-234m
67.25	1.09E-01	Pa-234		240.27	1.02E-01	Th-231	692.6	3.73E+00	Pa-234
67.67	3.65E-01	Th-230		240.88	2.61E+01	U-235	695.5	2.92E+00	Pa-234m
68.5	2.04E+00	Th-231		242.5	2.92E-01	Th-231	699.02	1.03E+01	Pa-234m
72.7	4.22E+01	U-235		245.37	2.27E+00	Pa-234	699.03	1.09E+01	Pa-234
72.75	8.87E+01	Th-231		246.83	1.94E+01	U-235	702	1.30E+01	Pa-234m
73.92	2.34E+01	Th-234		247.7	4.39E-01	Pa-234m	705.9	6.83E+00	Pa-234
73.92	2.34E+01	Pa-234m		249.22	7.46E+00	Pa-234	705.94	1.01E+01	Pa-234m
74.94	1.80E+01	U-235		249.6	2.78E-01	Th-231	708.2	1.21E+00	Pa-234m
77.69	1.48E+00	Th-231		250.45	2.32E-01	Th-231	713.7	4.31E-01	Pa-234
79.84	1.87E-01	Pa-234		257.2	1.55E-01	Pa-234	727.8	3.42E-01	Pa-234
81.07	1.56E-01	Ra-223	X	258.23	1.38E+02	Pa-234m	730.9	1.89E+00	Pa-234
81.23	3.17E+02	Th-231		266.45	2.11E+00	U-235	732.5	2.34E+00	Pa-234m
82.09	1.48E+02	Th-231		267.12	5.17E-01	Pa-234	733.39	2.07E+01	Pa-234
83.3	1.08E+02	Th-234		267.62	4.40E-01	Th-231	738	3.47E+00	Pa-234
83.79	2.57E-01	Ra-223	X	269.46	1.45E-01	Ra-223	740.1	1.96E+01	Pa-234m
84.21	2.32E+03	Th-231		271.23	1.12E-01	Rn-219	742.81	1.92E+02	Pa-234m
89.95	3.52E+02	Th-231		272.28	3.24E+00	Pa-234	742.81	6.20E+00	Pa-234
89.96	1.21E+03	U-235	X	275.04	2.78E-01	Pa-234	745.9	9.47E-01	Pa-234
89.96	2.70E+01	U-234	X	275.35	1.80E+01	U-235	748.1	3.10E-01	Pa-234
89.96	1.22E+00	U-238	X	275.49	1.13E+01	U-235	755	3.65E+00	Pa-234
92.28	1.23E+02	Th-231	X	275.5	5.58E-01	Pa-234m	758.9	7.46E-01	Pa-234
92.28	3.08E+01	Th-234	X	278.3	1.23E-01	Pa-234	761	2.18E-01	Pa-234
92.38	3.83E+03	Th-234		281.42	2.11E+00	U-235	764.8	6.03E-01	Pa-234
92.8	3.78E+03	Th-234		282.92	2.11E+00	U-235	766.4	2.30E-01	Pa-234
93.02	1.65E+01	Th-231		283.69	1.27E-01	Pa-231	766.42	5.71E+02	Pa-234m

93.35	1.95E+03	U-235	X	289.56	2.46E+00	U-235	769.1	5.57E-01	Pa-234
93.35	4.26E+01	U-234	X	291.65	1.41E+01	U-235	772.4	2.18E-01	Pa-234
93.35	1.98E+00	U-238	X	293.79	8.90E+00	Pa-234	780.4	2.70E+00	Pa-234
94.65	3.59E+01	Pa-234	X	295.91	4.31E-01	Pa-234	781.75	1.40E+01	Pa-234m
94.65	1.21E+01	Pa-234m	X	299	1.17E+00	Pa-234m	783.4	8.90E-01	Pa-234
95.86	2.01E+02	Th-231	X	300.07	1.84E-01	Pa-231	786.27	3.59E+00	Pa-234
95.86	5.04E+01	Th-234	X	301.7	1.76E+00	U-235	786.28	9.79E+01	Pa-234m
96.09	3.20E+01	U-235		302.65	1.64E-01	Pa-231	792.8	1.32E-01	Pa-234
97.17	7.18E-01	Pa-234		308.78	1.27E-01	Th-231	794.9	2.01E+00	Pa-234
98.43	5.74E+01	Pa-234	X	310.2	2.18E-01	Pa-234	796.1	7.75E+00	Pa-234
98.43	1.94E+01	Pa-234m	X	311	1.09E+00	Th-231	804.1	1.87E+00	Pa-234
99.28	4.61E+01	Th-231		311	1.51E-01	Pa-234m	805.75	1.06E+01	Pa-234m
99.86	9.47E+00	Pa-234		313.5	3.10E-01	Pa-234	805.8	7.46E+00	Pa-234
100.89	3.73E-01	Pa-234		316.7	3.42E-01	Pa-234m	808.2	5.00E+00	Pa-234m
102.27	1.54E+02	Th-231		316.7	3.10E-01	Pa-234	808.4	1.09E-01	Pa-234
103.35	5.76E+00	Th-234		317.1	3.52E-01	U-235	811.5	3.73E-01	Pa-234
103.77	7.18E-01	Pa-234		320.4	1.55E-01	Pa-234	814.2	9.18E-01	Pa-234
104.82	2.41E+02	U-235	X	330.06	1.04E-01	Pa-231	818.2	1.80E+00	Pa-234m
104.82	5.30E+00	U-234	X	330.4	1.41E+00	Pa-234	819.2	5.68E+00	Pa-234
104.82	2.45E-01	U-238	X	330.4	9.18E-01	Pa-234	825.1	5.68E+00	Pa-234
105.6	4.61E+02	U-235	X	331.4	2.18E-01	Pa-234	825.6	1.19E+01	Pa-234m
105.6	1.01E+01	U-234	X	338.1	1.98E+00	Pa-234m	829.3	1.09E+00	Pa-234
105.6	4.68E-01	U-238	X	340.2	1.26E-01	Pa-234m	831.5	1.23E+01	Pa-234
105.81	2.75E+00	Th-231		340.2	1.21E-01	Pa-234	844.1	1.98E+00	Pa-234m
106.61	6.20E+00	Th-231		343.5	1.06E+00	U-235	844.1	1.26E+00	Pa-234
106.68	1.09E-01	Pa-234		343.8	1.03E-01	Pa-234	851.58	1.24E+01	Pa-234m
107.6	2.50E+01	Th-231	X	345.92	1.41E+01	U-235	851.8	2.18E-01	Pa-234
107.6	6.12E+00	Th-234	X	351.07	1.35E-01	Bi-211	857.7	1.09E-01	Pa-234
108.42	4.75E+01	Th-231	X	351.9	1.23E+00	Pa-234	863.2	2.18E-01	Pa-234
108.42	1.17E+01	Th-234	X	356.03	1.76E+00	U-235	866.8	2.05E+00	Pa-234m
108.58	1.76E+02	U-235	X	357.5	1.44E+00	Pa-234m	869.7	6.03E-01	Pa-234
108.58	3.85E+00	U-234	X	357.9	1.09E-01	Pa-234	874	1.09E-01	Pa-234
108.58	1.78E-01	U-238	X	362.8	1.22E+00	Pa-234m	876	7.61E+00	Pa-234
109.19	5.84E+02	U-235		369.5	7.46E+00	Pa-234	880.5	1.87E+01	Pa-234
110.42	7.20E+00	Pa-234	X	372	3.65E+00	Pa-234	880.5	1.26E+01	Pa-234
110.42	2.43E+00	Pa-234m	X	379.1	1.23E-01	Pa-234	880.9	7.20E+00	Pa-234m
111.3	1.38E+01	Pa-234	X	385.4	1.23E-01	Pa-234	883.22	6.30E+00	Pa-234m
111.3	4.68E+00	Pa-234m	X	387.6	1.67E+00	Pa-234m	883.24	2.87E+01	Pa-234
111.49	1.83E+01	Th-231	X	387.6	8.42E-01	Pa-234m	898.67	9.76E+00	Pa-234
111.49	4.50E+00	Th-234	X	387.84	1.41E+01	U-235	904.2	1.03E+00	Pa-234
112.81	3.78E+02	Th-234		394.1	2.78E-01	Pa-234	918.4	2.99E-01	Pa-234
113.5	1.84E+01	U-238		409.8	1.03E+00	Pa-234	921.72	2.30E+01	Pa-234m
114.44	5.28E+00	Pa-234	X	410.29	1.06E+00	U-235	925	2.35E+01	Pa-234
114.44	1.78E+00	Pa-234m	X	416.1	1.09E-01	Pa-234	926	5.17E+00	Pa-234
115.45	1.06E+01	U-235		426.95	1.38E+00	Pa-234	926.61	2.23E+00	Pa-234m
115.63	3.73E-01	Th-231		433.1	2.78E-01	Pa-234	926.72	2.18E+01	Pa-234
116.82	7.81E+00	Th-231		446.6	3.42E-01	Pa-234	935.8	1.98E-01	Pa-234
120.35	9.15E+00	U-235		448.4	3.52E-01	U-235	936.3	1.98E+00	Pa-234m
120.9	3.64E+02	U-234		450.97	5.60E+00	Pa-234m	941.96	4.54E+00	Pa-234m
124.91	2.04E+01	Th-231		453.58	3.83E+00	Pa-234m	942	1.38E-01	Pa-234
125.46	2.35E+00	Pa-234		454.95	2.60E-01	U-234	945.94	1.82E+01	Pa-234m
131.3	5.42E+01	Pa-234		456.7	1.30E+00	Pa-234m	946	4.02E+01	Pa-234
134.03	8.80E+00	Th-231		458.68	3.42E+00	Pa-234	947.7	4.88E+00	Pa-234
134.61	3.42E-01	Pa-234		461.5	1.03E-01	Pa-234	952.7	2.47E-01	Pa-234
135.66	2.78E+01	Th-231		468	6.60E-01	Pa-234	960	1.44E+00	Pa-234m
136.55	4.22E+00	U-235		468.43	4.12E+00	Pa-234m	960	2.18E-01	Pa-234
136.75	1.55E+00	Th-231		472.3	1.09E+00	Pa-234	965.8	1.44E+00	Pa-234
140.1	2.30E+00	Pa-234m		474.2	1.09E-01	Pa-234	978.2	2.70E-01	Pa-234
140.15	1.52E+00	Pa-234		475.74	4.30E+00	Pa-234m	980.3	8.04E+00	Pa-234
140.54	2.57E-01	Th-231		478.6	3.73E-01	Pa-234	980.3	5.28E+00	Pa-234
140.76	7.04E+01	U-235		481	9.18E-01	Pa-234	981.6	2.18E+00	Pa-234
140.91	9.18E-01	Pa-234		498	1.87E-01	Pa-234	984.2	4.88E+00	Pa-234
142.4	1.76E+00	U-235		506.75	3.88E+00	Pa-234	989.5	3.10E-01	Pa-234
143.76	3.86E+03	U-235		507.5	2.83E+00	Pa-234m	994.6	1.87E-01	Pa-234
143.78	9.47E-01	Pa-234		508.2	1.56E-01	U-234	996.1	1.01E+01	Pa-234m
145.06	2.01E+00	Th-231		509.2	3.78E+00	Pa-234m	997.7	1.38E-01	Pa-234
145.94	1.12E+01	Th-231		513.4	2.27E+00	Pa-234	1001.03	1.52E+03	Pa-234m
149.88	2.18E-01	Pa-234		513.4	1.15E+00	Pa-234	1009.9	1.98E-01	Pa-234
150.93	3.17E+01	U-235		519.6	1.18E+00	Pa-234	1021.8	4.31E-01	Pa-234
152.71	1.81E+01	Pa-234		521.4	2.24E+00	Pa-234	1028.7	1.69E+00	Pa-234

159.48	1.95E+00	Pa-234	527.9	1.18E+00	Pa-234	1041.1	9.47E-02	Pa-234
163.1	5.42E+01	Th-231	529.1	2.87E-01	Pa-234	1041.7	2.23E+00	Pa-234m
163.36	1.79E+03	U-235	534.1	2.47E-01	Pa-234	1051.4	1.87E-01	Pa-234
164.94	1.55E-01	Pa-234	537.2	2.47E-01	Pa-234	1059.4	4.10E+00	Pa-234m
165	1.21E+00	Th-231	543.8	4.02E-01	Pa-234	1061.86	3.85E+00	Pa-234m
165.61	2.18E-01	Pa-234	543.98	6.61E+00	Pa-234m	1073.6	3.10E-01	Pa-234
169.66	4.65E-01	Th-231	553.7	1.32E-01	Pa-234	1081.9	1.62E+00	Pa-234m
170.85	1.52E+00	Pa-234	558	2.78E-01	Pa-234	1083.2	1.52E+00	Pa-234

Table A2.6. Input peak intensities for the 50 year old commercial enriched uranium between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope	keV	Photons/s	isotope
9.2	1.16E+01	Th-231		158.63	1.29E-01	Ra-223	509.2	3.78E+00	Pa-234m
10.25	1.77E+01	Th-231		159.48	1.95E+00	Pa-234	513.4	2.27E+00	Pa-234
10.8	6.19E-01	Pb-214	X	163.1	5.42E+01	Th-231	513.4	1.15E+00	Pa-234
10.8	4.31E-01	Pb-210	X	163.36	1.79E+03	U-235	519.6	1.18E+00	Pa-234
11.1	1.89E-01	Rn-219	X	164.94	1.55E-01	Pa-234	521.4	2.24E+00	Pa-234
11.7	4.24E+00	Ra-223	X	165	1.21E+00	Th-231	527.9	1.18E+00	Pa-234
12.3	3.70E+01	Th-230	X	165.61	2.18E-01	Pa-234	529.1	2.87E-01	Pa-234
12.7	1.21E+01	Pa-231	X	169.66	4.65E-01	Th-231	534.1	2.47E-01	Pa-234
13	1.04E+05	U-234	X	170.85	1.52E+00	Pa-234	537.2	2.47E-01	Pa-234
13	1.31E+04	U-238	X	173.3	2.11E+00	U-235	543.8	4.02E-01	Pa-234
13	9.50E+03	U-235	X	174.15	6.27E+00	Th-231	543.98	6.61E+00	Pa-234m
13	6.44E-01	Ac-227	X	174.55	4.88E-01	Pa-234	553.7	1.32E-01	Pa-234
13.3	2.08E+04	Th-231	X	179.8	1.32E-01	Pa-234	558	2.78E-01	Pa-234
13.3	1.28E+04	Th-234	X	182.62	1.37E+02	U-235	559.2	2.18E-01	Pa-234
13.3	9.72E+01	Pa-234m	X	183.5	1.16E+01	Th-231	562.8	1.09E-01	Pa-234
13.6	2.50E+02	Pa-234	X	184.7	3.02E+00	Pa-234m	565.2	3.10E+00	Pa-234
13.6	2.45E+01	Pa-234m	X	185.71	2.01E+04	U-235	568.9	1.09E+01	Pa-234
16.5	1.12E-01	Pa-231		186.15	5.31E+00	Pa-234	569.5	2.47E+01	Pa-234
17.2	8.10E+01	Th-231		186.21	1.88E-01	Ra-226	572	1.56E+00	Pa-234m
19	1.41E-01	Pa-231		188.76	1.16E+00	Th-231	581.19	1.48E-01	Pa-234m
19.1	8.45E+01	Th-231		193.4	1.30E+00	Pa-234m	581.7	1.25E-01	U-234
19.55	2.22E+04	U-235		193.4	1.30E+00	Pa-234m	584.1	5.17E-01	Pa-234
20.02	9.00E+00	Th-234		193.73	1.49E+00	Pa-234	586.3	2.18E-01	Pa-234
25.64	4.96E+03	Th-231		194.94	2.22E+02	U-235	590.3	1.09E-01	Pa-234
27.36	3.83E+00	Pa-231		196.8	2.18E-01	Pa-234	595.4	2.78E-01	Pa-234
29.49	2.16E+00	Th-234		198.9	1.27E+01	U-235	596.9	6.03E-01	Pa-234
31.6	5.98E+00	U-235		199.9	1.03E+00	Pa-234m	602.6	1.61E+00	Pa-234
34.7	1.30E+01	U-235		199.95	2.18E-01	Pa-234	604.6	1.55E-01	Pa-234
41.4	1.06E+01	U-235		200.97	2.70E+00	Pa-234	609.32	2.35E+00	Bi-214
41.96	2.11E+01	U-235		202.12	3.80E+02	U-235	612	1.15E+00	Pa-234
42.86	2.08E+01	Th-231		203.12	3.70E+00	Pa-234	617	1.55E-01	Pa-234
43.49	3.73E-01	Pa-234		203.3	3.06E+00	Pa-234m	619	1.09E-01	Pa-234
44.08	2.46E-01	Th-231		205.32	1.77E+03	U-235	624.2	1.06E+00	Pa-234
49.55	1.15E+02	U-238		209.9	2.43E+00	Pa-234m	624.6	2.07E-01	Pa-234m
50.13	1.54E+00	Th-227		210.62	2.29E-01	Th-227	628.1	7.18E-01	Pa-234
51.21	1.20E+01	U-235		215.28	1.02E+01	U-235	629.4	1.06E+00	Pa-234
53.2	1.28E+03	U-234		217.94	1.39E+01	Th-231	632.6	1.09E-01	Pa-234
54.1	1.76E-01	U-235		220	4.31E-01	Pa-234	634.3	4.02E-01	Pa-234
54.25	5.28E+00	U-235		221.15	1.55E-01	Pa-234	646.5	3.42E-01	Pa-234
58.57	1.63E+02	Th-231		221.39	4.15E+01	U-235	649	1.80E+00	Pa-234m
62.7	4.59E+00	Pa-234		221.83	2.18E-01	Pa-234	653.7	1.41E+00	Pa-234
62.7	2.16E+00	Pa-234m		226.5	1.26E+01	Pa-234	655.2	4.02E-01	Pa-234
62.86	2.88E+01	Th-234		227.25	1.72E+01	Pa-234	655.3	2.48E+00	Pa-234m
63.29	6.66E+03	Th-234		228.78	2.46E+00	U-235	657.4	1.18E+00	Pa-234
63.86	8.10E+00	Th-231		232.21	5.17E-01	Pa-234	663.9	1.61E+00	Pa-234
64.45	4.58E+00	U-235		233.5	1.34E+01	U-235	666.5	3.50E+00	Pa-234
67.25	1.09E-01	Pa-234		235.11	3.42E-01	Pa-234	669.7	2.99E+00	Pa-234
67.67	1.82E+00	Th-230		235.9	1.44E-01	Pa-234m	670.8	6.66E-01	Pa-234m
68.5	2.04E+00	Th-231		235.96	2.36E+00	Th-227	673.9	1.17E+00	Pa-234m
72.7	4.22E+01	U-235		236.01	3.24E+00	Th-231	675.1	3.01E-01	Pa-234
72.75	8.87E+01	Th-231		240.2	1.55E-01	Pa-234	683.4	1.03E+00	Pa-234m
73.92	2.34E+01	Th-234		240.27	1.02E-01	Th-231	683.9	4.59E-01	Pa-234
73.92	2.34E+01	Pa-234m		240.88	2.61E+01	U-235	685.1	4.31E-01	Pa-234
74.82	2.99E-01	Pb-214	X	241.99	3.74E-01	Pb-214	691	1.61E+01	Pa-234m
74.94	1.80E+01	U-235		242.5	2.92E-01	Th-231	692.6	3.73E+00	Pa-234
77.11	5.01E-01	Pb-214	X	245.37	2.27E+00	Pa-234	695.5	2.92E+00	Pa-234m
77.69	1.48E+00	Th-231		246.83	1.94E+01	U-235	699.02	1.03E+01	Pa-234m
79.29	1.65E-01	Rn-219	X	247.7	4.39E-01	Pa-234m	699.03	1.09E+01	Pa-234
79.69	3.57E-01	Th-227		249.22	7.46E+00	Pa-234	702	1.30E+01	Pa-234m
79.84	1.87E-01	Pa-234		249.6	2.78E-01	Th-231	705.9	6.83E+00	Pa-234
81.07	2.78E+00	Ra-223	X	250.45	2.32E-01	Th-231	705.94	1.01E+01	Pa-234m
81.23	3.17E+02	Th-231		254.63	1.30E-01	Th-227	708.2	1.21E+00	Pa-234m
82.09	1.48E+02	Th-231		256.23	1.28E+00	Th-227	713.7	4.31E-01	Pa-234
83.3	1.08E+02	Th-234		257.2	1.55E-01	Pa-234	727.8	3.42E-01	Pa-234
83.79	4.57E+00	Ra-223	X	258.23	1.38E+02	Pa-234m	730.9	1.89E+00	Pa-234
84.21	2.32E+03	Th-231		266.45	2.11E+00	U-235	732.5	2.34E+00	Pa-234m
85.43	2.45E-01	Th-227	X	267.12	5.17E-01	Pa-234	733.39	2.07E+01	Pa-234
87.35	1.16E-01	Pb-214	X	267.62	4.40E-01	Th-231	738	3.47E+00	Pa-234
87.68	2.79E-01	Pa-231	X	269.46	2.57E+00	Ra-223	740.1	1.96E+01	Pa-234m
88.47	3.99E-01	Th-227	X	271.23	2.00E+00	Rn-219	742.81	1.92E+02	Pa-234m
89.95	3.52E+02	Th-231		272.28	3.24E+00	Pa-234	742.81	6.20E+00	Pa-234
89.96	1.21E+03	U-235	X	275.04	2.78E-01	Pa-234	745.9	9.47E-01	Pa-234
89.96	2.70E+01	U-234	X	275.35	1.80E+01	U-235	748.1	3.10E-01	Pa-234
89.96	1.22E+00	U-238	X	275.49	1.13E+01	U-235	755	3.65E+00	Pa-234
90.89	4.54E-01	Pa-231	X	275.5	5.58E-01	Pa-234m	758.9	7.46E-01	Pa-234

92.28	1.23E+02	Th-231	X	278.3	1.23E-01	Pa-234		761	2.18E-01	Pa-234
92.28	3.08E+01	Th-234	X	281.42	2.11E+00	U-235		764.8	6.03E-01	Pa-234
92.38	3.83E+03	Th-234		282.92	2.11E+00	U-235		766.4	2.30E-01	Pa-234
92.8	3.78E+03	Th-234		283.69	6.32E-01	Pa-231		766.42	5.71E+02	Pa-234m
93.02	1.65E+01	Th-231		286.09	3.18E-01	Th-227		766.51	1.14E-01	Pb-211
93.35	1.95E+03	U-235	X	289.56	2.46E+00	U-235		768.36	2.53E-01	Bi-214
93.35	4.26E+01	U-234	X	289.59	3.48E-01	Th-227		769.1	5.57E-01	Pa-234
93.35	1.98E+00	U-238	X	291.65	1.41E+01	U-235		772.4	2.18E-01	Pa-234
93.88	2.76E-01	Th-227		293.79	8.90E+00	Pa-234		780.4	2.70E+00	Pa-234
94.25	5.51E-01	Ra-223	X	295.22	9.51E-01	Pb-214		781.75	1.40E+01	Pa-234m
94.65	3.59E+01	Pa-234	X	295.91	4.31E-01	Pa-234		783.4	8.90E-01	Pa-234
94.65	1.21E+01	Pa-234m	X	299	1.17E+00	Pa-234m		786.27	3.59E+00	Pa-234
94.87	1.05E+00	Ra-223	X	299.98	4.04E-01	Th-227		786.28	9.79E+01	Pa-234m
95.86	2.01E+02	Th-231	X	300.07	9.19E-01	Pa-231		792.8	1.32E-01	Pa-234
95.86	5.04E+01	Th-234	X	301.7	1.76E+00	U-235		794.9	2.01E+00	Pa-234
96.09	3.20E+01	U-235		302.65	8.18E-01	Pa-231		796.1	7.75E+00	Pa-234
97.17	7.18E-01	Pa-234		302.65	2.53E-01	Pa-231		804.1	1.87E+00	Pa-234
97.53	3.96E-01	Ra-223	X	304.5	2.11E-01	Th-227		805.75	1.06E+01	Pa-234m
98.43	5.74E+01	Pa-234	X	308.78	1.27E-01	Th-231		805.8	7.46E+00	Pa-234
98.43	1.94E+01	Pa-234m	X	310.2	2.18E-01	Pa-234		808.2	5.00E+00	Pa-234m
99.28	4.61E+01	Th-231		311	1.09E+00	Th-231		808.4	1.09E-01	Pa-234
99.86	9.47E+00	Pa-234		311	1.51E-01	Pa-234m		811.5	3.73E-01	Pa-234
100.89	3.73E-01	Pa-234		313.5	3.10E-01	Pa-234		814.2	9.18E-01	Pa-234
102.27	1.54E+02	Th-231		316.7	3.42E-01	Pa-234m		818.2	1.80E+00	Pa-234m
102.84	1.06E-01	Pa-231	X	316.7	3.10E-01	Pa-234		819.2	5.68E+00	Pa-234
103.35	5.76E+00	Th-234		317.1	3.52E-01	U-235		825.1	5.68E+00	Pa-234
103.77	7.18E-01	Pa-234		320.4	1.55E-01	Pa-234		825.6	1.19E+01	Pa-234m
104.82	2.41E+02	U-235	X	323.87	7.38E-01	Ra-223		829.3	1.09E+00	Pa-234
104.82	5.30E+00	U-234	X	329.85	5.31E-01	Th-227		831.5	1.23E+01	Pa-234
104.82	2.45E-01	U-238	X	330.06	5.21E-01	Pa-231		832.01	6.51E-01	Pb-211
105.6	4.61E+02	U-235	X	330.4	1.41E+00	Pa-234		844.1	1.98E+00	Pa-234m
105.6	1.01E+01	U-234	X	330.4	9.18E-01	Pa-234		844.1	1.26E+00	Pa-234
105.6	4.68E-01	U-238	X	331.4	2.18E-01	Pa-234		851.58	1.24E+01	Pa-234m
105.81	2.75E+00	Th-231		334.37	2.09E-01	Th-227		851.8	2.18E-01	Pa-234
106.61	6.20E+00	Th-231		338.1	1.98E+00	Pa-234m		857.7	1.09E-01	Pa-234
106.68	1.09E-01	Pa-234		338.28	5.25E-01	Ra-223		863.2	2.18E-01	Pa-234
107.6	2.50E+01	Th-231	X	340.2	1.26E-01	Pa-234m		866.8	2.05E+00	Pa-234m
107.6	6.12E+00	Th-234	X	340.2	1.21E-01	Pa-234		869.7	6.03E-01	Pa-234
108.42	4.75E+01	Th-231	X	343.5	1.06E+00	U-235		874	1.09E-01	Pa-234
108.42	1.17E+01	Th-234	X	343.8	1.03E-01	Pa-234		876	7.61E+00	Pa-234
108.58	1.76E+02	U-235	X	345.92	1.41E+01	U-235		880.5	1.87E+01	Pa-234
108.58	3.85E+00	U-234	X	351.07	2.41E+00	Bi-211		880.5	1.26E+01	Pa-234
108.58	1.78E-01	U-238	X	351.9	1.23E+00	Pa-234		880.9	7.20E+00	Pa-234m
109.19	5.84E+02	U-235		351.93	1.84E+00	Pb-214		883.22	6.30E+00	Pa-234m
110.42	7.20E+00	Pa-234	X	356.03	1.76E+00	U-235		883.24	2.87E+01	Pa-234
110.42	2.43E+00	Pa-234m	X	357.5	1.44E+00	Pa-234m		898.67	9.76E+00	Pa-234
111.3	1.38E+01	Pa-234	X	357.9	1.09E-01	Pa-234		904.2	1.03E+00	Pa-234
111.3	4.68E+00	Pa-234m	X	362.8	1.22E+00	Pa-234m		918.4	2.99E-01	Pa-234
111.49	1.83E+01	Th-231	X	369.5	7.46E+00	Pa-234		921.72	2.30E+01	Pa-234m
111.49	4.50E+00	Th-234	X	372	3.65E+00	Pa-234		925	2.35E+01	Pa-234
112.81	3.78E+02	Th-234		379.1	1.23E-01	Pa-234		926	5.17E+00	Pa-234
113.5	1.84E+01	U-238		385.4	1.23E-01	Pa-234		926.61	2.23E+00	Pa-234m
114.44	5.28E+00	Pa-234	X	387.6	1.67E+00	Pa-234m		926.72	2.18E+01	Pa-234
114.44	1.78E+00	Pa-234m	X	387.6	8.42E-01	Pa-234m		934.06	1.60E-01	Bi-214
115.45	1.06E+01	U-235		387.84	1.41E+01	U-235		935.8	1.98E-01	Pa-234
115.63	3.73E-01	Th-231		394.1	2.78E-01	Pa-234		936.3	1.98E+00	Pa-234m
116.82	7.81E+00	Th-231		401.81	1.22E+00	Rn-219		941.96	4.54E+00	Pa-234m
120.35	9.15E+00	U-235		404.85	6.99E-01	Pb-211		942	1.38E-01	Pa-234
120.9	3.64E+02	U-234		409.8	1.03E+00	Pa-234		945.94	1.82E+01	Pa-234m
122.32	2.24E-01	Ra-223		410.29	1.06E+00	U-235		946	4.02E+01	Pa-234
124.91	2.04E+01	Th-231		416.1	1.09E-01	Pa-234		947.7	4.88E+00	Pa-234
125.46	2.35E+00	Pa-234		426.95	1.38E+00	Pa-234		952.7	2.47E-01	Pa-234
131.3	5.42E+01	Pa-234		427.09	3.26E-01	Pb-211		960	1.44E+00	Pa-234m
134.03	8.80E+00	Th-231		433.1	2.78E-01	Pa-234		960	2.18E-01	Pa-234
134.61	3.42E-01	Pa-234		445.03	2.39E-01	Ra-223		965.8	1.44E+00	Pa-234
135.66	2.78E+01	Th-231		446.6	3.42E-01	Pa-234		978.2	2.70E-01	Pa-234
136.55	4.22E+00	U-235		448.4	3.52E-01	U-235		980.3	8.04E+00	Pa-234
136.75	1.55E+00	Th-231		450.97	5.60E+00	Pa-234m		980.3	5.28E+00	Pa-234
140.1	2.30E+00	Pa-234m		453.58	3.83E+00	Pa-234m		981.6	2.18E+00	Pa-234
140.15	1.52E+00	Pa-234		454.95	2.60E-01	U-234		984.2	4.88E+00	Pa-234
140.54	2.57E-01	Th-231		456.7	1.30E+00	Pa-234m		989.5	3.10E-01	Pa-234
140.76	7.04E+01	U-235		458.68	3.42E+00	Pa-234		994.6	1.87E-01	Pa-234
140.91	9.18E-01	Pa-234		461.5	1.03E-01	Pa-234		996.1	1.01E+01	Pa-234m
142.4	1.76E+00	U-235		468	6.60E-01	Pa-234		997.7	1.38E-01	Pa-234
143.76	3.86E+03	U-235		468.43	4.12E+00	Pa-234m		1001.03	1.52E+03	Pa-234m
143.78	9.47E-01	Pa-234		472.3	1.09E+00	Pa-234		1009.9	1.98E-01	Pa-234
143.87	2.35E-01	Th-230		474.2	1.09E-01	Pa-234		1021.8	4.31E-01	Pa-234
144.24	6.05E-01	Ra-223		475.74	4.30E+00	Pa-234m		1028.7	1.69E+00	Pa-234
145.06	2.01E+00	Th-231		478.6	3.73E-01	Pa-234		1041.7	2.23E+00	Pa-234m
145.94	1.12E+01	Th-231		481	9.18E-01	Pa-234		1051.4	1.87E-01	Pa-234

149.88	2.18E-01	Pa-234	498	1.87E-01	Pa-234	1059.4	4.10E+00	Pa-234m
150.93	3.17E+01	U-235	506.75	3.88E+00	Pa-234	1061.86	3.85E+00	Pa-234m
152.71	1.81E+01	Pa-234	507.5	2.83E+00	Pa-234m	1073.6	3.10E-01	Pa-234
154.21	1.06E+00	Ra-223	508.2	1.56E-01	U-234	1081.9	1.62E+00	Pa-234m

Table A2.7. Input peak intensities for the 1 year old fuel grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
12.98	7.31E+03	Pu-239		110.42	5.13E-01	Pu-240	X	311.78	5.11E+00	Pu-239
13.6	9.70E+05	Pu-240	X	111.3	6.88E+02	Pu-241	X	316.41	2.61E+00	Pu-239
13.6	8.49E+05	Pu-239	X	111.3	2.63E+02	Pu-239	X	319.68	9.50E-01	Pu-239
13.6	6.42E+05	Pu-238	X	111.3	1.38E+00	Pu-238	X	320.86	1.07E+01	Pu-239
13.6	7.29E+03	Pu-241	X	111.3	9.70E-01	Pu-240	X	322.52	1.46E+00	Am-241
13.6	2.47E+02	Pu-242	X	113.3	4.39E+02	U-237	X	323.84	1.07E+01	Pu-239
13.81	1.42E+01	U-237		113.3	2.17E+00	Am-241	X	332.35	1.72E+02	U-237
13.9	3.54E+05	Am-241	X	114	4.72E+02	Pu-241		332.35	1.43E+00	Am-241
13.9	8.87E+03	U-237	X	114.23	8.31E+02	U-237	X	332.85	9.78E+01	Pu-239
26.34	2.17E+04	Am-241		114.23	4.12E+00	Am-241	X	335.37	1.36E+01	U-237
26.34	3.48E+02	U-237		114.44	2.68E+02	Pu-241	X	335.37	4.75E+00	Am-241
26.7	5.83E+02	Pu-241		114.44	1.03E+02	Pu-239	X	336.11	2.22E+01	Pu-239
30.04	4.30E+01	Pu-239		114.44	5.36E-01	Pu-238	X	337.7	1.27E+00	U-237
33.2	1.21E+03	Am-241		114.44	3.77E-01	Pu-240	X	341.51	1.31E+01	Pu-239
33.2	1.86E+01	U-237		115.38	9.11E+01	Pu-239		345.01	1.10E+02	Pu-239
38.54	5.72E+01	U-237		116.26	1.12E+02	Pu-239		345.01	5.94E+00	Pu-239
38.66	2.07E+03	Pu-239		117.46	3.25E+02	U-237	X	354	1.39E-01	Pu-239
41.93	2.89E+01	Pu-239		117.46	1.61E+00	Am-241	X	361.89	2.42E+00	Pu-239
42.7	5.26E+01	Am-241		119.7	4.16E+00	Pu-239		367.07	1.76E+01	Pu-239
43.42	6.99E+02	Am-241		119.7	1.88E+00	Pu-239		368.55	1.74E+01	Pu-239
43.42	3.43E+00	U-237		121.2	4.00E+00	Pu-241		368.62	5.61E+00	U-237
43.5	2.47E+03	Pu-238		122.35	1.88E-01	Pu-239		368.65	2.08E+00	Am-241
44.2	2.43E+01	Pu-241		123.05	9.57E+00	Am-241		370.94	1.53E+01	U-237
44.86	4.86E+00	Pu-241		123.62	4.69E+00	Pu-239		370.94	5.01E-01	Am-241
44.92	1.09E+00	Pu-242		124.51	1.35E+01	Pu-239		375.05	3.08E+02	Pu-239
45.24	4.52E+03	Pu-240		125.21	1.12E+01	Pu-239		376.65	1.32E+00	Am-241
46.21	1.43E+01	Pu-239		125.3	3.91E+01	Am-241		380.19	6.04E+01	Pu-239
46.68	9.21E+00	Pu-239		129.3	1.25E+03	Pu-239		382.75	5.13E+01	Pu-239
47.6	1.24E+01	Pu-239		141.66	6.34E+00	Pu-239		383.81	2.70E-01	Am-241
51.01	4.86E+01	U-237		143.35	3.43E+00	Pu-239		392.53	4.06E+01	Pu-239
51.01	2.49E-01	Am-241		144.2	5.60E+01	Pu-239		393.14	6.93E+01	Pu-239
51.62	5.39E+03	Pu-239		146.09	2.36E+01	Pu-239		399.53	1.17E+00	Pu-239
54.04	3.85E+01	Pu-239		146.55	4.41E+00	Am-241		406.8	4.95E-01	Pu-239
55.56	1.73E+02	Am-241		148.57	1.08E+03	Pu-241		411.2	1.39E+00	Pu-239
56.32	1.46E+01	Pu-241		150.04	7.08E-01	Am-241		413.71	2.90E+02	Pu-239
56.76	5.71E+00	Pu-241		152.72	5.84E+01	Pu-238		419.33	2.75E-01	Am-241
56.83	2.28E+02	Pu-239		158.1	1.98E-01	Pu-239		422.6	2.42E+01	Pu-239
59.54	3.44E+05	Am-241		159.96	3.81E+01	Pu-241		426.47	2.35E-01	Am-241
59.54	4.93E+03	U-237		160.19	1.23E+00	Pu-239		426.68	4.61E+00	Pu-239
64.83	1.83E+02	U-237		160.31	4.06E+01	Pu-240		428.4	1.98E-01	Pu-239
64.83	1.39E+00	Am-241		161.45	2.44E+01	Pu-239		430.08	8.51E-01	Pu-239
65.71	1.03E+01	Pu-239		164.61	2.66E+02	U-237		445.72	1.74E+00	Pu-239
67.45	4.02E+00	Am-241		164.69	6.38E-01	Am-241		451.48	3.75E+01	Pu-239
67.67	3.00E+01	Pu-239		165.81	2.22E-01	Am-241		457.61	2.95E-01	Pu-239
68.7	7.13E+01	Pu-239		167.81	5.74E-01	Pu-239		461.25	4.50E-01	Pu-239
68.74	2.57E+01	Pu-239		169.56	1.66E+00	Am-241		481.66	9.11E-01	Pu-239
69.76	2.78E+01	Am-241		171.39	2.18E+01	Pu-239		493.08	1.72E-01	Pu-239
69.76	1.36E-01	U-237		173.7	6.14E-01	Pu-239		582.89	1.22E-01	Pu-239
71.6	1.67E+01	Pu-241		175.07	1.74E-01	Am-241		597.99	3.31E-01	Pu-239
75.8	5.65E+00	Am-241		179.22	1.31E+01	Pu-239		612.83	1.88E-01	Pu-239
77.1	1.20E+02	Pu-241		188.23	2.16E+00	Pu-239		617.1	2.65E-01	Pu-239
77.59	7.52E+01	Pu-239		189.36	1.64E+01	Pu-239		618.28	4.04E-01	Pu-239
78.43	3.05E+01	Pu-239		191.96	2.07E-01	Am-241		619.01	5.69E-01	Am-241
89.64	5.35E+00	Pu-239		195.68	2.12E+01	Pu-239		619.21	2.40E-01	Pu-239
89.7	3.96E-01	Pu-239		200.97	2.45E-01	Pu-238		633.15	5.01E-01	Pu-239
94.65	1.82E+03	Pu-241	X	203.55	1.13E+02	Pu-239		637.7	5.07E-01	Pu-239
94.65	6.93E+02	Pu-239	X	208.01	3.03E+03	U-237		637.8	5.07E-01	Pu-239
94.65	3.64E+00	Pu-238	X	208.01	7.57E+00	Am-241		639.99	1.72E+00	Pu-239
94.65	2.57E+00	Pu-240	X	212.46	2.93E+00	Pu-240		642.35	1.31E+00	Pu-240
96.14	7.50E+00	Pu-239		218	2.38E-01	Pu-239		645.94	3.01E+00	Pu-239
97.07	2.20E+03	U-237	X	221.46	4.06E-01	Am-241		649.32	1.41E-01	Pu-239
97.07	1.09E+01	Am-241	X	221.8	3.03E+00	U-237		652.05	1.31E+00	Pu-239
97.6	1.78E+01	Pu-239		225.42	2.99E+00	Pu-239		653.02	3.61E-01	Am-241
98.43	2.91E+03	Pu-241	X	234.4	2.93E+00	U-237		654.88	4.46E-01	Pu-239
98.43	1.11E+03	Pu-239	X	237.77	2.85E+00	Pu-239		658.86	1.92E+00	Pu-239

98.43	5.82E+00	Pu-238	X	242.08	1.45E+00	Pu-239	662.4	3.48E+00	Am-241
98.43	4.09E+00	Pu-240	X	243.38	5.01E+00	Pu-239	664.58	3.29E-01	Pu-239
98.78	2.91E+02	Pu-239		244.92	1.01E+00	Pu-239	674.05	1.02E-01	Pu-239
98.97	1.94E+02	Am-241		248.95	1.43E+00	Pu-239	674.4	1.02E-01	Pu-239
99.85	4.59E+02	Pu-238		255.38	1.58E+01	Pu-239	687.57	3.54E-01	Pu-240
101	4.14E-01	Pu-241		263.95	5.25E+00	Pu-239	688.72	3.11E-01	Am-241
101.06	3.50E+03	U-237	X	265.7	3.17E-01	Pu-239	690.81	1.78E-01	Pu-239
101.06	1.73E+01	Am-241	X	267.54	1.02E+02	U-237	701.1	1.01E-01	Pu-239
102.98	1.87E+02	Am-241		267.58	2.52E-01	Am-241	703.68	7.82E-01	Pu-239
102.98	9.15E-01	U-237		281.2	4.16E-01	Pu-239	718	5.54E-01	Pu-239
103.06	4.28E+01	Pu-239		285.3	3.76E-01	Pu-239	722.01	1.88E+00	Am-241
103.68	5.90E+02	Pu-241		292.77	3.58E-01	U-237	742.81	3.27E-01	Pu-238
104.23	7.21E+02	Pu-240		292.77	1.36E-01	Am-241	756.4	5.54E-01	Pu-239
110.42	3.64E+02	Pu-241	X	297.46	9.86E+00	Pu-239	756.4	1.33E-01	Pu-239
110.42	1.39E+02	Pu-239	X	302.87	1.01E+00	Pu-239	766.39	1.38E+00	Pu-238
110.42	7.30E-01	Pu-238	X	307.85	1.09E+00	Pu-239	769.15	1.01E+00	Pu-239

Table A2.8. Input peak intensities for the 10 year old fuel grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
8.22	1.22E+00	Np-237		111.3	2.63E+02	Pu-239	X	332.35	1.11E+02	U-237
12.98	7.31E+03	Pu-239		111.3	1.29E+00	Pu-238	X	332.35	1.15E+01	Am-241
13	1.72E+01	U-234	X	111.3	9.70E-01	Pu-240	X	332.85	9.78E+01	Pu-239
13	2.68E-01	U-236	X	111.3	5.33E-01	Pa-233	X	335.37	3.83E+01	Am-241
13.3	6.71E+00	Np-237	X	113.3	2.84E+02	U-237	X	335.37	8.81E+00	U-237
13.3	1.15E-01	Th-231	X	113.3	1.75E+01	Am-241	X	336.11	2.22E+01	Pu-239
13.6	9.70E+05	Pu-240	X	114	3.05E+02	Pu-241		337.7	8.24E-01	U-237
13.6	8.49E+05	Pu-239	X	114.23	5.38E+02	U-237	X	337.7	3.31E-01	Am-241
13.6	5.98E+05	Pu-238	X	114.23	3.32E+01	Am-241	X	340.48	5.92E-01	Pa-233
13.6	4.71E+03	Pu-241	X	114.44	1.73E+02	Pu-241	X	341.51	1.31E+01	Pu-239
13.6	2.47E+02	Pu-242	X	114.44	1.03E+02	Pu-239	X	345.01	1.10E+02	Pu-239
13.6	5.72E+00	Pa-233	X	114.44	4.99E-01	Pu-238	X	345.01	5.94E+00	Pu-239
13.81	9.17E+00	U-237		114.44	3.77E-01	Pu-240	X	354	1.39E-01	Pu-239
13.9	2.86E+06	Am-241	X	114.44	2.06E-01	Pa-233	X	361.89	2.42E+00	Pu-239
13.9	5.74E+03	U-237	X	115.38	9.11E+01	Pu-239		367.07	1.76E+01	Pu-239
19.55	1.23E-01	U-235		116.26	1.12E+02	Pu-239		368.55	1.74E+01	Pu-239
26.34	1.75E+05	Am-241		117.46	2.10E+02	U-237	X	368.62	3.63E+00	U-237
26.34	2.25E+02	U-237		117.46	1.30E+01	Am-241	X	368.65	1.68E+01	Am-241
26.7	3.77E+02	Pu-241		119.7	4.16E+00	Pu-239		370.94	9.94E+00	U-237
29.37	1.92E+00	Np-237		119.7	1.88E+00	Pu-239		370.94	4.04E+00	Am-241
30.04	4.30E+01	Pu-239		120.36	3.47E-01	Am-241		375.05	3.08E+02	Pu-239
33.2	9.73E+03	Am-241		121.2	2.59E+00	Pu-241		376.65	1.07E+01	Am-241
33.2	1.20E+01	U-237		122.35	1.88E-01	Pu-239		380.19	6.04E+01	Pu-239
38.54	3.70E+01	U-237		123.05	7.72E+01	Am-241		382.75	5.13E+01	Pu-239
38.66	2.07E+03	Pu-239		123.62	4.69E+00	Pu-239		383.81	2.18E+00	Am-241
41.93	2.89E+01	Pu-239		124.51	1.35E+01	Pu-239		392.53	4.06E+01	Pu-239
42.7	4.25E+02	Am-241		125.21	1.12E+01	Pu-239		393.14	6.93E+01	Pu-239
43.42	5.64E+03	Am-241		125.3	3.15E+02	Am-241		398.49	1.85E-01	Pa-233
43.42	2.22E+00	U-237		129.3	1.25E+03	Pu-239		398.64	1.54E-01	Am-241
43.5	2.30E+03	Pu-238		139.44	4.09E-01	Am-241		399.53	1.17E+00	Pu-239
44.2	1.57E+01	Pu-241		141.66	6.34E+00	Pu-239		406.35	1.12E-01	Am-241
44.86	3.14E+00	Pu-241		143.35	3.43E+00	Pu-239		406.8	4.95E-01	Pu-239
44.92	1.09E+00	Pu-242		144.2	5.60E+01	Pu-239		411.2	1.39E+00	Pu-239
45.24	4.52E+03	Pu-240		146.09	2.36E+01	Pu-239		413.71	2.90E+02	Pu-239
46.21	1.43E+01	Pu-239		146.55	3.56E+01	Am-241		415.76	2.30E-01	Pa-233
46.68	9.21E+00	Pu-239		148.57	7.01E+02	Pu-241		419.33	2.22E+00	Am-241
47.6	1.24E+01	Pu-239		150.04	5.71E+00	Am-241		422.6	2.42E+01	Pu-239
51.01	3.15E+01	U-237		152.72	5.44E+01	Pu-238		426.47	1.90E+00	Am-241
51.01	2.01E+00	Am-241		158.1	1.98E-01	Pu-239		426.68	4.61E+00	Pu-239
51.62	5.39E+03	Pu-239		159.26	1.08E-01	Am-241		428.4	1.98E-01	Pu-239
53.2	2.12E-01	U-234		159.96	2.47E+01	Pu-241		430.08	8.51E-01	Pu-239
54.04	3.85E+01	Pu-239		160.19	1.23E+00	Pu-239		445.72	1.74E+00	Pu-239
55.56	1.40E+03	Am-241		160.31	4.06E+01	Pu-240		451.48	3.75E+01	Pu-239
56.32	9.42E+00	Pu-241		161.45	2.44E+01	Pu-239		452.6	1.85E-01	Am-241
56.76	3.70E+00	Pu-241		161.54	1.16E-01	Am-241		454.66	7.49E-01	Am-241
56.83	2.28E+02	Pu-239		164.61	1.72E+02	U-237		457.61	2.95E-01	Pu-239
59.54	2.77E+06	Am-241		164.69	5.15E+00	Am-241		459.68	2.78E-01	Am-241
59.54	3.20E+03	U-237		165.81	1.79E+00	Am-241		461.25	4.50E-01	Pu-239
64.83	1.19E+02	U-237		167.81	5.74E-01	Pu-239		468.12	2.22E-01	Am-241
64.83	1.12E+01	Am-241		169.56	1.34E+01	Am-241		481.66	9.11E-01	Pu-239
65.71	1.03E+01	Pu-239		171.39	2.18E+01	Pu-239		493.08	1.72E-01	Pu-239
67.45	3.24E+01	Am-241		173.7	6.14E-01	Pu-239		514	2.01E-01	Am-241
67.67	3.00E+01	Pu-239		175.07	1.41E+00	Am-241		582.89	1.22E-01	Pu-239
68.7	7.13E+01	Pu-239		179.22	1.31E+01	Pu-239		586.59	1.01E-01	Am-241
68.74	2.57E+01	Pu-239		185.71	1.11E-01	U-235		590.28	2.21E-01	Am-241
69.76	2.24E+02	Am-241		188.23	2.16E+00	Pu-239		597.48	5.71E-01	Am-241
71.6	1.08E+01	Pu-241		189.36	1.64E+01	Pu-239		597.99	3.31E-01	Pu-239
75.27	1.76E-01	Pa-233		191.96	1.67E+00	Am-241		612.83	1.88E-01	Pu-239
75.8	4.56E+01	Am-241		195.68	2.12E+01	Pu-239		617.1	2.65E-01	Pu-239
77.1	7.77E+01	Pu-241		200.97	2.29E-01	Pu-238		618.28	4.04E-01	Pu-239
77.59	7.52E+01	Pu-239		203.55	1.13E+02	Pu-239		619.01	4.59E+00	Am-241
78.43	3.05E+01	Pu-239		204.06	2.24E-01	Am-241		619.21	2.40E-01	Pu-239
86.48	1.69E+00	Np-237		208.01	1.96E+03	U-237		633.15	5.01E-01	Pu-239
86.6	2.59E-01	Pa-233		208.01	6.11E+01	Am-241		637.7	5.07E-01	Pu-239

89.64	5.35E+00	Pu-239		212.46	2.93E+00	Pu-240	637.8	5.07E-01	Pu-239
89.7	3.96E-01	Pu-239		218	2.38E-01	Pu-239	639.99	1.72E+00	Pu-239
92.28	2.26E-01	Np-237	X	221.46	3.27E+00	Am-241	641.47	5.48E-01	Am-241
94.65	1.18E+03	Pu-241	X	221.8	1.96E+00	U-237	642.35	1.31E+00	Pu-240
94.65	6.93E+02	Pu-239	X	225.42	2.99E+00	Pu-239	645.94	3.01E+00	Pu-239
94.65	3.39E+00	Pu-238	X	232.81	3.55E-01	Am-241	649.32	1.41E-01	Pu-239
94.65	2.57E+00	Pu-240	X	234.4	1.90E+00	U-237	652.05	1.31E+00	Pu-239
94.65	1.40E+00	Pa-233	X	237.77	2.85E+00	Pu-239	653.02	2.91E+00	Am-241
95.86	3.65E-01	Np-237	X	242.08	1.45E+00	Pu-239	654.88	4.46E-01	Pu-239
96.14	7.50E+00	Pu-239		243.38	5.01E+00	Pu-239	658.86	1.92E+00	Pu-239
97.07	1.43E+03	U-237	X	244.92	1.01E+00	Pu-239	662.4	2.81E+01	Am-241
97.07	8.80E+01	Am-241	X	246.73	1.85E-01	Am-241	664.58	3.29E-01	Pu-239
97.6	1.78E+01	Pu-239		248.95	1.43E+00	Pu-239	674.05	1.02E-01	Pu-239
98.43	1.88E+03	Pu-241	X	255.38	1.58E+01	Pu-239	674.4	1.02E-01	Pu-239
98.43	1.11E+03	Pu-239	X	263.95	5.25E+00	Pu-239	680.1	2.42E-01	Am-241
98.43	5.42E+00	Pu-238	X	264.89	6.95E-01	Am-241	687.57	3.54E-01	Pu-240
98.43	4.09E+00	Pu-240	X	265.7	3.17E-01	Pu-239	688.72	2.51E+00	Am-241
98.43	2.25E+00	Pa-233	X	267.54	6.59E+01	U-237	690.81	1.78E-01	Pu-239
98.78	2.91E+02	Pu-239		267.58	2.03E+00	Am-241	696.6	4.12E-01	Am-241
98.97	1.57E+03	Am-241		275.77	5.10E-01	Am-241	701.1	1.01E-01	Pu-239
99.85	4.27E+02	Pu-238		281.2	4.16E-01	Pu-239	703.68	7.82E-01	Pu-239
101	2.68E-01	Pu-241		285.3	3.76E-01	Pu-239	718	5.54E-01	Pu-239
101.06	2.27E+03	U-237	X	291.3	2.39E-01	Am-241	722.01	1.51E+01	Am-241
101.06	1.40E+02	Am-241	X	292.77	1.10E+00	Am-241	729.72	1.03E-01	Am-241
102.98	1.51E+03	Am-241		292.77	2.32E-01	U-237	737.34	6.18E-01	Am-241
102.98	5.93E-01	U-237		297.46	9.86E+00	Pu-239	742.81	3.05E-01	Pu-238
103.06	4.28E+01	Pu-239		300.13	8.82E-01	Pa-233	755.9	5.87E-01	Am-241
103.68	3.82E+02	Pu-241		302.87	1.01E+00	Pu-239	756.4	5.54E-01	Pu-239
103.86	1.14E-01	Pa-233		307.85	1.09E+00	Pu-239	756.4	1.33E-01	Pu-239
104.23	7.21E+02	Pu-240		309.1	1.08E-01	Am-241	766.39	1.29E+00	Pu-238
109.7	3.78E-01	Am-241		311.78	5.11E+00	Pu-239	767	3.86E-01	Am-241
110.42	2.36E+02	Pu-241	X	311.9	5.12E+00	Pa-233	769.15	1.01E+00	Pu-239
110.42	1.39E+02	Pu-239	X	316.41	2.61E+00	Pu-239	769.37	1.35E+00	Pu-239
110.42	6.80E-01	Pu-238	X	319.68	9.50E-01	Pu-239	770.57	3.66E-01	Am-241
110.42	5.13E-01	Pu-240	X	320.86	1.07E+01	Pu-239	772.4	2.05E-01	Am-241
110.42	2.82E-01	Pa-233	X	322.52	1.17E+01	Am-241	786.3	1.88E-01	Pu-238
111.3	4.45E+02	Pu-241	X	323.84	1.07E+01	Pu-239	801.94	1.05E-01	Am-241

Table A2.9. Input peak intensities for the 50 year old fuel grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
5.18	4.40E-01	Np-237		111.3	9.39E-01	Pu-238	X	320.86	1.07E+01	Pu-239
8.22	1.78E+01	Np-237		111.49	4.83E-01	Np-237	X	322.52	2.66E+01	Am-241
12.98	7.27E+03	Pu-239		113.3	4.11E+01	U-237	X	323.84	1.06E+01	Pu-239
13	7.39E+01	U-234	X	113.3	3.97E+01	Am-241	X	332.35	2.61E+01	Am-241
13	1.34E+00	U-236	X	114	4.43E+01	Pu-241		332.35	1.61E+01	U-237
13	2.62E-01	U-235	X	114.23	7.79E+01	U-237	X	332.85	9.73E+01	Pu-239
13.3	9.76E+01	Np-237	X	114.23	7.53E+01	Am-241	X	335.37	8.68E+01	Am-241
13.3	5.74E-01	Th-231	X	114.44	1.02E+02	Pu-239	X	335.37	1.27E+00	U-237
13.6	9.60E+05	Pu-240	X	114.44	2.51E+01	Pu-241	X	336.11	2.21E+01	Pu-239
13.6	8.45E+05	Pu-239	X	114.44	3.07E+00	Pa-233	X	337.7	7.51E-01	Am-241
13.6	4.36E+05	Pu-238	X	114.44	3.73E-01	Pu-240	X	337.7	1.19E-01	U-237
13.6	6.84E+02	Pu-241	X	114.44	3.64E-01	Pu-238	X	340.48	8.81E+00	Pa-233
13.6	2.47E+02	Pu-242	X	115.38	9.06E+01	Pu-239		341.51	1.30E+01	Pu-239
13.6	8.51E+01	Pa-233	X	116.26	1.12E+02	Pu-239		345.01	1.10E+02	Pu-239
13.81	1.33E+00	U-237		117.46	3.04E+01	U-237	X	345.01	5.91E+00	Pu-239
13.9	6.48E+06	Am-241	X	117.46	2.94E+01	Am-241	X	354	1.38E-01	Pu-239
13.9	8.31E+02	U-237	X	117.7	3.35E-01	Np-237		358.25	2.10E-01	Am-241
19.55	6.12E-01	U-235		119.7	4.14E+00	Pu-239		361.89	2.40E+00	Pu-239
25.64	1.37E-01	Th-231		119.7	1.87E+00	Pu-239		367.07	1.75E+01	Pu-239
26.34	3.97E+05	Am-241		120.36	7.88E-01	Am-241		368.55	1.73E+01	Pu-239
26.34	3.26E+01	U-237		120.9	2.59E-01	U-234		368.62	5.25E-01	U-237
26.7	5.47E+01	Pu-241		121.2	3.75E-01	Pu-241		368.65	3.80E+01	Am-241
28.56	1.41E-01	Pa-233		122.35	1.87E-01	Pu-239		370.94	9.15E+00	Am-241
29.37	2.80E+01	Np-237		123.05	1.75E+02	Am-241		370.94	1.44E+00	U-237
30.04	4.28E+01	Pu-239		123.62	4.67E+00	Pu-239		375.05	3.06E+02	Pu-239
33.2	2.21E+04	Am-241		124.51	1.34E+01	Pu-239		375.4	1.34E+00	Pa-233
33.2	1.74E+00	U-237		125.21	1.11E+01	Pu-239		376.65	2.42E+01	Am-241
38.54	5.36E+00	U-237		125.3	7.14E+02	Am-241		380.19	6.01E+01	Pu-239
38.66	2.06E+03	Pu-239		129.3	1.24E+03	Pu-239		382.75	5.10E+01	Pu-239
41.93	2.88E+01	Pu-239		131.1	1.70E-01	Np-237		383.81	4.94E+00	Am-241
42.7	9.63E+02	Am-241		134.29	1.33E-01	Np-237		392.53	4.04E+01	Pu-239
43.42	1.28E+04	Am-241		139.44	9.28E-01	Am-241		393.14	6.90E+01	Pu-239
43.42	3.22E-01	U-237		141.66	6.30E+00	Pu-239		398.49	2.75E+00	Pa-233
43.5	1.67E+03	Pu-238		143.25	8.77E-01	Np-237		398.64	3.50E-01	Am-241
44.2	2.28E+00	Pu-241		143.35	3.41E+00	Pu-239		399.53	1.16E+00	Pu-239
44.86	4.56E-01	Pu-241		143.76	1.07E-01	U-235		406.35	2.54E-01	Am-241
44.92	1.09E+00	Pu-242		144.2	5.58E+01	Pu-239		406.8	4.93E-01	Pu-239
45.24	4.47E+03	Pu-240		146.09	2.34E+01	Pu-239		411.2	1.38E+00	Pu-239
46.21	1.42E+01	Pu-239		146.55	8.07E+01	Am-241		413.71	2.89E+02	Pu-239
46.53	2.06E-01	Np-237		148.57	1.02E+02	Pu-241		415.76	3.43E+00	Pa-233
46.68	9.16E+00	Pu-239		150.04	1.30E+01	Am-241		419.33	5.02E+00	Am-241
47.6	1.23E+01	Pu-239		151.41	4.59E-01	Np-237		422.6	2.40E+01	Pu-239
51.01	4.56E+00	U-237		152.72	3.97E+01	Pu-238		426.47	4.31E+00	Am-241
51.01	4.55E+00	Am-241		155.24	1.76E-01	Np-237		426.68	4.59E+00	Pu-239
51.62	5.36E+03	Pu-239		158.1	1.97E-01	Pu-239		428.4	1.97E-01	Pu-239
53.2	9.09E-01	U-234		159.26	2.45E-01	Am-241		430.08	8.47E-01	Pu-239
54.04	3.83E+01	Pu-239		159.96	3.58E+00	Pu-241		445.72	1.73E+00	Pu-239
55.56	3.17E+03	Am-241		160.19	1.22E+00	Pu-239		451.48	3.73E+01	Pu-239
56.32	1.37E+00	Pu-241		160.31	4.02E+01	Pu-240		452.6	4.20E-01	Am-241
56.76	5.36E-01	Pu-241		161.45	2.42E+01	Pu-239		454.66	1.70E+00	Am-241
56.83	2.27E+02	Pu-239		161.54	2.63E-01	Am-241		457.61	2.94E-01	Pu-239
57.1	7.01E-01	Np-237		164.61	2.49E+01	U-237		459.68	6.30E-01	Am-241
59.54	6.28E+06	Am-241		164.69	1.17E+01	Am-241		461.25	4.47E-01	Pu-239
59.54	4.62E+02	U-237		165.81	4.06E+00	Am-241		463.22	1.75E-01	Am-241
64.83	2.54E+01	Am-241		167.81	5.71E-01	Pu-239		468.12	5.04E-01	Am-241
64.83	1.72E+01	U-237		169.16	1.25E-01	Np-237		481.66	9.06E-01	Pu-239
65.71	1.02E+01	Pu-239		169.56	3.03E+01	Am-241		493.08	1.71E-01	Pu-239
67.45	7.35E+01	Am-241		171.39	2.17E+01	Pu-239		512.5	2.01E-01	Am-241
67.67	2.99E+01	Pu-239		173.7	6.11E-01	Pu-239		514	4.55E-01	Am-241
68.7	7.09E+01	Pu-239		175.07	3.19E+00	Am-241		522.06	1.75E-01	Am-241
68.74	2.56E+01	Pu-239		179.22	1.30E+01	Pu-239		545.4	1.30E-01	Am-241
69.76	5.08E+02	Am-241		185.71	5.54E-01	U-235		563.05	1.30E-01	Am-241
71.6	1.57E+00	Pu-241		188.23	2.15E+00	Pu-239		573.94	2.19E-01	Am-241
75.27	2.61E+00	Pa-233		189.36	1.64E+01	Pu-239		582.89	1.21E-01	Pu-239

75.8	1.03E+02	Am-241		191.96	3.78E+00	Am-241	586.59	2.29E-01	Am-241
77.1	1.13E+01	Pu-241		194.95	3.51E-01	Np-237	590.28	5.01E-01	Am-241
77.59	7.49E+01	Pu-239		195.68	2.11E+01	Pu-239	597.48	1.30E+00	Am-241
78.43	3.04E+01	Pu-239		200.97	1.67E-01	Pu-238	597.99	3.29E-01	Pu-239
86.48	2.46E+01	Np-237		203.55	1.12E+02	Pu-239	612.83	1.87E-01	Pu-239
86.6	3.86E+00	Pa-233		204.06	5.08E-01	Am-241	617.1	2.64E-01	Pu-239
87.99	3.31E-01	Np-237		208.01	2.84E+02	U-237	618.28	4.02E-01	Pu-239
89.64	5.32E+00	Pu-239		208.01	1.38E+02	Am-241	619.01	1.04E+01	Am-241
89.7	3.94E-01	Pu-239		212.29	2.99E-01	Np-237	619.21	2.38E-01	Pu-239
92.28	3.29E+00	Np-237	X	212.46	2.90E+00	Pu-240	632.93	2.21E-01	Am-241
94.64	1.22E+00	Np-237		218	2.36E-01	Pu-239	633.15	4.98E-01	Pu-239
94.65	6.90E+02	Pu-239	X	221.46	7.42E+00	Am-241	637.7	5.04E-01	Pu-239
94.65	1.71E+02	Pu-241	X	221.8	2.84E-01	U-237	637.8	5.04E-01	Pu-239
94.65	2.09E+01	Pa-233	X	225.42	2.98E+00	Pu-239	639.99	1.71E+00	Pu-239
94.65	2.54E+00	Pu-240	X	232.81	8.05E-01	Am-241	641.47	1.24E+00	Am-241
94.65	2.47E+00	Pu-238	X	234.33	1.23E-01	Am-241	642.35	1.30E+00	Pu-240
95.86	5.31E+00	Np-237	X	234.4	2.75E-01	U-237	645.94	2.99E+00	Pu-239
96.14	7.47E+00	Pu-239		237.77	2.84E+00	Pu-239	649.32	1.40E-01	Pu-239
97.07	2.06E+02	U-237	X	237.86	1.13E-01	Np-237	652.05	1.30E+00	Pu-239
97.07	2.00E+02	Am-241	X	242.08	1.44E+00	Pu-239	653.02	6.60E+00	Am-241
97.6	1.77E+01	Pu-239		243.38	4.98E+00	Pu-239	654.88	4.43E-01	Pu-239
98.43	1.10E+03	Pu-239	X	244.92	1.01E+00	Pu-239	658.86	1.91E+00	Pu-239
98.43	2.73E+02	Pu-241	X	246.73	4.20E-01	Am-241	662.4	6.37E+01	Am-241
98.43	3.35E+01	Pa-233	X	248.38	1.21E-01	Pa-233	664.58	3.27E-01	Pu-239
98.43	4.05E+00	Pu-240	X	248.95	1.42E+00	Pu-239	674.05	1.02E-01	Pu-239
98.43	3.95E+00	Pu-238	X	255.38	1.58E+01	Pu-239	674.4	1.02E-01	Pu-239
98.78	2.90E+02	Pu-239		260.8	2.12E-01	Am-241	676.03	1.12E-01	Am-241
98.97	3.55E+03	Am-241		263.95	5.22E+00	Pu-239	680.1	5.48E-01	Am-241
99.85	3.11E+02	Pu-238		264.89	1.58E+00	Am-241	687.57	3.50E-01	Pu-240
101.06	3.28E+02	U-237	X	265.7	3.15E-01	Pu-239	688.72	5.69E+00	Am-241
101.06	3.17E+02	Am-241	X	267.54	9.54E+00	U-237	690.81	1.77E-01	Pu-239
102.98	3.41E+03	Am-241		267.58	4.60E+00	Am-241	696.6	9.35E-01	Am-241
103.06	4.26E+01	Pu-239		271.55	6.40E-01	Pa-233	701.1	1.01E-01	Pu-239
103.68	5.54E+01	Pu-241		275.77	1.16E+00	Am-241	703.68	7.78E-01	Pu-239
103.86	1.69E+00	Pa-233		281.2	4.14E-01	Pu-239	718	5.52E-01	Pu-239
104.23	7.14E+02	Pu-240		285.3	3.74E-01	Pu-239	722.01	3.43E+01	Am-241
107.6	6.59E-01	Np-237	X	291.3	5.43E-01	Am-241	729.72	2.33E-01	Am-241
108.42	1.25E+00	Np-237	X	292.77	2.49E+00	Am-241	737.34	1.40E+00	Am-241
108.7	1.35E-01	Np-237		297.46	9.81E+00	Pu-239	742.81	2.22E-01	Pu-238
109.7	8.58E-01	Am-241		298.81	1.74E-01	Pa-233	755.9	1.33E+00	Am-241
110.42	1.38E+02	Pu-239	X	300.13	1.31E+01	Pa-233	756.4	5.52E-01	Pu-239
110.42	3.42E+01	Pu-241	X	302.87	1.01E+00	Pu-239	756.4	1.32E-01	Pu-239
110.42	4.20E+00	Pa-233	X	304.21	1.77E-01	Am-241	766.39	9.39E-01	Pu-238
110.42	5.08E-01	Pu-240	X	307.85	1.08E+00	Pu-239	767	8.75E-01	Am-241
110.42	4.95E-01	Pu-238	X	309.1	2.45E-01	Am-241	769.15	1.01E+00	Pu-239
111.3	2.62E+02	Pu-239	X	311.78	5.08E+00	Pu-239	769.37	1.34E+00	Pu-239
111.3	6.46E+01	Pu-241	X	311.9	7.62E+01	Pa-233	770.57	8.30E-01	Am-241
111.3	7.94E+00	Pa-233	X	316.41	2.60E+00	Pu-239	772.4	4.66E-01	Am-241
111.3	9.60E-01	Pu-240	X	319.68	9.46E-01	Pu-239	786	1.09E-01	Am-241

Table A2.10. Input peak intensities for the 1 year old highly enriched uranium of Russian origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope	keV	Photons/s	isotope
9.2	3.50E+02	Th-231		115.45	3.18E+02	U-235	450.97	5.04E-01	Pa-234m
10.25	5.32E+02	Th-231		115.63	1.12E+01	Th-231	453.58	3.45E-01	Pa-234m
12.7	7.23E+00	Pa-231	X	116.82	2.35E+02	Th-231	454.95	8.20E+00	U-234
13	3.28E+06	U-234	X	120.35	2.76E+02	U-235	456.7	1.17E-01	Pa-234m
13	2.86E+05	U-235	X	120.9	1.15E+04	U-234	458.68	3.08E-01	Pa-234
13	1.21E+04	U-236	X	124.91	6.15E+02	Th-231	468.43	3.71E-01	Pa-234m
13	1.18E+03	U-238	X	125.46	2.12E-01	Pa-234	475.74	3.87E-01	Pa-234m
13.3	6.25E+05	Th-231	X	131.3	4.90E+00	Pa-234	503.5	3.15E-01	U-234
13.3	1.15E+03	Th-234	X	134.03	2.65E+02	Th-231	506.75	3.50E-01	Pa-234
13.3	8.75E+00	Pa-234m	X	135.66	8.37E+02	Th-231	507.5	2.54E-01	Pa-234m
13.6	2.25E+01	Pa-234	X	136.55	1.27E+02	U-235	508.2	4.92E+00	U-234
13.6	2.20E+00	Pa-234m	X	136.75	4.66E+01	Th-231	509.2	3.40E-01	Pa-234m
17.2	2.44E+03	Th-231		140.1	2.07E-01	Pa-234m	513.4	2.05E-01	Pa-234
19.1	2.54E+03	Th-231		140.15	1.37E-01	Pa-234	513.4	1.04E-01	Pa-234
19.55	6.68E+05	U-235		140.54	7.74E+00	Th-231	519.6	1.06E-01	Pa-234
20.02	8.10E-01	Th-234		140.76	2.12E+03	U-235	521.4	2.02E-01	Pa-234
25.64	1.50E+05	Th-231		142.4	5.30E+01	U-235	527.9	1.06E-01	Pa-234
27.36	2.30E+00	Pa-231		143.76	1.16E+05	U-235	543.98	5.95E-01	Pa-234m
29.49	1.94E-01	Th-234		145.06	6.04E+01	Th-231	565.2	2.80E-01	Pa-234
31.6	1.80E+02	U-235		145.94	3.36E+02	Th-231	568.9	9.84E-01	Pa-234
34.7	3.92E+02	U-235		150.93	9.54E+02	U-235	569.5	2.23E+00	Pa-234
41.4	3.18E+02	U-235		152.71	1.63E+00	Pa-234	572	1.41E-01	Pa-234m
41.96	6.36E+02	U-235		159.48	1.76E-01	Pa-234	581.7	3.94E+00	U-234
42.86	6.25E+02	Th-231		163.1	1.63E+03	Th-231	602.6	1.45E-01	Pa-234
44.08	7.42E+00	Th-231		163.36	5.39E+04	U-235	612	1.04E-01	Pa-234
49.46	1.05E+02	U-236		165	3.64E+01	Th-231	624.4	2.62E-01	U-234
49.55	1.04E+01	U-238		169.66	1.40E+01	Th-231	649	1.62E-01	Pa-234m
51.21	3.60E+02	U-235		170.85	1.37E-01	Pa-234	653.7	1.27E-01	Pa-234
53.2	4.03E+04	U-234		173.3	6.36E+01	U-235	655.3	2.24E-01	Pa-234m
54.1	5.30E+00	U-235		174.15	1.89E+02	Th-231	657.4	1.06E-01	Pa-234
54.25	1.59E+02	U-235		182.62	4.13E+03	U-235	663.9	1.45E-01	Pa-234
58.57	4.90E+03	Th-231		183.5	3.50E+02	Th-231	666.5	3.16E-01	Pa-234
62.7	4.14E-01	Pa-234		184.7	2.72E-01	Pa-234m	669.7	2.69E-01	Pa-234
62.7	1.94E-01	Pa-234m		185.71	6.04E+05	U-235	673.9	1.05E-01	Pa-234m
62.86	2.59E+00	Th-234		186.15	4.79E-01	Pa-234	677.6	3.21E-01	U-234
63.29	5.99E+02	Th-234		188.76	3.50E+01	Th-231	691	1.45E+00	Pa-234m
63.86	2.44E+02	Th-231		193.4	1.17E-01	Pa-234m	692.6	3.37E-01	Pa-234
64.45	1.38E+02	U-235		193.4	1.17E-01	Pa-234m	695.5	2.62E-01	Pa-234m
68.5	6.15E+01	Th-231		193.73	1.35E-01	Pa-234	699.02	9.23E-01	Pa-234m
72.7	1.27E+03	U-235		194.94	6.68E+03	U-235	699.03	9.84E-01	Pa-234
72.75	2.67E+03	Th-231		198.9	3.82E+02	U-235	702	1.17E+00	Pa-234m
73.92	2.11E+00	Th-234		200.97	2.44E-01	Pa-234	705.9	6.16E-01	Pa-234
73.92	2.11E+00	Pa-234m		202.12	1.15E+04	U-235	705.94	9.07E-01	Pa-234m
74.94	5.41E+02	U-235		203.12	3.34E-01	Pa-234	708.2	1.09E-01	Pa-234m
77.69	4.45E+01	Th-231		203.3	2.75E-01	Pa-234m	730.9	1.71E-01	Pa-234
81.23	9.54E+03	Th-231		205.32	5.32E+04	U-235	732.5	2.11E-01	Pa-234m
82.09	4.45E+03	Th-231		209.9	2.19E-01	Pa-234m	733.39	1.87E+00	Pa-234
83.3	9.72E+00	Th-234		215.28	3.07E+02	U-235	738	3.13E-01	Pa-234
84.21	7.00E+04	Th-231		217.94	4.20E+02	Th-231	740.1	1.77E+00	Pa-234m
87.68	1.67E-01	Pa-231	X	221.39	1.25E+03	U-235	742.81	1.73E+01	Pa-234m
89.95	1.06E+04	Th-231		226.5	1.14E+00	Pa-234	742.81	5.59E-01	Pa-234
89.96	3.64E+04	U-235	X	227.25	1.55E+00	Pa-234	755	3.29E-01	Pa-234
89.96	8.53E+02	U-234	X	228.78	7.42E+01	U-235	766.42	5.14E+01	Pa-234m
89.96	1.66E+00	U-236	X	233.5	4.03E+02	U-235	780.4	2.44E-01	Pa-234
89.96	1.10E-01	U-238	X	236.01	9.75E+01	Th-231	781.75	1.26E+00	Pa-234m
90.89	2.72E-01	Pa-231	X	240.27	3.07E+00	Th-231	786.27	3.24E-01	Pa-234
92.28	3.71E+03	Th-231	X	240.88	7.84E+02	U-235	786.28	8.81E+00	Pa-234m
92.28	2.77E+00	Th-234	X	242.5	8.80E+00	Th-231	794.9	1.81E-01	Pa-234
92.38	3.45E+02	Th-234		245.37	2.05E-01	Pa-234	796.1	6.99E-01	Pa-234
92.8	3.40E+02	Th-234		246.83	5.83E+02	U-235	804.1	1.68E-01	Pa-234
93.02	4.98E+02	Th-231		249.22	6.73E-01	Pa-234	805.75	9.56E-01	Pa-234m
93.35	5.87E+04	U-235	X	249.6	8.37E+00	Th-231	805.8	6.73E-01	Pa-234
93.35	1.35E+03	U-234	X	250.45	7.00E+00	Th-231	808.2	4.50E-01	Pa-234m
93.35	2.68E+00	U-236	X	258.23	1.24E+01	Pa-234m	818.2	1.62E-01	Pa-234m

93.35	1.78E-01	U-238	X	266.45	6.36E+01	U-235	819.2	5.13E-01	Pa-234
94.65	3.24E+00	Pa-234	X	267.62	1.33E+01	Th-231	825.1	5.13E-01	Pa-234
94.65	1.09E+00	Pa-234m	X	272.28	2.93E-01	Pa-234	825.6	1.07E+00	Pa-234m
95.86	6.04E+03	Th-231	X	274.1	3.60E-01	Th-231	831.5	1.11E+00	Pa-234
95.86	4.54E+00	Th-234	X	275.35	5.41E+02	U-235	844.1	1.78E-01	Pa-234m
96.09	9.65E+02	U-235		275.49	3.39E+02	U-235	844.1	1.14E-01	Pa-234
98.43	5.18E+00	Pa-234	X	281.42	6.36E+01	U-235	851.58	1.12E+00	Pa-234m
98.43	1.75E+00	Pa-234m	X	282.92	6.36E+01	U-235	866.8	1.85E-01	Pa-234m
99.28	1.39E+03	Th-231		283.69	3.79E-01	Pa-231	876	6.86E-01	Pa-234
99.86	8.55E-01	Pa-234		289.56	7.42E+01	U-235	880.5	1.68E+00	Pa-234
102.27	4.62E+03	Th-231		291.65	4.24E+02	U-235	880.5	1.14E+00	Pa-234
103.35	5.18E-01	Th-234		293.79	8.03E-01	Pa-234	880.9	6.48E-01	Pa-234m
104.82	7.26E+03	U-235	X	299	1.05E-01	Pa-234m	883.22	5.67E-01	Pa-234m
104.82	1.67E+02	U-234	X	300.07	5.51E-01	Pa-231	883.24	2.59E+00	Pa-234
104.82	3.35E-01	U-236	X	301.7	5.30E+01	U-235	898.67	8.81E-01	Pa-234
105.6	1.39E+04	U-235	X	302.65	4.91E-01	Pa-231	921.72	2.07E+00	Pa-234m
105.6	3.18E+02	U-234	X	302.65	1.52E-01	Pa-231	925	2.12E+00	Pa-234
105.6	6.30E-01	U-236	X	308.78	3.82E+00	Th-231	926	4.66E-01	Pa-234
105.81	8.27E+01	Th-231		311	3.29E+01	Th-231	926.61	2.01E-01	Pa-234m
106.61	1.87E+02	Th-231		317.1	1.06E+01	U-235	926.72	1.97E+00	Pa-234
107.6	7.53E+02	Th-231	X	317.87	1.02E+00	Th-231	936.3	1.78E-01	Pa-234m
107.6	5.51E-01	Th-234	X	320.15	1.59E+00	Th-231	941.96	4.08E-01	Pa-234m
108.42	1.43E+03	Th-231	X	330.06	3.12E-01	Pa-231	945.94	1.64E+00	Pa-234m
108.42	1.05E+00	Th-234	X	330.4	1.27E-01	Pa-234	946	3.63E+00	Pa-234
108.58	5.30E+03	U-235	X	338.1	1.78E-01	Pa-234m	947.7	4.40E-01	Pa-234
108.58	1.21E+02	U-234	X	343.5	3.18E+01	U-235	960	1.30E-01	Pa-234m
108.58	2.41E-01	U-236	X	345.92	4.24E+02	U-235	965.8	1.30E-01	Pa-234
109.19	1.76E+04	U-235		351.8	7.00E-01	Th-231	980.3	7.25E-01	Pa-234
110.42	6.50E-01	Pa-234	X	351.9	1.11E-01	Pa-234	980.3	4.77E-01	Pa-234
110.42	2.19E-01	Pa-234m	X	356.03	5.30E+01	U-235	981.6	1.97E-01	Pa-234
111.3	1.24E+00	Pa-234	X	357.5	1.30E-01	Pa-234m	984.2	4.40E-01	Pa-234
111.3	4.21E-01	Pa-234m	X	362.8	1.10E-01	Pa-234m	996.1	9.07E-01	Pa-234m
111.49	5.51E+02	Th-231	X	369.5	6.73E-01	Pa-234	1001.03	1.36E+02	Pa-234m
111.49	4.05E-01	Th-234	X	372	3.29E-01	Pa-234	1028.7	1.53E-01	Pa-234
112.79	2.55E+01	U-236		387.6	1.51E-01	Pa-234m	1041.7	2.01E-01	Pa-234m
112.81	3.40E+01	Th-234		387.84	4.24E+02	U-235	1059.4	3.69E-01	Pa-234m
113.5	1.65E+00	U-238		410.29	3.18E+01	U-235	1061.86	3.47E-01	Pa-234m
114.44	4.77E-01	Pa-234	X	426.95	1.24E-01	Pa-234	1081.9	1.46E-01	Pa-234m
114.44	1.60E-01	Pa-234m	X	448.4	1.06E+01	U-235	1083.2	1.37E-01	Pa-234

Table A2.11. Input peak intensities for the 10 year old highly enriched uranium of Russian origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
9.2	3.50E+02	Th-231		109.19	1.76E+04	U-235		334.37	3.56E-01	Th-227
10.25	5.32E+02	Th-231		110.42	6.50E-01	Pa-234	X	338.1	1.78E-01	Pa-234m
10.8	7.81E-01	Pb-214	X	110.42	2.19E-01	Pa-234m	X	338.28	8.89E-01	Ra-223
10.8	1.53E-01	Pb-211	X	111.3	1.24E+00	Pa-234	X	340.74	4.04E-01	Pa-231
10.8	1.42E-01	Pb-210	X	111.3	4.21E-01	Pa-234m	X	342.55	1.09E-01	Th-227
11.1	3.19E-01	Rn-219	X	111.49	5.51E+02	Th-231	X	343.5	3.18E+01	U-235
11.7	7.17E+00	Ra-223	X	111.49	4.05E-01	Th-234	X	345.92	4.24E+02	U-235
12.3	2.32E+02	Th-230	X	112.79	2.55E+01	U-236		351.07	4.08E+00	Bi-211
12.3	1.19E-01	Fr-223	X	112.81	3.40E+01	Th-234		351.8	7.00E-01	Th-231
12.7	7.23E+01	Pa-231	X	113.11	1.69E-01	Th-227		351.9	1.11E-01	Pa-234
13	3.28E+06	U-234	X	113.5	1.65E+00	U-238		351.93	2.32E+00	Pb-214
13	2.86E+05	U-235	X	114.44	4.77E-01	Pa-234	X	354.46	2.23E-01	Pa-231
13	1.21E+04	U-236	X	114.44	1.60E-01	Pa-234m	X	356.03	5.30E+01	U-235
13	1.18E+03	U-238	X	115.45	3.18E+02	U-235		357.12	3.90E-01	Pa-231
13	1.11E+00	Ac-227	X	115.63	1.12E+01	Th-231		357.5	1.30E-01	Pa-234m
13.3	6.25E+05	Th-231	X	116.82	2.35E+02	Th-231		362.8	1.10E-01	Pa-234m
13.3	1.15E+03	Th-234	X	120.35	2.76E+02	U-235		369.5	6.73E-01	Pa-234
13.3	8.75E+00	Pa-234m	X	120.9	1.15E+04	U-234		371.68	1.52E-01	Ra-223
13.6	2.25E+01	Pa-234	X	122.32	3.78E-01	Ra-223		372	3.29E-01	Pa-234
13.6	2.20E+00	Pa-234m	X	124.91	6.15E+02	Th-231		379.3	1.12E-01	Pa-231
16.5	6.69E-01	Pa-231		125.46	2.12E-01	Pa-234		387.6	1.51E-01	Pa-234m
17.2	2.44E+03	Th-231		131.3	4.90E+00	Pa-234		387.84	4.24E+02	U-235
19	8.47E-01	Pa-231		134.03	2.65E+02	Th-231		401.81	2.07E+00	Rn-219
19.1	2.54E+03	Th-231		135.66	8.37E+02	Th-231		404.85	1.18E+00	Pb-211
19.55	6.68E+05	U-235		136.55	1.27E+02	U-235		410.29	3.18E+01	U-235
20.02	8.10E-01	Th-234		136.75	4.66E+01	Th-231		426.95	1.24E-01	Pa-234
25.51	2.61E-01	Pa-231		140.1	2.07E-01	Pa-234m		427.09	5.51E-01	Pb-211
25.64	1.50E+05	Th-231		140.15	1.37E-01	Pa-234		445.03	4.04E-01	Ra-223
27.36	2.30E+01	Pa-231		140.54	7.74E+00	Th-231		448.4	1.06E+01	U-235
29.49	1.94E-01	Th-234		140.76	2.12E+03	U-235		450.97	5.04E-01	Pa-234m
29.96	2.43E-01	Pa-231		142.4	5.30E+01	U-235		453.58	3.45E-01	Pa-234m
31.6	1.80E+02	U-235		143.76	1.16E+05	U-235		454.95	8.20E+00	U-234
34.7	3.92E+02	U-235		143.87	1.48E+00	Th-230		456.7	1.17E-01	Pa-234m
38.19	3.57E-01	Pa-231		144.24	1.02E+00	Ra-223		458.68	3.08E-01	Pa-234
41.4	3.18E+02	U-235		145.06	6.04E+01	Th-231		468.43	3.71E-01	Pa-234m
41.96	6.36E+02	U-235		145.94	3.36E+02	Th-231		475.74	3.87E-01	Pa-234m
42.86	6.25E+02	Th-231		150.93	9.54E+02	U-235		503.5	3.15E-01	U-234
44.08	7.42E+00	Th-231		152.71	1.63E+00	Pa-234		506.75	3.50E-01	Pa-234
44.15	1.45E-01	Pa-231		154.21	1.78E+00	Ra-223		507.5	2.54E-01	Pa-234m
46.35	4.97E-01	Pa-231		158.63	2.18E-01	Ra-223		508.2	4.92E+00	U-234
49.46	1.05E+02	U-236		159.48	1.76E-01	Pa-234		509.2	3.40E-01	Pa-234m
49.55	1.04E+01	U-238		163.1	1.63E+03	Th-231		513.4	2.05E-01	Pa-234
49.82	1.34E-01	Th-227		163.36	5.39E+04	U-235		513.4	1.04E-01	Pa-234
50.09	1.50E-01	Fr-223		165	3.64E+01	Th-231		519.6	1.06E-01	Pa-234
50.13	2.62E+00	Th-227		169.66	1.40E+01	Th-231		521.4	2.02E-01	Pa-234
51.21	3.60E+02	U-235		170.85	1.37E-01	Pa-234		527.9	1.06E-01	Pa-234
52.73	1.90E-01	Pa-231		173.3	6.36E+01	U-235		543.98	5.95E-01	Pa-234m
53.2	4.03E+04	U-234		174.15	1.89E+02	Th-231		565.2	2.80E-01	Pa-234
54.1	5.30E+00	U-235		182.62	4.13E+03	U-235		568.9	9.84E-01	Pa-234
54.25	1.59E+02	U-235		183.5	3.50E+02	Th-231		569.5	2.23E+00	Pa-234
54.6	1.72E-01	Pa-231		184.7	2.72E-01	Pa-234m		572	1.41E-01	Pa-234m
58.57	4.90E+03	Th-231		185.71	6.04E+05	U-235		581.7	3.94E+00	U-234
62.7	4.14E-01	Pa-234		186.05	2.65E-01	Th-230		602.6	1.45E-01	Pa-234
62.7	1.94E-01	Pa-234m		186.15	4.79E-01	Pa-234		609.32	2.96E+00	Bi-214
62.86	2.59E+00	Th-234		186.21	2.37E-01	Ra-226		612	1.04E-01	Pa-234
63.29	5.99E+02	Th-234		188.76	3.50E+01	Th-231		624.4	2.62E-01	U-234
63.65	1.12E-01	Pa-231		193.4	1.17E-01	Pa-234m		649	1.62E-01	Pa-234m
63.86	2.44E+02	Th-231		193.4	1.17E-01	Pa-234m		653.7	1.27E-01	Pa-234
64.45	1.38E+02	U-235		193.73	1.35E-01	Pa-234		655.3	2.24E-01	Pa-234m
67.67	1.14E+01	Th-230		194.94	6.68E+03	U-235		657.4	1.06E-01	Pa-234
68.5	6.15E+01	Th-231		198.9	3.82E+02	U-235		663.9	1.45E-01	Pa-234
72.7	1.27E+03	U-235		200.97	2.44E-01	Pa-234		666.5	3.16E-01	Pa-234
72.75	2.67E+03	Th-231		202.12	1.15E+04	U-235		669.7	2.69E-01	Pa-234
73.92	2.11E+00	Th-234		203.12	3.34E-01	Pa-234		673.9	1.05E-01	Pa-234m
73.92	2.11E+00	Pa-234m		203.3	2.75E-01	Pa-234m		677.6	3.21E-01	U-234
74.82	3.78E-01	Pb-214	X	205.32	5.32E+04	U-235		691	1.45E+00	Pa-234m
74.94	5.41E+02	U-235		209.9	2.19E-01	Pa-234m		692.6	3.37E-01	Pa-234
76.86	1.69E-01	Rn-219	X	210.62	3.90E-01	Th-227		695.5	2.62E-01	Pa-234m
77.11	6.32E-01	Pb-214	X	215.28	3.07E+02	U-235		699.02	9.23E-01	Pa-234m
77.11	1.15E-01	Pb-211	X	217.94	4.20E+02	Th-231		699.03	9.84E-01	Pa-234

77.34	1.63E-01	Pa-231		221.39	1.25E+03	U-235	702	1.17E+00	Pa-234m
77.69	4.45E+01	Th-231		226.5	1.14E+00	Pa-234	704.64	1.45E-01	Pb-211
79.29	2.79E-01	Rn-219	X	227.25	1.55E+00	Pa-234	705.9	6.16E-01	Pa-234
79.69	6.08E-01	Th-227		228.78	7.42E+01	U-235	705.94	9.07E-01	Pa-234m
81.07	4.70E+00	Ra-223	X	233.5	4.03E+02	U-235	708.2	1.09E-01	Pa-234m
81.23	9.54E+03	Th-231		234.76	1.40E-01	Th-227	730.9	1.71E-01	Pa-234
82.09	4.45E+03	Th-231		235.96	4.03E+00	Th-227	732.5	2.11E-01	Pa-234m
83.3	9.72E+00	Th-234		236.01	9.75E+01	Th-231	733.39	1.87E+00	Pa-234
83.79	7.73E+00	Ra-223	X	240.27	3.07E+00	Th-231	738	3.13E-01	Pa-234
84.21	7.00E+04	Th-231		240.88	7.84E+02	U-235	740.1	1.77E+00	Pa-234m
85.43	4.18E-01	Th-227	X	241.99	4.72E-01	Pb-214	742.81	1.73E+01	Pa-234m
85.43	1.26E-01	Th-230	X	242.5	8.80E+00	Th-231	742.81	5.59E-01	Pa-234
87.35	1.46E-01	Pb-214	X	243.08	1.07E-01	Pa-231	755	3.29E-01	Pa-234
87.68	1.67E+00	Pa-231	X	245.37	2.05E-01	Pa-234	766.42	5.14E+01	Pa-234m
88.47	6.80E-01	Th-227	X	246.83	5.83E+02	U-235	766.51	1.93E-01	Pb-211
88.47	2.05E-01	Th-230	X	249.22	6.73E-01	Pa-234	768.36	3.19E-01	Bi-214
89.95	1.06E+04	Th-231		249.6	8.37E+00	Th-231	780.4	2.44E-01	Pa-234
89.96	3.64E+04	U-235	X	250.27	1.40E-01	Th-227	781.75	1.26E+00	Pa-234m
89.96	8.53E+02	U-234	X	250.45	7.00E+00	Th-231	786.27	3.24E-01	Pa-234
89.96	1.66E+00	U-236	X	253.73	3.34E-01	Th-230	786.28	8.81E+00	Pa-234m
89.96	1.10E-01	U-238	X	254.63	2.22E-01	Th-227	794.9	1.81E-01	Pa-234
90.89	2.72E+00	Pa-231	X	255.77	2.50E-01	Pa-231	796.1	6.99E-01	Pa-234
92.28	3.71E+03	Th-231	X	256.23	2.18E+00	Th-227	804.1	1.68E-01	Pa-234
92.28	2.77E+00	Th-234	X	258.23	1.24E+01	Pa-234m	805.75	9.56E-01	Pa-234m
92.38	3.45E+02	Th-234		260.19	4.19E-01	Pa-231	805.8	6.73E-01	Pa-234
92.8	3.40E+02	Th-234		266.45	6.36E+01	U-235	808.2	4.50E-01	Pa-234m
93.02	4.98E+02	Th-231		267.62	1.33E+01	Th-231	818.2	1.62E-01	Pa-234m
93.35	5.87E+04	U-235	X	269.46	4.35E+00	Ra-223	819.2	5.13E-01	Pa-234
93.35	1.35E+03	U-234	X	271.23	3.38E+00	Rn-219	825.1	5.13E-01	Pa-234
93.35	2.68E+00	U-236	X	272.28	2.93E-01	Pa-234	825.6	1.07E+00	Pa-234m
93.35	1.78E-01	U-238	X	272.91	1.59E-01	Th-227	831.5	1.11E+00	Pa-234
93.88	4.71E-01	Th-227		273.14	1.34E-01	Pa-231	832.01	1.10E+00	Pb-211
94.25	9.33E-01	Ra-223	X	274.1	3.60E-01	Th-231	844.1	1.78E-01	Pa-234m
94.65	3.24E+00	Pa-234	X	275.35	5.41E+02	U-235	844.1	1.14E-01	Pa-234
94.65	1.09E+00	Pa-234m	X	275.49	3.39E+02	U-235	851.58	1.12E+00	Pa-234m
94.87	1.78E+00	Ra-223	X	277.32	1.54E-01	Pa-231	866.8	1.85E-01	Pa-234m
95.86	6.04E+03	Th-231	X	281.42	6.36E+01	U-235	876	6.86E-01	Pa-234
95.86	4.54E+00	Th-234	X	282.92	6.36E+01	U-235	880.5	1.68E+00	Pa-234
96.09	9.65E+02	U-235		283.69	3.79E+00	Pa-231	880.5	1.14E+00	Pa-234
96.84	2.12E-01	Pa-231		286.09	5.43E-01	Th-227	880.9	6.48E-01	Pa-234m
97.53	6.70E-01	Ra-223	X	289.56	7.42E+01	U-235	883.22	5.67E-01	Pa-234m
98.43	5.18E+00	Pa-234	X	289.59	5.93E-01	Th-227	883.24	2.59E+00	Pa-234
98.43	1.75E+00	Pa-234m	X	291.65	4.24E+02	U-235	898.67	8.81E-01	Pa-234
99.28	1.39E+03	Th-231		293.79	8.03E-01	Pa-234	921.72	2.07E+00	Pa-234m
99.86	8.55E-01	Pa-234		295.22	1.20E+00	Pb-214	925	2.12E+00	Pa-234
100.13	1.59E-01	Th-227	X	296.5	1.37E-01	Th-227	926	4.66E-01	Pa-234
102.1	3.35E-01	Pa-231	X	299	1.05E-01	Pa-234m	926.61	2.01E-01	Pa-234m
102.27	4.62E+03	Th-231		299.98	6.90E-01	Th-227	926.72	1.97E+00	Pa-234
102.84	6.38E-01	Pa-231	X	300.07	5.51E+00	Pa-231	934.06	2.02E-01	Bi-214
103.35	5.18E-01	Th-234		301.7	5.30E+01	U-235	936.3	1.78E-01	Pa-234m
104.82	7.26E+03	U-235	X	302.65	4.91E+00	Pa-231	941.96	4.08E-01	Pa-234m
104.82	1.67E+02	U-234	X	302.65	1.52E+00	Pa-231	945.94	1.64E+00	Pa-234m
104.82	3.35E-01	U-236	X	304.5	3.59E-01	Th-227	946	3.63E+00	Pa-234
105.6	1.39E+04	U-235	X	308.78	3.82E+00	Th-231	947.7	4.40E-01	Pa-234
105.6	3.18E+02	U-234	X	311	3.29E+01	Th-231	960	1.30E-01	Pa-234m
105.6	6.30E-01	U-236	X	312.69	1.62E-01	Th-227	965.8	1.30E-01	Pa-234
105.74	2.43E-01	Pa-231	X	312.92	2.28E-01	Pa-231	980.3	7.25E-01	Pa-234
105.81	8.27E+01	Th-231		314.85	1.53E-01	Th-227	980.3	4.77E-01	Pa-234
106.61	1.87E+02	Th-231		314.85	1.53E-01	Th-227	981.6	1.97E-01	Pa-234
107.6	7.53E+02	Th-231	X	317.1	1.06E+01	U-235	984.2	4.40E-01	Pa-234
107.6	5.51E-01	Th-234	X	317.87	1.02E+00	Th-231	996.1	9.07E-01	Pa-234m
108.42	1.43E+03	Th-231	X	320.15	1.59E+00	Th-231	1001.03	1.36E+02	Pa-234m
108.42	1.05E+00	Th-234	X	323.87	1.25E+00	Ra-223	1028.7	1.53E-01	Pa-234
108.58	5.30E+03	U-235	X	329.85	9.05E-01	Th-227	1041.7	2.01E-01	Pa-234m
108.58	1.21E+02	U-234	X	330.06	3.12E+00	Pa-231	1059.4	3.69E-01	Pa-234m
108.58	2.41E-01	U-236	X	330.4	1.27E-01	Pa-234	1061.86	3.47E-01	Pa-234m

Table A2.12. Input peak intensities for the 50 year old highly enriched uranium of Russian origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
6.5	4.94E-01	Th-227		107.6	5.51E-01	Th-234	X	333.37	1.05E-01	Bi-214
9.2	3.50E+02	Th-231		108.42	1.43E+03	Th-231	X	334.01	5.62E-01	Ra-223
10.25	5.32E+02	Th-231		108.42	1.05E+00	Th-234	X	334.37	6.26E+00	Th-227
10.8	1.94E+01	Pb-214	X	108.58	5.30E+03	U-235	X	338.1	1.78E-01	Pa-234m
10.8	1.35E+01	Pb-210	X	108.58	1.21E+02	U-234	X	338.28	1.58E+01	Ra-223
10.8	2.72E+00	Pb-211	X	108.58	2.41E-01	U-236	X	340.74	2.03E+00	Pa-231
11.1	5.67E+00	Rn-219	X	109.19	1.76E+04	U-235		342.55	1.92E+00	Th-227
11.1	1.25E+00	Bi-214	X	110.42	6.50E-01	Pa-234	X	342.87	1.23E+00	Ra-223
11.7	1.27E+02	Ra-223	X	110.42	2.19E-01	Pa-234m	X	342.91	1.95E-01	Pb-211
11.7	1.31E+00	Ra-226	X	110.86	3.23E-01	Ra-223		343.5	3.18E+01	U-235
12	4.58E-01	Ac-227	X	111.3	1.24E+00	Pa-234	X	345.92	4.24E+02	U-235
12.3	1.16E+03	Th-230	X	111.3	4.21E-01	Pa-234m	X	348.92	1.69E-01	Bi-214
12.3	2.08E+00	Fr-223	X	111.49	5.51E+02	Th-231	X	350.54	6.04E-01	Th-227
12.7	3.63E+02	Pa-231	X	111.49	4.05E-01	Th-234	X	351.07	7.24E+01	Bi-211
13	3.27E+06	U-234	X	112.79	2.55E+01	U-236		351.8	7.00E-01	Th-231
13	2.86E+05	U-235	X	112.81	3.40E+01	Th-234		351.9	1.13E-01	Bi-214
13	1.21E+04	U-236	X	113.11	2.97E+00	Th-227		351.9	1.11E-01	Pa-234
13	1.18E+03	U-238	X	113.11	8.51E-01	Th-227		351.93	5.77E+01	Pb-214
13	1.93E+01	Ac-227	X	113.5	1.65E+00	U-238		354.46	1.12E+00	Pa-231
13.3	6.25E+05	Th-231	X	114.44	4.77E-01	Pa-234	X	356.03	5.30E+01	U-235
13.3	1.15E+03	Th-234	X	114.44	1.60E-01	Pa-234m	X	357.12	1.96E+00	Pa-231
13.3	8.75E+00	Pa-234m	X	115.45	3.18E+02	U-235		357.5	1.30E-01	Pa-234m
13.6	2.25E+01	Pa-234	X	115.63	1.12E+01	Th-231		359.3	1.01E-01	Pa-231
13.6	2.20E+00	Pa-234m	X	116.82	2.35E+02	Th-231		362.05	2.56E-01	Ra-223
16.5	3.36E+00	Pa-231		117.2	1.09E+00	Th-227		362.07	2.39E-01	Pb-211
17.2	2.44E+03	Th-231		118.17	1.52E-01	Pb-214		362.63	2.80E-01	Th-227
19	4.26E+00	Pa-231		120.35	2.76E+02	U-235		362.8	1.10E-01	Pa-234m
19.1	2.54E+03	Th-231		120.9	1.14E+04	U-234		369.5	6.73E-01	Pa-234
19.55	6.68E+05	U-235		122.32	6.72E+00	Ra-223		371.68	2.71E+00	Ra-223
20.02	8.10E-01	Th-234		124.91	6.15E+02	Th-231		372	3.29E-01	Pa-234
20.25	1.32E+00	Th-227		125.46	2.12E-01	Pa-234		372.9	2.78E-01	Ra-223
20.27	1.23E-01	Fr-223		130.6	7.23E-01	Rn-219		379.3	5.60E-01	Pa-231
24.5	1.56E-01	Ac-227		131.3	4.90E+00	Pa-234		383.51	1.37E-01	Th-227
25.51	1.31E+00	Pa-231		134.03	2.65E+02	Th-231		386.78	4.78E-01	Bi-214
25.64	1.50E+05	Th-231		134.6	1.87E-01	Th-227		387.6	1.51E-01	Pa-234m
27.36	1.15E+02	Pa-231		135.66	8.37E+02	Th-231		387.84	4.24E+02	U-235
28.6	2.34E-01	Ac-227		136.55	1.27E+02	U-235		388.89	6.51E-01	Bi-214
29.49	1.94E-01	Th-234		136.75	4.66E+01	Th-231		401.81	3.67E+01	Rn-219
29.86	4.17E-01	Th-227		140.1	2.07E-01	Pa-234m		404.85	2.10E+01	Pb-211
29.96	1.22E+00	Pa-231		140.15	1.37E-01	Pa-234		405.72	2.74E-01	Bi-214
31.58	3.73E-01	Th-227		140.54	7.74E+00	Th-231		407.81	4.03E-01	Pa-231
31.6	1.80E+02	U-235		140.76	2.12E+03	U-235		410.29	3.18E+01	U-235
34.7	3.92E+02	U-235		141.42	6.59E-01	Th-227		426.95	1.24E-01	Pa-234
35.83	1.81E-01	Pa-231		141.42	6.59E-01	Th-227		427.09	9.79E+00	Pb-211
37.9	2.73E-01	Ac-227		142.4	5.30E+01	U-235		430.6	1.06E-01	Ra-223
38.19	1.79E+00	Pa-231		143.76	1.16E+05	U-235		432.12	1.95E-01	Ra-223
41.4	3.18E+02	U-235		143.87	7.40E+00	Th-230		445.03	7.17E+00	Ra-223
41.93	1.54E-01	Th-227		144.24	1.82E+01	Ra-223		448.4	1.06E+01	U-235
41.96	6.36E+02	U-235		144.39	1.33E-01	Pa-231		450.97	5.04E-01	Pa-234m
42.86	6.25E+02	Th-231		145.06	6.04E+01	Th-231		453.58	3.45E-01	Pa-234m
43.77	1.17E+00	Th-227		145.94	3.36E+02	Th-231		454.79	4.73E-01	Bi-214
43.8	3.02E-01	Th-227		150.93	9.54E+02	U-235		454.95	8.18E+00	U-234
44.08	7.42E+00	Th-231		152.71	1.63E+00	Pa-234		456.7	1.17E-01	Pa-234m
44.15	7.28E-01	Pa-231		154.21	3.17E+01	Ra-223		458.68	3.08E-01	Pa-234
44.22	2.91E-01	Th-227		158.63	3.86E+00	Ra-223		462.02	3.43E-01	Pb-214
46.35	2.50E+00	Pa-231		159.48	1.76E-01	Pa-234		468.43	3.71E-01	Pa-234m
46.54	2.53E+00	Pb-210		163.1	1.63E+03	Th-231		469.77	2.14E-01	Bi-214
49.46	1.05E+02	U-236		163.36	5.39E+04	U-235		474.44	1.60E-01	Bi-214
49.55	1.04E+01	U-238		165	3.64E+01	Th-231		475.74	3.87E-01	Pa-234m
49.8	2.16E-01	Fr-223		169.66	1.40E+01	Th-231		480.43	5.46E-01	Pb-214
49.82	2.36E+00	Th-227		170.85	1.37E-01	Pa-234		487.14	7.00E-01	Pb-214
50.09	2.62E+00	Fr-223		173.3	6.36E+01	U-235		503.5	3.14E-01	U-234
50.13	4.61E+01	Th-227		174.15	1.89E+02	Th-231		506.75	3.50E-01	Pa-234
51.21	3.60E+02	U-235		175.65	1.06E-01	Ra-223		507.5	2.54E-01	Pa-234m
52.73	9.52E-01	Pa-231		175.8	1.15E-01	Th-227		508.2	4.91E+00	U-234

53.2	4.02E+04	U-234		177.3	2.61E-01	Ra-223		509.2	3.40E-01	Pa-234m
53.23	1.74E+00	Pb-214		179.54	8.51E-01	Ra-223		510	1.23E-01	Rn-222
54.1	5.30E+00	U-235		182.62	4.13E+03	U-235		513.4	2.05E-01	Pa-234
54.25	1.59E+02	U-235		183.5	3.50E+02	Th-231		513.4	1.04E-01	Pa-234
54.6	8.62E-01	Pa-231		184.65	1.98E-01	Th-227		517.6	2.45E-01	Rn-219
57.19	3.02E-01	Pa-231		184.7	2.72E-01	Pa-234m		519.6	1.06E-01	Pa-234
58.57	4.90E+03	Th-231		185.71	6.04E+05	U-235		521.4	2.02E-01	Pa-234
61.44	4.94E-01	Th-227		186.05	1.33E+00	Th-230		527.61	3.95E-01	Ra-223
62.45	1.10E+00	Th-227		186.15	4.79E-01	Pa-234		527.9	1.06E-01	Pa-234
62.45	1.10E+00	Th-227		186.21	5.90E+00	Ra-226		533.66	2.93E-01	Pb-214
62.7	4.14E-01	Pa-234		188.76	3.50E+01	Th-231		536.78	1.05E-01	Bi-214
62.7	1.94E-01	Pa-234m		193.4	1.17E-01	Pa-234m		542.83	1.25E-01	Bi-214
62.86	2.59E+00	Th-234		193.4	1.17E-01	Pa-234m		543.98	5.95E-01	Pa-234m
63.29	5.99E+02	Th-234		193.73	1.35E-01	Pa-234		565.2	2.80E-01	Pa-234
63.65	5.60E-01	Pa-231		194.94	6.68E+03	U-235		568.9	9.84E-01	Pa-234
63.86	2.44E+02	Th-231		196.19	1.09E-01	Pb-214		569.5	2.23E+00	Pa-234
64.35	1.43E-01	Th-227		198.9	3.82E+02	U-235		572	1.41E-01	Pa-234m
64.45	1.38E+02	U-235		200.97	2.44E-01	Pa-234		572.78	1.26E-01	Bi-214
65.42	4.28E-01	Pb-211		201.64	1.32E-01	Th-227		580.14	5.99E-01	Pb-214
67.67	5.74E+01	Th-230		202.12	1.15E+04	U-235		581.7	3.92E+00	U-234
68.5	6.15E+01	Th-231		203.12	3.34E-01	Pa-234		598.72	5.28E-01	Ra-223
68.74	3.18E-01	Th-227		203.3	2.75E-01	Pa-234m		602.6	1.45E-01	Pa-234
68.74	3.18E-01	Th-227		204.14	1.26E+00	Th-227		609.31	3.17E-01	Ra-223
72.7	1.27E+03	U-235		204.98	8.78E-01	Th-227		609.32	7.37E+01	Bi-214
72.75	2.67E+03	Th-231		205.32	5.32E+04	U-235		609.38	2.39E-01	Pb-211
72.85	1.37E-01	Th-227		206.08	1.37E+00	Th-227		612	1.04E-01	Pa-234
73.92	2.11E+00	Th-234		209.9	2.19E-01	Pa-234m		624.4	2.62E-01	U-234
73.92	2.11E+00	Pa-234m		210.62	6.86E+00	Th-227		649	1.62E-01	Pa-234m
74.15	2.69E-01	Pa-231		212.7	4.34E-01	Th-227		653.7	1.27E-01	Pa-234
74.82	9.40E+00	Pb-214	X	212.7	1.04E-01	Th-227		655.3	2.24E-01	Pa-234m
74.82	1.22E+00	Pb-211	X	215.28	3.07E+02	U-235		657.4	1.06E-01	Pa-234
74.94	5.41E+02	U-235		217.94	4.20E+02	Th-231		663.9	1.45E-01	Pa-234
75.01	1.48E-01	Th-227		218.9	6.04E-01	Th-227		665.45	2.48E+00	Bi-214
76.86	3.00E+00	Rn-219	X	218.9	6.04E-01	Th-227		666.5	3.16E-01	Pa-234
76.86	8.83E-01	Bi-214	X	221.32	2.00E-01	Ra-223		669.7	2.69E-01	Pa-234
77.11	1.57E+01	Pb-214	X	221.39	1.25E+03	U-235		673.9	1.05E-01	Pa-234m
77.11	2.04E+00	Pb-211	X	226.5	1.14E+00	Pa-234		677.6	3.21E-01	U-234
77.34	8.18E-01	Pa-231		227.25	1.55E+00	Pa-234		683.23	1.33E-01	Bi-214
77.69	4.45E+01	Th-231		228.78	7.42E+01	U-235		691	1.45E+00	Pa-234m
79.29	4.95E+00	Rn-219	X	233.5	4.03E+02	U-235		692.6	3.37E-01	Pa-234
79.29	1.47E+00	Bi-214	X	234.75	2.31E-01	Fr-223		695.5	2.62E-01	Pa-234m
79.65	6.70E-01	Fr-223		234.76	2.47E+00	Th-227		697.93	1.09E-01	Bi-214
79.69	1.07E+01	Th-227		235.96	7.08E+01	Th-227		699.02	9.23E-01	Pa-234m
81.07	8.34E+01	Ra-223	X	236.01	9.75E+01	Th-231		699.03	9.84E-01	Pa-234
81.07	3.18E-01	Ra-226	X	240.27	3.07E+00	Th-231		702	1.17E+00	Pa-234m
81.23	9.54E+03	Th-231		240.88	7.84E+02	U-235		703.11	7.65E-01	Bi-214
82.09	4.45E+03	Th-231		241.99	1.18E+01	Pb-214		704.64	2.57E+00	Pb-211
83.3	9.72E+00	Th-234		242.5	8.80E+00	Th-231		705.9	6.16E-01	Pa-234
83.79	1.37E+02	Ra-223	X	243.08	5.38E-01	Pa-231		705.94	9.07E-01	Pa-234m
83.79	5.23E-01	Ra-226	X	245.37	2.05E-01	Pa-234		708.2	1.09E-01	Pa-234m
84.21	7.00E+04	Th-231		246.04	1.24E-01	Pa-231		710.71	1.20E-01	Bi-214
85.43	7.36E+00	Th-227	X	246.83	5.83E+02	U-235		719.87	6.35E-01	Bi-214
85.43	6.34E-01	Th-230	X	249.22	6.73E-01	Pa-234		730.9	1.71E-01	Pa-234
85.43	1.26E-01	Fr-223	X	249.3	2.17E-01	Ra-223		732.5	2.11E-01	Pa-234m
86.83	1.90E+00	Pb-214	X	249.6	8.37E+00	Th-231		733.39	1.87E+00	Pa-234
86.83	2.46E-01	Pb-211	X	250.27	2.47E+00	Th-227		738	3.13E-01	Pa-234
87.35	3.63E+00	Pb-214	X	250.45	7.00E+00	Th-231		740.1	1.77E+00	Pa-234m
87.35	4.73E-01	Pb-211	X	251.6	2.34E-01	Ra-223		742.81	1.73E+01	Pa-234m
87.68	8.40E+00	Pa-231	X	252.5	6.09E-01	Th-227		742.81	5.59E-01	Pa-234
88.47	1.20E+01	Th-227	X	253.73	1.68E+00	Th-230		752.85	2.07E-01	Bi-214
88.47	1.03E+00	Th-230	X	253.8	1.28E-01	Th-230		755	3.29E-01	Pa-234
88.47	2.08E-01	Fr-223	X	254.63	3.90E+00	Th-227		766.42	5.14E+01	Pa-234m
89.26	6.01E-01	Rn-219	X	255.2	2.95E-01	Ra-223		766.51	3.43E+00	Pb-211
89.26	1.78E-01	Bi-214	X	255.77	1.25E+00	Pa-231		768.36	7.93E+00	Bi-214
89.78	1.33E+00	Pb-214	X	256.23	3.84E+01	Th-227		780.4	2.44E-01	Pa-234
89.78	1.74E-01	Pb-211	X	258.23	1.24E+01	Pa-234m		781.75	1.26E+00	Pa-234m
89.81	1.17E+00	Rn-219	X	258.86	8.60E-01	Pb-214		785.96	1.72E+00	Pb-214
89.81	3.40E-01	Bi-214	X	260.19	2.11E+00	Pa-231		786.27	3.24E-01	Pa-234
89.95	1.06E+04	Th-231		262.87	5.87E-01	Th-227		786.28	8.81E+00	Pa-234m
89.96	3.64E+04	U-235	X	266.45	6.36E+01	U-235		786.35	5.18E-01	Bi-214

89.96	8.50E+02	U-234	X	267.62	1.33E+01	Th-231	794.9	1.81E-01	Pa-234
89.96	1.66E+00	U-236	X	269.46	7.73E+01	Ra-223	796.1	6.99E-01	Pa-234
89.96	1.10E-01	U-238	X	270.56	1.54E-01	Th-227	804.1	1.68E-01	Pa-234
90.89	1.37E+01	Pa-231	X	271.23	6.01E+01	Rn-219	805.75	9.56E-01	Pa-234m
92.28	3.71E+03	Th-231	X	272.28	2.93E-01	Pa-234	805.8	6.73E-01	Pa-234
92.28	2.77E+00	Th-234	X	272.91	2.80E+00	Th-227	806.18	2.05E+00	Bi-214
92.32	4.28E-01	Rn-219	X	273.14	6.72E-01	Pa-231	808.2	4.50E-01	Pa-234m
92.32	1.26E-01	Bi-214	X	273.8	2.07E-01	Bi-214	818.2	1.62E-01	Pa-234m
92.38	3.45E+02	Th-234		274.1	3.60E-01	Th-231	819.2	5.13E-01	Pa-234
92.8	3.40E+02	Th-234		274.8	5.75E-01	Pb-214	821.18	2.61E-01	Bi-214
93.02	4.98E+02	Th-231		275.35	5.41E+02	U-235	825.1	5.13E-01	Pa-234
93.35	5.87E+04	U-235	X	275.49	3.39E+02	U-235	825.6	1.07E+00	Pa-234m
93.35	1.34E+03	U-234	X	277.32	7.73E-01	Pa-231	826.45	1.90E-01	Bi-214
93.35	2.68E+00	U-236	X	279.8	2.97E-01	Th-227	831.5	1.11E+00	Pa-234
93.35	1.78E-01	U-238	X	280.97	1.09E-01	Bi-214	832.01	1.96E+01	Pb-211
93.88	8.29E+00	Th-227		281.42	6.36E+01	U-235	839.07	9.45E-01	Pb-214
94.25	1.66E+01	Ra-223	X	281.42	9.77E-01	Th-227	844.1	1.78E-01	Pa-234m
94.65	3.24E+00	Pa-234	X	281.42	9.77E-01	Th-227	844.1	1.14E-01	Pa-234
94.65	1.09E+00	Pa-234m	X	282.92	6.36E+01	U-235	851.58	1.12E+00	Pa-234m
94.87	3.16E+01	Ra-223	X	283.69	1.90E+01	Pa-231	866.8	1.85E-01	Pa-234m
94.87	1.21E-01	Ra-226	X	284.24	2.20E-01	Th-227	876	6.86E-01	Pa-234
94.97	1.37E-01	Th-227		285.52	2.42E-01	Th-227	880.5	1.68E+00	Pa-234
94.97	1.37E-01	Th-227		286.09	9.55E+00	Th-227	880.5	1.14E+00	Pa-234
95	1.00E-01	Pb-211		288.18	8.90E-01	Ra-223	880.9	6.48E-01	Pa-234m
95.86	6.04E+03	Th-231	X	289.56	7.42E+01	U-235	883.22	5.67E-01	Pa-234m
95.86	4.54E+00	Th-234	X	289.59	1.04E+01	Th-227	883.24	2.59E+00	Pa-234
96.03	3.84E-01	Th-227		289.77	1.04E-01	Th-227	897.77	1.46E+00	Tl-207
96.09	9.65E+02	U-235		291.65	4.24E+02	U-235	898.67	8.81E-01	Pa-234
96.84	1.06E+00	Pa-231		292.41	3.62E-01	Th-227	904.31	1.23E-01	Bi-214
97.53	1.19E+01	Ra-223	X	293.56	4.06E-01	Rn-219	921.72	2.07E+00	Pa-234m
98.43	5.18E+00	Pa-234	X	293.79	8.03E-01	Pa-234	925	2.12E+00	Pa-234
98.43	1.75E+00	Pa-234m	X	295.22	2.98E+01	Pb-214	926	4.66E-01	Pa-234
99.28	1.39E+03	Th-231		296.5	2.42E+00	Th-227	926.61	2.01E-01	Pa-234m
99.43	1.47E+00	Th-227	X	299	1.05E-01	Pa-234m	926.72	1.97E+00	Pa-234
99.43	1.25E-01	Th-230	X	299.98	1.21E+01	Th-227	934.06	5.03E+00	Bi-214
99.58	1.43E-01	Th-227		300.07	2.77E+01	Pa-231	936.3	1.78E-01	Pa-234m
99.86	8.55E-01	Pa-234		301.7	5.30E+01	U-235	941.96	4.08E-01	Pa-234m
100.13	2.81E+00	Th-227	X	302.65	2.46E+01	Pa-231	945.94	1.64E+00	Pa-234m
100.13	2.40E-01	Th-230	X	302.65	7.62E+00	Pa-231	946	3.63E+00	Pa-234
100.27	4.61E-01	Th-227		304.5	6.31E+00	Th-227	947.7	4.40E-01	Pa-234
100.84	3.36E-01	Pa-231		308.78	3.82E+00	Th-231	951	1.22E-01	Pb-211
102.1	1.68E+00	Pa-231	X	311	3.29E+01	Th-231	960	1.30E-01	Pa-234m
102.27	4.62E+03	Th-231		312.69	2.86E+00	Th-227	964.08	5.91E-01	Bi-214
102.5	1.06E+00	Th-227	X	312.92	1.14E+00	Pa-231	965.8	1.30E-01	Pa-234
102.84	3.20E+00	Pa-231	X	313.59	1.72E-01	Pb-211	980.3	7.25E-01	Pa-234
103.35	5.18E-01	Th-234		314.33	1.26E-01	Pb-214	980.3	4.77E-01	Pa-234
104.23	1.06E-01	Ra-223		314.85	2.69E+00	Th-227	981.6	1.97E-01	Pa-234
104.82	7.26E+03	U-235	X	314.85	2.69E+00	Th-227	984.2	4.40E-01	Pa-234
104.82	1.67E+02	U-234	X	317.1	1.06E+01	U-235	996.1	9.07E-01	Pa-234m
104.82	3.35E-01	U-236	X	317.87	1.02E+00	Th-231	1001.03	1.36E+02	Pa-234m
105.6	1.39E+04	U-235	X	319.24	1.76E-01	Th-227	1028.7	1.53E-01	Pa-234
105.6	3.17E+02	U-234	X	320.15	1.59E+00	Th-231	1032.38	1.02E-01	Bi-214
105.6	6.30E-01	U-236	X	323.87	2.22E+01	Ra-223	1041.7	2.01E-01	Pa-234m
105.74	1.22E+00	Pa-231	X	327.13	4.26E-01	Pa-231	1051.96	5.07E-01	Bi-214
105.81	8.27E+01	Th-231		328.38	1.16E+00	Ra-223	1059.4	3.69E-01	Pa-234m
106.61	1.87E+02	Th-231		329.85	1.59E+01	Th-227	1061.86	3.47E-01	Pa-234m
106.78	1.31E-01	Ra-223		330.06	1.57E+01	Pa-231	1069.96	4.41E-01	Bi-214
107.6	7.53E+02	Th-231	X	330.4	1.27E-01	Pa-234	1081.9	1.46E-01	Pa-234m

Table A2.13. Input peak intensities for the 1 year old highly enriched uranium of American origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
9.2	3.63E+02	Th-231		109.19	1.83E+04	U-235		330.06	3.23E-01	Pa-231
10.25	5.52E+02	Th-231		110.42	3.99E-01	Pa-234	X	338.1	1.09E-01	Pa-234m
12.3	2.35E+01	Th-230	X	110.42	1.34E-01	Pa-234m	X	343.5	3.30E+01	U-235
12.7	7.48E+00	Pa-231	X	111.3	7.63E-01	Pa-234	X	345.92	4.40E+02	U-235
13	3.32E+06	U-234	X	111.3	2.58E-01	Pa-234m	X	351.8	7.26E-01	Th-231
13	2.97E+05	U-235	X	111.49	5.72E+02	Th-231	X	356.03	5.50E+01	U-235
13	1.42E+04	U-236	X	111.49	2.48E-01	Th-234	X	369.5	4.13E-01	Pa-234
13	7.23E+02	U-238	X	112.79	3.00E+01	U-236		372	2.02E-01	Pa-234
13.3	6.49E+05	Th-231	X	112.81	2.08E+01	Th-234		387.84	4.40E+02	U-235
13.3	7.04E+02	Th-234	X	113.5	1.01E+00	U-238		410.29	3.30E+01	U-235
13.3	5.35E+00	Pa-234m	X	114.44	2.93E-01	Pa-234	X	448.4	1.10E+01	U-235
13.6	1.38E+01	Pa-234	X	115.45	3.30E+02	U-235		450.97	3.08E-01	Pa-234m
13.6	1.35E+00	Pa-234m	X	115.63	1.17E+01	Th-231		453.58	2.11E-01	Pa-234m
17.2	2.53E+03	Th-231		116.82	2.44E+02	Th-231		454.95	8.30E+00	U-234
19.1	2.64E+03	Th-231		120.35	2.86E+02	U-235		458.68	1.89E-01	Pa-234
19.55	6.93E+05	U-235		120.9	1.16E+04	U-234		468.43	2.27E-01	Pa-234m
20.02	4.96E-01	Th-234		124.91	6.38E+02	Th-231		475.74	2.37E-01	Pa-234m
25.64	1.55E+05	Th-231		125.46	1.30E-01	Pa-234		503.5	3.19E-01	U-234
27.36	2.38E+00	Pa-231		131.3	3.01E+00	Pa-234		506.75	2.15E-01	Pa-234
29.49	1.19E-01	Th-234		134.03	2.75E+02	Th-231		507.5	1.56E-01	Pa-234m
31.6	1.87E+02	U-235		135.66	8.69E+02	Th-231		508.2	4.98E+00	U-234
34.7	4.07E+02	U-235		136.55	1.32E+02	U-235		509.2	2.08E-01	Pa-234m
41.4	3.30E+02	U-235		136.75	4.84E+01	Th-231		513.4	1.26E-01	Pa-234
41.96	6.60E+02	U-235		140.1	1.27E-01	Pa-234m		521.4	1.24E-01	Pa-234
42.86	6.49E+02	Th-231		140.54	8.03E+00	Th-231		543.98	3.64E-01	Pa-234m
44.08	7.70E+00	Th-231		140.76	2.20E+03	U-235		565.2	1.72E-01	Pa-234
49.46	1.23E+02	U-236		142.4	5.50E+01	U-235		568.9	6.04E-01	Pa-234
49.55	6.34E+00	U-238		143.76	1.21E+05	U-235		569.5	1.37E+00	Pa-234
51.21	3.74E+02	U-235		143.87	1.50E-01	Th-230		581.7	3.98E+00	U-234
53.2	4.08E+04	U-234		145.06	6.27E+01	Th-231		624.4	2.66E-01	U-234
54.1	5.50E+00	U-235		145.94	3.49E+02	Th-231		655.3	1.37E-01	Pa-234m
54.25	1.65E+02	U-235		150.93	9.90E+02	U-235		666.5	1.94E-01	Pa-234
58.57	5.08E+03	Th-231		152.71	1.00E+00	Pa-234		669.7	1.65E-01	Pa-234
62.7	2.54E-01	Pa-234		159.48	1.08E-01	Pa-234		677.6	3.25E-01	U-234
62.7	1.19E-01	Pa-234m		163.1	1.69E+03	Th-231		691	8.84E-01	Pa-234m
62.86	1.59E+00	Th-234		163.36	5.59E+04	U-235		692.6	2.07E-01	Pa-234
63.29	3.67E+02	Th-234		165	3.77E+01	Th-231		695.5	1.61E-01	Pa-234m
63.86	2.53E+02	Th-231		169.66	1.45E+01	Th-231		699.02	5.65E-01	Pa-234m
64.45	1.43E+02	U-235		173.3	6.60E+01	U-235		699.03	6.04E-01	Pa-234
67.67	1.16E+00	Th-230		174.15	1.96E+02	Th-231		702	7.18E-01	Pa-234m
68.5	6.38E+01	Th-231		182.62	4.29E+03	U-235		705.9	3.78E-01	Pa-234
72.7	1.32E+03	U-235		183.5	3.63E+02	Th-231		705.94	5.55E-01	Pa-234m
72.75	2.77E+03	Th-231		184.7	1.67E-01	Pa-234m		730.9	1.05E-01	Pa-234
73.92	1.29E+00	Th-234		185.71	6.27E+05	U-235		732.5	1.29E-01	Pa-234m
73.92	1.29E+00	Pa-234m		186.15	2.94E-01	Pa-234		733.39	1.15E+00	Pa-234
74.94	5.61E+02	U-235		188.76	3.63E+01	Th-231		738	1.92E-01	Pa-234
77.69	4.62E+01	Th-231		194.94	6.93E+03	U-235		740.1	1.08E+00	Pa-234m
81.23	9.90E+03	Th-231		198.9	3.96E+02	U-235		742.81	1.06E+01	Pa-234m
82.09	4.62E+03	Th-231		200.97	1.50E-01	Pa-234		742.81	3.43E-01	Pa-234
83.3	5.95E+00	Th-234		202.12	1.19E+04	U-235		755	2.02E-01	Pa-234
84.21	7.26E+04	Th-231		203.12	2.05E-01	Pa-234		766.42	3.14E+01	Pa-234m
87.68	1.73E-01	Pa-231	X	203.3	1.69E-01	Pa-234m		780.4	1.50E-01	Pa-234
89.95	1.10E+04	Th-231		205.32	5.52E+04	U-235		781.75	7.70E-01	Pa-234m
89.96	3.77E+04	U-235	X	209.9	1.34E-01	Pa-234m		786.27	1.99E-01	Pa-234
89.96	8.63E+02	U-234	X	215.28	3.19E+02	U-235		786.28	5.39E+00	Pa-234m
89.96	1.96E+00	U-236	X	217.94	4.36E+02	Th-231		794.9	1.11E-01	Pa-234
90.89	2.82E-01	Pa-231	X	221.39	1.30E+03	U-235		796.1	4.29E-01	Pa-234
92.28	3.85E+03	Th-231	X	226.5	7.00E-01	Pa-234		804.1	1.03E-01	Pa-234
92.28	1.70E+00	Th-234	X	227.25	9.54E-01	Pa-234		805.75	5.85E-01	Pa-234m
92.38	2.11E+02	Th-234		228.78	7.70E+01	U-235		805.8	4.13E-01	Pa-234
92.8	2.08E+02	Th-234		233.5	4.18E+02	U-235		808.2	2.76E-01	Pa-234m
93.02	5.17E+02	Th-231		236.01	1.01E+02	Th-231		819.2	3.15E-01	Pa-234
93.35	6.09E+04	U-235	X	240.27	3.19E+00	Th-231		825.1	3.15E-01	Pa-234
93.35	1.36E+03	U-234	X	240.88	8.14E+02	U-235		825.6	6.54E-01	Pa-234m
93.35	3.16E+00	U-236	X	242.5	9.13E+00	Th-231		831.5	6.84E-01	Pa-234

93.35	1.09E-01	U-238	X	245.37	1.26E-01	Pa-234	844.1	1.09E-01	Pa-234m
94.65	1.99E+00	Pa-234	X	246.83	6.05E+02	U-235	851.58	6.84E-01	Pa-234m
94.65	6.64E-01	Pa-234m	X	249.22	4.13E-01	Pa-234	866.8	1.13E-01	Pa-234m
95.86	6.27E+03	Th-231	X	249.6	8.69E+00	Th-231	876	4.21E-01	Pa-234
95.86	2.78E+00	Th-234	X	250.45	7.26E+00	Th-231	880.5	1.03E+00	Pa-234
96.09	1.00E+03	U-235		258.23	7.57E+00	Pa-234m	880.5	7.00E-01	Pa-234
98.43	3.18E+00	Pa-234	X	266.45	6.60E+01	U-235	880.9	3.96E-01	Pa-234m
98.43	1.07E+00	Pa-234m	X	267.62	1.38E+01	Th-231	883.22	3.47E-01	Pa-234m
99.28	1.44E+03	Th-231		272.28	1.80E-01	Pa-234	883.24	1.59E+00	Pa-234
99.86	5.25E-01	Pa-234		274.1	3.74E-01	Th-231	898.67	5.41E-01	Pa-234
102.27	4.80E+03	Th-231		275.35	5.61E+02	U-235	921.72	1.27E+00	Pa-234m
103.35	3.17E-01	Th-234		275.49	3.52E+02	U-235	925	1.30E+00	Pa-234
104.82	7.54E+03	U-235	X	281.42	6.60E+01	U-235	926	2.86E-01	Pa-234
104.82	1.69E+02	U-234	X	282.92	6.60E+01	U-235	926.61	1.23E-01	Pa-234m
104.82	3.95E-01	U-236	X	283.69	3.93E-01	Pa-231	926.72	1.21E+00	Pa-234
105.6	1.44E+04	U-235	X	289.56	7.70E+01	U-235	936.3	1.09E-01	Pa-234m
105.6	3.22E+02	U-234	X	291.65	4.40E+02	U-235	941.96	2.50E-01	Pa-234m
105.6	7.43E-01	U-236	X	293.79	4.93E-01	Pa-234	945.94	1.00E+00	Pa-234m
105.81	8.58E+01	Th-231		300.07	5.71E-01	Pa-231	946	2.23E+00	Pa-234
106.61	1.94E+02	Th-231		301.7	5.50E+01	U-235	947.7	2.70E-01	Pa-234
107.6	7.81E+02	Th-231	X	302.65	5.08E-01	Pa-231	980.3	4.45E-01	Pa-234
107.6	3.37E-01	Th-234	X	302.65	1.57E-01	Pa-231	980.3	2.93E-01	Pa-234
108.42	1.49E+03	Th-231	X	308.78	3.96E+00	Th-231	981.6	1.21E-01	Pa-234
108.42	6.44E-01	Th-234	X	311	3.41E+01	Th-231	984.2	2.70E-01	Pa-234
108.58	5.50E+03	U-235	X	317.1	1.10E+01	U-235	996.1	5.55E-01	Pa-234m
108.58	1.23E+02	U-234	X	317.87	1.06E+00	Th-231	1001.03	8.34E+01	Pa-234m
108.58	2.84E-01	U-236	X	320.15	1.65E+00	Th-231	1041.7	1.23E-01	Pa-234m

Table A2.14 Input peak intensities for the 10 year old highly enriched uranium of American origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
9.2	3.63E+02	Th-231		105.74	2.53E-01	Pa-231	X	304.5	3.72E-01	Th-227
10.25	5.52E+02	Th-231		105.81	8.58E+01	Th-231		308.78	3.96E+00	Th-231
10.8	7.90E-01	Pb-214	X	106.61	1.94E+02	Th-231		311	3.41E+01	Th-231
10.8	1.59E-01	Pb-211	X	107.6	7.81E+02	Th-231	X	312.69	1.68E-01	Th-227
10.8	1.44E-01	Pb-210	X	107.6	3.37E-01	Th-234	X	312.92	2.37E-01	Pa-231
11.1	3.32E-01	Rn-219	X	108.42	1.49E+03	Th-231	X	314.85	1.58E-01	Th-227
11.7	7.44E+00	Ra-223	X	108.42	6.44E-01	Th-234	X	314.85	1.58E-01	Th-227
12.3	2.35E+02	Th-230	X	108.58	5.50E+03	U-235	X	317.1	1.10E+01	U-235
12.3	1.24E-01	Fr-223	X	108.58	1.23E+02	U-234	X	317.87	1.06E+00	Th-231
12.7	7.52E+01	Pa-231	X	108.58	2.84E-01	U-236	X	320.15	1.65E+00	Th-231
13	3.32E+06	U-234	X	109.19	1.83E+04	U-235		323.87	1.30E+00	Ra-223
13	2.97E+05	U-235	X	110.42	3.99E-01	Pa-234	X	329.85	9.37E-01	Th-227
13	1.42E+04	U-236	X	110.42	1.34E-01	Pa-234m	X	330.06	3.25E+00	Pa-231
13	7.23E+02	U-238	X	111.3	7.63E-01	Pa-234	X	334.37	3.68E-01	Th-227
13	1.15E+00	Ac-227	X	111.3	2.58E-01	Pa-234m	X	338.1	1.09E-01	Pa-234m
13.3	6.49E+05	Th-231	X	111.49	5.72E+02	Th-231	X	338.28	9.23E-01	Ra-223
13.3	7.04E+02	Th-234	X	111.49	2.48E-01	Th-234	X	340.74	4.20E-01	Pa-231
13.3	5.35E+00	Pa-234m	X	112.79	3.00E+01	U-236		342.55	1.13E-01	Th-227
13.6	1.38E+01	Pa-234	X	112.81	2.08E+01	Th-234		343.5	3.30E+01	U-235
13.6	1.35E+00	Pa-234m	X	113.11	1.74E-01	Th-227		345.92	4.40E+02	U-235
16.5	6.96E-01	Pa-231		113.5	1.01E+00	U-238		351.07	4.23E+00	Bi-211
17.2	2.53E+03	Th-231		114.44	2.93E-01	Pa-234	X	351.8	7.26E-01	Th-231
19	8.82E-01	Pa-231		115.45	3.30E+02	U-235		351.93	2.34E+00	Pb-214
19.1	2.64E+03	Th-231		115.63	1.17E+01	Th-231		354.46	2.32E-01	Pa-231
19.55	6.93E+05	U-235		116.82	2.44E+02	Th-231		356.03	5.50E+01	U-235
20.02	4.96E-01	Th-234		120.35	2.86E+02	U-235		357.12	4.06E-01	Pa-231
25.51	2.71E-01	Pa-231		120.9	1.16E+04	U-234		369.5	4.13E-01	Pa-234
25.64	1.55E+05	Th-231		122.32	3.93E-01	Ra-223		371.68	1.58E-01	Ra-223
27.36	2.39E+01	Pa-231		124.91	6.38E+02	Th-231		372	2.02E-01	Pa-234
29.49	1.19E-01	Th-234		125.46	1.30E-01	Pa-234		379.3	1.16E-01	Pa-231
29.96	2.53E-01	Pa-231		131.3	3.01E+00	Pa-234		387.84	4.40E+02	U-235
31.6	1.87E+02	U-235		134.03	2.75E+02	Th-231		401.81	2.15E+00	Rn-219
34.7	4.07E+02	U-235		135.66	8.69E+02	Th-231		404.85	1.23E+00	Pb-211
38.19	3.71E-01	Pa-231		136.55	1.32E+02	U-235		410.29	3.30E+01	U-235
41.4	3.30E+02	U-235		136.75	4.84E+01	Th-231		427.09	5.72E-01	Pb-211
41.96	6.60E+02	U-235		140.1	1.27E-01	Pa-234m		445.03	4.19E-01	Ra-223
42.86	6.49E+02	Th-231		140.54	8.03E+00	Th-231		448.4	1.10E+01	U-235
44.08	7.70E+00	Th-231		140.76	2.20E+03	U-235		450.97	3.08E-01	Pa-234m
44.15	1.51E-01	Pa-231		142.4	5.50E+01	U-235		453.58	2.11E-01	Pa-234m
46.35	5.17E-01	Pa-231		143.76	1.21E+05	U-235		454.95	8.30E+00	U-234
49.46	1.23E+02	U-236		143.87	1.50E+00	Th-230		458.68	1.89E-01	Pa-234
49.55	6.34E+00	U-238		144.24	1.06E+00	Ra-223		468.43	2.27E-01	Pa-234m
49.82	1.39E-01	Th-227		145.06	6.27E+01	Th-231		475.74	2.37E-01	Pa-234m
50.09	1.56E-01	Fr-223		145.94	3.49E+02	Th-231		503.5	3.19E-01	U-234
50.13	2.71E+00	Th-227		150.93	9.90E+02	U-235		506.75	2.15E-01	Pa-234
51.21	3.74E+02	U-235		152.71	1.00E+00	Pa-234		507.5	1.56E-01	Pa-234m
52.73	1.97E-01	Pa-231		154.21	1.85E+00	Ra-223		508.2	4.98E+00	U-234
53.2	4.08E+04	U-234		158.63	2.26E-01	Ra-223		509.2	2.08E-01	Pa-234m
54.1	5.50E+00	U-235		159.48	1.08E-01	Pa-234		513.4	1.26E-01	Pa-234
54.25	1.65E+02	U-235		163.1	1.69E+03	Th-231		521.4	1.24E-01	Pa-234
54.6	1.79E-01	Pa-231		163.36	5.59E+04	U-235		543.98	3.64E-01	Pa-234m
58.57	5.08E+03	Th-231		165	3.77E+01	Th-231		565.2	1.72E-01	Pa-234
62.7	2.54E-01	Pa-234		169.66	1.45E+01	Th-231		568.9	6.04E-01	Pa-234
62.7	1.19E-01	Pa-234m		173.3	6.60E+01	U-235		569.5	1.37E+00	Pa-234
62.86	1.59E+00	Th-234		174.15	1.96E+02	Th-231		581.7	3.98E+00	U-234
63.29	3.67E+02	Th-234		182.62	4.29E+03	U-235		609.32	2.99E+00	Bi-214
63.65	1.16E-01	Pa-231		183.5	3.63E+02	Th-231		624.4	2.66E-01	U-234
63.86	2.53E+02	Th-231		184.7	1.67E-01	Pa-234m		655.3	1.37E-01	Pa-234m
64.45	1.43E+02	U-235		185.71	6.27E+05	U-235		665.45	1.01E-01	Bi-214
67.67	1.16E+01	Th-230		186.05	2.68E-01	Th-230		666.5	1.94E-01	Pa-234
68.5	6.38E+01	Th-231		186.15	2.94E-01	Pa-234		669.7	1.65E-01	Pa-234
72.7	1.32E+03	U-235		186.21	2.40E-01	Ra-226		677.6	3.25E-01	U-234
72.75	2.77E+03	Th-231		188.76	3.63E+01	Th-231		691	8.84E-01	Pa-234m
73.92	1.29E+00	Th-234		194.94	6.93E+03	U-235		692.6	2.07E-01	Pa-234
73.92	1.29E+00	Pa-234m		198.9	3.96E+02	U-235		695.5	1.61E-01	Pa-234m

74.82	3.82E-01	Pb-214	X	200.97	1.50E-01	Pa-234	699.02	5.65E-01	Pa-234m
74.94	5.61E+02	U-235		202.12	1.19E+04	U-235	699.03	6.04E-01	Pa-234
76.86	1.76E-01	Rn-219	X	203.12	2.05E-01	Pa-234	702	7.18E-01	Pa-234m
77.11	6.38E-01	Pb-214	X	203.3	1.69E-01	Pa-234m	704.64	1.50E-01	Pb-211
77.11	1.19E-01	Pb-211	X	205.32	5.52E+04	U-235	705.9	3.78E-01	Pa-234
77.34	1.69E-01	Pa-231		209.9	1.34E-01	Pa-234m	705.94	5.55E-01	Pa-234m
77.69	4.62E+01	Th-231		210.62	4.04E-01	Th-227	730.9	1.05E-01	Pa-234
79.29	2.89E-01	Rn-219	X	215.28	3.19E+02	U-235	732.5	1.29E-01	Pa-234m
79.69	6.30E-01	Th-227		217.94	4.36E+02	Th-231	733.39	1.15E+00	Pa-234
81.07	4.88E+00	Ra-223	X	221.39	1.30E+03	U-235	738	1.92E-01	Pa-234
81.23	9.90E+03	Th-231		226.5	7.00E-01	Pa-234	740.1	1.08E+00	Pa-234m
82.09	4.62E+03	Th-231		227.25	9.54E-01	Pa-234	742.81	1.06E+01	Pa-234m
83.3	5.95E+00	Th-234		228.78	7.70E+01	U-235	742.81	3.43E-01	Pa-234
83.79	8.03E+00	Ra-223	X	233.5	4.18E+02	U-235	755	2.02E-01	Pa-234
84.21	7.26E+04	Th-231		234.76	1.45E-01	Th-227	766.42	3.14E+01	Pa-234m
85.43	4.33E-01	Th-227	X	235.96	4.17E+00	Th-227	766.51	2.01E-01	Pb-211
85.43	1.28E-01	Th-230	X	236.01	1.01E+02	Th-231	768.36	3.22E-01	Bi-214
87.35	1.47E-01	Pb-214	X	240.27	3.19E+00	Th-231	780.4	1.50E-01	Pa-234
87.68	1.74E+00	Pa-231	X	240.88	8.14E+02	U-235	781.75	7.70E-01	Pa-234m
88.47	7.04E-01	Th-227	X	241.99	4.77E-01	Pb-214	786.27	1.99E-01	Pa-234
88.47	2.07E-01	Th-230	X	242.5	9.13E+00	Th-231	786.28	5.39E+00	Pa-234m
89.95	1.10E+04	Th-231		243.08	1.11E-01	Pa-231	794.9	1.11E-01	Pa-234
89.96	3.77E+04	U-235	X	245.37	1.26E-01	Pa-234	796.1	4.29E-01	Pa-234
89.96	8.63E+02	U-234	X	246.83	6.05E+02	U-235	804.1	1.03E-01	Pa-234
89.96	1.96E+00	U-236	X	249.22	4.13E-01	Pa-234	805.75	5.85E-01	Pa-234m
90.89	2.83E+00	Pa-231	X	249.6	8.69E+00	Th-231	805.8	4.13E-01	Pa-234
92.28	3.85E+03	Th-231	X	250.27	1.45E-01	Th-227	808.2	2.76E-01	Pa-234m
92.28	1.70E+00	Th-234	X	250.45	7.26E+00	Th-231	819.2	3.15E-01	Pa-234
92.38	2.11E+02	Th-234		253.73	3.39E-01	Th-230	825.1	3.15E-01	Pa-234
92.8	2.08E+02	Th-234		254.63	2.29E-01	Th-227	825.6	6.54E-01	Pa-234m
93.02	5.17E+02	Th-231		255.77	2.60E-01	Pa-231	831.5	6.84E-01	Pa-234
93.35	6.09E+04	U-235	X	256.23	2.26E+00	Th-227	832.01	1.14E+00	Pb-211
93.35	1.36E+03	U-234	X	258.23	7.57E+00	Pa-234m	844.1	1.09E-01	Pa-234m
93.35	3.16E+00	U-236	X	260.19	4.36E-01	Pa-231	851.58	6.84E-01	Pa-234m
93.35	1.09E-01	U-238	X	266.45	6.60E+01	U-235	866.8	1.13E-01	Pa-234m
93.88	4.88E-01	Th-227		267.62	1.38E+01	Th-231	876	4.21E-01	Pa-234
94.25	9.69E-01	Ra-223	X	269.46	4.52E+00	Ra-223	880.5	1.03E+00	Pa-234
94.65	1.99E+00	Pa-234	X	271.23	3.51E+00	Rn-219	880.5	7.00E-01	Pa-234
94.65	6.64E-01	Pa-234m	X	272.28	1.80E-01	Pa-234	880.9	3.96E-01	Pa-234m
94.87	1.85E+00	Ra-223	X	272.91	1.65E-01	Th-227	883.22	3.47E-01	Pa-234m
95.86	6.27E+03	Th-231	X	273.14	1.39E-01	Pa-231	883.24	1.59E+00	Pa-234
95.86	2.78E+00	Th-234	X	274.1	3.74E-01	Th-231	898.67	5.41E-01	Pa-234
96.09	1.00E+03	U-235		275.35	5.61E+02	U-235	921.72	1.27E+00	Pa-234m
96.84	2.20E-01	Pa-231		275.49	3.52E+02	U-235	925	1.30E+00	Pa-234
97.53	6.96E-01	Ra-223	X	277.32	1.60E-01	Pa-231	926	2.86E-01	Pa-234
98.43	3.18E+00	Pa-234	X	281.42	6.60E+01	U-235	926.61	1.23E-01	Pa-234m
98.43	1.07E+00	Pa-234m	X	282.92	6.60E+01	U-235	926.72	1.21E+00	Pa-234
99.28	1.44E+03	Th-231		283.69	3.94E+00	Pa-231	934.06	2.04E-01	Bi-214
99.86	5.25E-01	Pa-234		286.09	5.62E-01	Th-227	936.3	1.09E-01	Pa-234m
100.13	1.65E-01	Th-227	X	289.56	7.70E+01	U-235	941.96	2.50E-01	Pa-234m
102.1	3.48E-01	Pa-231	X	289.59	6.14E-01	Th-227	945.94	1.00E+00	Pa-234m
102.27	4.80E+03	Th-231		291.65	4.40E+02	U-235	946	2.23E+00	Pa-234
102.84	6.64E-01	Pa-231	X	293.79	4.93E-01	Pa-234	947.7	2.70E-01	Pa-234
103.35	3.17E-01	Th-234		295.22	1.21E+00	Pb-214	980.3	4.45E-01	Pa-234
104.82	7.54E+03	U-235	X	296.5	1.42E-01	Th-227	980.3	2.93E-01	Pa-234
104.82	1.69E+02	U-234	X	299.98	7.14E-01	Th-227	981.6	1.21E-01	Pa-234
104.82	3.95E-01	U-236	X	300.07	5.73E+00	Pa-231	984.2	2.70E-01	Pa-234
105.6	1.44E+04	U-235	X	301.7	5.50E+01	U-235	996.1	5.55E-01	Pa-234m
105.6	3.22E+02	U-234	X	302.65	5.10E+00	Pa-231	1001.03	8.34E+01	Pa-234m
105.6	7.43E-01	U-236	X	302.65	1.58E+00	Pa-231	1041.7	1.23E-01	Pa-234m

Table A2.15. Input peak intensities for the 50 year old highly enriched uranium of American origin between 0 and 1100 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
6.5	5.12E-01	Th-227		104.82	1.69E+02	U-234	X	313.59	1.79E-01	Pb-211
9.2	3.63E+02	Th-231		104.82	3.95E-01	U-236	X	314.33	1.28E-01	Pb-214
10.25	5.52E+02	Th-231		105.6	1.44E+04	U-235	X	314.85	2.79E+00	Th-227
10.8	1.97E+01	Pb-214	X	105.6	3.22E+02	U-234	X	314.85	2.79E+00	Th-227
10.8	1.37E+01	Pb-210	X	105.6	7.43E-01	U-236	X	317.1	1.10E+01	U-235
10.8	2.82E+00	Pb-211	X	105.74	1.26E+00	Pa-231	X	317.87	1.06E+00	Th-231
11.1	5.88E+00	Rn-219	X	105.81	8.58E+01	Th-231		319.24	1.82E-01	Th-227
11.1	1.26E+00	Bi-214	X	106.61	1.94E+02	Th-231		320.15	1.65E+00	Th-231
11.7	1.32E+02	Ra-223	X	106.78	1.36E-01	Ra-223		323.87	2.30E+01	Ra-223
11.7	1.33E+00	Ra-226	X	107.6	7.81E+02	Th-231	X	327.13	4.41E-01	Pa-231
12	4.75E-01	Ac-227	X	107.6	3.37E-01	Th-234	X	328.38	1.20E+00	Ra-223
12.3	1.17E+03	Th-230	X	108.42	1.49E+03	Th-231	X	329.85	1.65E+01	Th-227
12.3	2.16E+00	Fr-223	X	108.42	6.44E-01	Th-234	X	330.06	1.62E+01	Pa-231
12.7	3.76E+02	Pa-231	X	108.58	5.50E+03	U-235	X	333.37	1.07E-01	Bi-214
13	3.32E+06	U-234	X	108.58	1.23E+02	U-234	X	334.01	5.82E-01	Ra-223
13	2.97E+05	U-235	X	108.58	2.84E-01	U-236	X	334.37	6.49E+00	Th-227
13	1.42E+04	U-236	X	109.19	1.83E+04	U-235		338.1	1.09E-01	Pa-234m
13	7.23E+02	U-238	X	110.42	3.99E-01	Pa-234	X	338.28	1.64E+01	Ra-223
13	2.00E+01	Ac-227	X	110.42	1.34E-01	Pa-234m	X	340.74	2.10E+00	Pa-231
13.3	6.49E+05	Th-231	X	110.86	3.34E-01	Ra-223		342.55	1.99E+00	Th-227
13.3	7.04E+02	Th-234	X	111.3	7.63E-01	Pa-234	X	342.87	1.28E+00	Ra-223
13.3	5.35E+00	Pa-234m	X	111.3	2.58E-01	Pa-234m	X	342.91	2.02E-01	Pb-211
13.6	1.38E+01	Pa-234	X	111.49	5.72E+02	Th-231	X	343.5	3.30E+01	U-235
13.6	1.35E+00	Pa-234m	X	111.49	2.48E-01	Th-234	X	345.92	4.40E+02	U-235
16.5	3.48E+00	Pa-231		112.79	3.00E+01	U-236		348.92	1.71E-01	Bi-214
17.2	2.53E+03	Th-231		112.81	2.08E+01	Th-234		350.54	6.26E-01	Th-227
19	4.41E+00	Pa-231		113.11	3.07E+00	Th-227		351.07	7.50E+01	Bi-211
19.1	2.64E+03	Th-231		113.11	8.82E-01	Th-227		351.8	7.26E-01	Th-231
19.55	6.93E+05	U-235		113.5	1.01E+00	U-238		351.9	1.15E-01	Bi-214
20.02	4.96E-01	Th-234		114.44	2.93E-01	Pa-234	X	351.93	5.84E+01	Pb-214
20.25	1.37E+00	Th-227		115.45	3.30E+02	U-235		354.46	1.16E+00	Pa-231
20.27	1.28E-01	Fr-223		115.63	1.17E+01	Th-231		356.03	5.50E+01	U-235
24.5	1.62E-01	Ac-227		116.82	2.44E+02	Th-231		357.12	2.03E+00	Pa-231
25.51	1.36E+00	Pa-231		117.2	1.13E+00	Th-227		359.3	1.04E-01	Pa-231
25.64	1.55E+05	Th-231		118.17	1.54E-01	Pb-214		362.05	2.65E-01	Ra-223
27.36	1.20E+02	Pa-231		120.35	2.86E+02	U-235		362.07	2.48E-01	Pb-211
28.6	2.43E-01	Ac-227		120.9	1.16E+04	U-234		362.63	2.90E-01	Th-227
29.49	1.19E-01	Th-234		122.32	6.96E+00	Ra-223		369.5	4.13E-01	Pa-234
29.86	4.32E-01	Th-227		124.91	6.38E+02	Th-231		371.68	2.81E+00	Ra-223
29.96	1.26E+00	Pa-231		125.46	1.30E-01	Pa-234		372	2.02E-01	Pa-234
31.58	3.87E-01	Th-227		130.6	7.49E-01	Rn-219		372.9	2.88E-01	Ra-223
31.6	1.87E+02	U-235		131.3	3.01E+00	Pa-234		379.3	5.80E-01	Pa-231
34.7	4.07E+02	U-235		134.03	2.75E+02	Th-231		383.51	1.42E-01	Th-227
35.83	1.88E-01	Pa-231		134.6	1.94E-01	Th-227		386.78	4.84E-01	Bi-214
37.9	2.84E-01	Ac-227		135.66	8.69E+02	Th-231		387.84	4.40E+02	U-235
38.19	1.86E+00	Pa-231		136.55	1.32E+02	U-235		388.89	6.59E-01	Bi-214
41.4	3.30E+02	U-235		136.75	4.84E+01	Th-231		398.14	1.02E-01	Pa-231
41.93	1.59E-01	Th-227		140.1	1.27E-01	Pa-234m		401.81	3.80E+01	Rn-219
41.96	6.60E+02	U-235		140.54	8.03E+00	Th-231		404.85	2.18E+01	Pb-211
42.86	6.49E+02	Th-231		140.76	2.20E+03	U-235		405.72	2.77E-01	Bi-214
43.77	1.21E+00	Th-227		141.42	6.83E-01	Th-227		407.81	4.18E-01	Pa-231
43.8	3.13E-01	Th-227		141.42	6.83E-01	Th-227		410.29	3.30E+01	U-235
44.08	7.70E+00	Th-231		142.4	5.50E+01	U-235		427.09	1.01E+01	Pb-211
44.15	7.54E-01	Pa-231		143.76	1.21E+05	U-235		430.6	1.09E-01	Ra-223
44.22	3.02E-01	Th-227		143.87	7.45E+00	Th-230		432.12	2.02E-01	Ra-223
46.35	2.59E+00	Pa-231		144.24	1.88E+01	Ra-223		445.03	7.43E+00	Ra-223
46.54	2.56E+00	Pb-210		144.39	1.38E-01	Pa-231		448.4	1.10E+01	U-235
49.46	1.23E+02	U-236		145.06	6.27E+01	Th-231		450.97	3.08E-01	Pa-234m
49.55	6.34E+00	U-238		145.94	3.49E+02	Th-231		453.58	2.11E-01	Pa-234m
49.8	2.24E-01	Fr-223		150.93	9.90E+02	U-235		454.79	4.79E-01	Bi-214
49.82	2.45E+00	Th-227		152.71	1.00E+00	Pa-234		454.95	8.30E+00	U-234
50.09	2.72E+00	Fr-223		154.21	3.28E+01	Ra-223		458.68	1.89E-01	Pa-234
50.13	4.78E+01	Th-227		158.63	4.00E+00	Ra-223		462.02	3.48E-01	Pb-214
51.21	3.74E+02	U-235		159.48	1.08E-01	Pa-234		468.43	2.27E-01	Pa-234m
52.73	9.86E-01	Pa-231		163.1	1.69E+03	Th-231		469.77	2.17E-01	Bi-214

53.2	4.08E+04	U-234		163.36	5.59E+04	U-235		474.44	1.62E-01	Bi-214
53.23	1.76E+00	Pb-214		165	3.77E+01	Th-231		475.74	2.37E-01	Pa-234m
54.1	5.50E+00	U-235		169.66	1.45E+01	Th-231		480.43	5.53E-01	Pb-214
54.25	1.65E+02	U-235		173.3	6.60E+01	U-235		487.14	7.09E-01	Pb-214
54.6	8.93E-01	Pa-231		174.15	1.96E+02	Th-231		503.5	3.19E-01	U-234
57.19	3.13E-01	Pa-231		175.65	1.09E-01	Ra-223		506.75	2.15E-01	Pa-234
58.57	5.08E+03	Th-231		175.8	1.20E-01	Th-227		507.5	1.56E-01	Pa-234m
61.44	5.12E-01	Th-227		177.3	2.71E-01	Ra-223		508.2	4.98E+00	U-234
62.45	1.14E+00	Th-227		179.54	8.81E-01	Ra-223		509.2	2.08E-01	Pa-234m
62.45	1.14E+00	Th-227		182.62	4.29E+03	U-235		510	1.25E-01	Rn-222
62.7	2.54E-01	Pa-234		183.5	3.63E+02	Th-231		513.4	1.26E-01	Pa-234
62.7	1.19E-01	Pa-234m		184.65	2.05E-01	Th-227		517.6	2.53E-01	Rn-219
62.86	1.59E+00	Th-234		184.7	1.67E-01	Pa-234m		521.4	1.24E-01	Pa-234
63.29	3.67E+02	Th-234		185.71	6.27E+05	U-235		527.61	4.09E-01	Ra-223
63.65	5.80E-01	Pa-231		186.05	1.34E+00	Th-230		533.66	2.97E-01	Pb-214
63.86	2.53E+02	Th-231		186.15	2.94E-01	Pa-234		536.78	1.07E-01	Bi-214
64.35	1.48E-01	Th-227		186.21	5.97E+00	Ra-226		542.83	1.26E-01	Bi-214
64.45	1.43E+02	U-235		188.76	3.63E+01	Th-231		543.98	3.64E-01	Pa-234m
65.42	4.44E-01	Pb-211		194.94	6.93E+03	U-235		565.2	1.72E-01	Pa-234
67.67	5.78E+01	Th-230		196.19	1.10E-01	Pb-214		568.9	6.04E-01	Pa-234
68.5	6.38E+01	Th-231		198.9	3.96E+02	U-235		569.5	1.37E+00	Pa-234
68.74	3.30E-01	Th-227		200.97	1.50E-01	Pa-234		572.78	1.28E-01	Bi-214
68.74	3.30E-01	Th-227		201.64	1.37E-01	Th-227		580.14	6.07E-01	Pb-214
72.7	1.32E+03	U-235		202.12	1.19E+04	U-235		581.7	3.98E+00	U-234
72.75	2.77E+03	Th-231		203.12	2.05E-01	Pa-234		598.72	5.47E-01	Ra-223
72.85	1.42E-01	Th-227		203.3	1.69E-01	Pa-234m		609.31	3.28E-01	Ra-223
73.92	1.29E+00	Th-234		204.14	1.31E+00	Th-227		609.32	7.46E+01	Bi-214
73.92	1.29E+00	Pa-234m		204.98	9.10E-01	Th-227		609.38	2.48E-01	Pb-211
74.15	2.78E-01	Pa-231		205.32	5.52E+04	U-235		624.4	2.66E-01	U-234
74.82	9.51E+00	Pb-214	X	206.08	1.42E+00	Th-227		655.3	1.37E-01	Pa-234m
74.82	1.27E+00	Pb-211	X	209.9	1.34E-01	Pa-234m		665.45	2.51E+00	Bi-214
74.94	5.61E+02	U-235		210.62	7.11E+00	Th-227		666.5	1.94E-01	Pa-234
75.01	1.54E-01	Th-227		212.7	4.50E-01	Th-227		669.7	1.65E-01	Pa-234
76.86	3.11E+00	Rn-219	X	212.7	1.08E-01	Th-227		677.6	3.25E-01	U-234
76.86	8.94E-01	Bi-214	X	215.28	3.19E+02	U-235		683.23	1.35E-01	Bi-214
77.11	1.59E+01	Pb-214	X	217.94	4.36E+02	Th-231		691	8.84E-01	Pa-234m
77.11	2.11E+00	Pb-211	X	218.9	6.26E-01	Th-227		692.6	2.07E-01	Pa-234
77.34	8.47E-01	Pa-231		218.9	6.26E-01	Th-227		695.5	1.61E-01	Pa-234m
77.69	4.62E+01	Th-231		221.32	2.07E-01	Ra-223		697.93	1.10E-01	Bi-214
79.29	5.13E+00	Rn-219	X	221.39	1.30E+03	U-235		699.02	5.65E-01	Pa-234m
79.29	1.49E+00	Bi-214	X	226.5	7.00E-01	Pa-234		699.03	6.04E-01	Pa-234
79.65	6.95E-01	Fr-223		227.25	9.54E-01	Pa-234		702	7.18E-01	Pa-234m
79.69	1.11E+01	Th-227		228.78	7.70E+01	U-235		703.11	7.74E-01	Bi-214
81.07	8.64E+01	Ra-223	X	233.5	4.18E+02	U-235		704.64	2.66E+00	Pb-211
81.07	3.21E-01	Ra-226	X	234.75	2.40E-01	Fr-223		705.9	3.78E-01	Pa-234
81.23	9.90E+03	Th-231		234.76	2.56E+00	Th-227		705.94	5.55E-01	Pa-234m
82.09	4.62E+03	Th-231		235.96	7.34E+01	Th-227		710.71	1.21E-01	Bi-214
83.3	5.95E+00	Th-234		236.01	1.01E+02	Th-231		719.87	6.43E-01	Bi-214
83.79	1.42E+02	Ra-223	X	240.27	3.19E+00	Th-231		730.9	1.05E-01	Pa-234
83.79	5.30E-01	Ra-226	X	240.88	8.14E+02	U-235		732.5	1.29E-01	Pa-234m
84.21	7.26E+04	Th-231		241.99	1.19E+01	Pb-214		733.39	1.15E+00	Pa-234
85.43	7.63E+00	Th-227	X	242.5	9.13E+00	Th-231		738	1.92E-01	Pa-234
85.43	6.38E-01	Th-230	X	243.08	5.57E-01	Pa-231		740.1	1.08E+00	Pa-234m
85.43	1.30E-01	Fr-223	X	245.37	1.26E-01	Pa-234		742.81	1.06E+01	Pa-234m
86.83	1.92E+00	Pb-214	X	246.04	1.29E-01	Pa-231		742.81	3.43E-01	Pa-234
86.83	2.55E-01	Pb-211	X	246.83	6.05E+02	U-235		752.85	2.10E-01	Bi-214
87.35	3.67E+00	Pb-214	X	249.22	4.13E-01	Pa-234		755	2.02E-01	Pa-234
87.35	4.90E-01	Pb-211	X	249.3	2.25E-01	Ra-223		766.42	3.14E+01	Pa-234m
87.68	8.70E+00	Pa-231	X	249.6	8.69E+00	Th-231		766.51	3.55E+00	Pb-211
88.47	1.24E+01	Th-227	X	250.27	2.56E+00	Th-227		768.36	8.03E+00	Bi-214
88.47	1.03E+00	Th-230	X	250.45	7.26E+00	Th-231		780.4	1.50E-01	Pa-234
88.47	2.16E-01	Fr-223	X	251.6	2.42E-01	Ra-223		781.75	7.70E-01	Pa-234m
89.26	6.22E-01	Rn-219	X	252.5	6.32E-01	Th-227		785.96	1.74E+00	Pb-214
89.26	1.80E-01	Bi-214	X	253.73	1.69E+00	Th-230		786.27	1.99E-01	Pa-234
89.78	1.35E+00	Pb-214	X	253.8	1.29E-01	Th-230		786.28	5.39E+00	Pa-234m
89.78	1.80E-01	Pb-211	X	254.63	4.04E+00	Th-227		786.35	5.25E-01	Bi-214
89.81	1.21E+00	Rn-219	X	255.2	3.05E-01	Ra-223		794.9	1.11E-01	Pa-234
89.81	3.44E-01	Bi-214	X	255.77	1.30E+00	Pa-231		796.1	4.29E-01	Pa-234
89.95	1.10E+04	Th-231		256.23	3.98E+01	Th-227		804.1	1.03E-01	Pa-234
89.96	3.77E+04	U-235	X	258.23	7.57E+00	Pa-234m		805.75	5.85E-01	Pa-234m

89.96	8.63E+02	U-234	X	258.86	8.71E-01	Pb-214	805.8	4.13E-01	Pa-234
89.96	1.96E+00	U-236	X	260.19	2.18E+00	Pa-231	806.18	2.07E+00	Bi-214
90.89	1.42E+01	Pa-231	X	262.87	6.09E-01	Th-227	808.2	2.76E-01	Pa-234m
92.28	3.85E+03	Th-231	X	266.45	6.60E+01	U-235	819.2	3.15E-01	Pa-234
92.28	1.70E+00	Th-234	X	267.62	1.38E+01	Th-231	821.18	2.64E-01	Bi-214
92.32	4.44E-01	Rn-219	X	269.46	8.01E+01	Ra-223	825.1	3.15E-01	Pa-234
92.32	1.27E-01	Bi-214	X	270.56	1.59E-01	Th-227	825.6	6.54E-01	Pa-234m
92.38	2.11E+02	Th-234		271.23	6.22E+01	Rn-219	826.45	1.92E-01	Bi-214
92.8	2.08E+02	Th-234		272.28	1.80E-01	Pa-234	831.5	6.84E-01	Pa-234
93.02	5.17E+02	Th-231		272.91	2.90E+00	Th-227	832.01	2.03E+01	Pb-211
93.35	6.09E+04	U-235	X	273.14	6.96E-01	Pa-231	839.07	9.56E-01	Pb-214
93.35	1.36E+03	U-234	X	273.8	2.10E-01	Bi-214	844.1	1.09E-01	Pa-234m
93.35	3.16E+00	U-236	X	274.1	3.74E-01	Th-231	851.58	6.84E-01	Pa-234m
93.35	1.09E-01	U-238	X	274.8	5.82E-01	Pb-214	866.8	1.13E-01	Pa-234m
93.88	8.59E+00	Th-227		275.35	5.61E+02	U-235	876	4.21E-01	Pa-234
94.25	1.72E+01	Ra-223	X	275.49	3.52E+02	U-235	880.5	1.03E+00	Pa-234
94.65	1.99E+00	Pa-234	X	277.32	8.00E-01	Pa-231	880.5	7.00E-01	Pa-234
94.65	6.64E-01	Pa-234m	X	279.8	3.07E-01	Th-227	880.9	3.96E-01	Pa-234m
94.87	3.28E+01	Ra-223	X	280.97	1.10E-01	Bi-214	883.22	3.47E-01	Pa-234m
94.87	1.22E-01	Ra-226	X	281.42	6.60E+01	U-235	883.24	1.59E+00	Pa-234
94.97	1.42E-01	Th-227		281.42	1.01E+00	Th-227	897.77	1.51E+00	Tl-207
94.97	1.42E-01	Th-227		281.42	1.01E+00	Th-227	898.67	5.41E-01	Pa-234
95	1.04E-01	Pb-211		282.92	6.60E+01	U-235	904.31	1.25E-01	Bi-214
95.86	6.27E+03	Th-231	X	283.69	1.97E+01	Pa-231	921.72	1.27E+00	Pa-234m
95.86	2.78E+00	Th-234	X	284.24	2.28E-01	Th-227	925	1.30E+00	Pa-234
96.03	3.98E-01	Th-227		285.52	2.50E-01	Th-227	926	2.86E-01	Pa-234
96.09	1.00E+03	U-235		286.09	9.90E+00	Th-227	926.61	1.23E-01	Pa-234m
96.84	1.10E+00	Pa-231		288.18	9.22E-01	Ra-223	926.72	1.21E+00	Pa-234
97.53	1.23E+01	Ra-223	X	289.56	7.70E+01	U-235	934.06	5.10E+00	Bi-214
98.43	3.18E+00	Pa-234	X	289.59	1.08E+01	Th-227	936.3	1.09E-01	Pa-234m
98.43	1.07E+00	Pa-234m	X	289.77	1.08E-01	Th-227	941.96	2.50E-01	Pa-234m
99.28	1.44E+03	Th-231		291.65	4.40E+02	U-235	945.94	1.00E+00	Pa-234m
99.43	1.52E+00	Th-227	X	292.41	3.76E-01	Th-227	946	2.23E+00	Pa-234
99.43	1.26E-01	Th-230	X	293.56	4.21E-01	Rn-219	947.7	2.70E-01	Pa-234
99.58	1.48E-01	Th-227		293.79	4.93E-01	Pa-234	951	1.27E-01	Pb-211
99.86	5.25E-01	Pa-234		295.22	3.02E+01	Pb-214	964.08	5.99E-01	Bi-214
100.13	2.91E+00	Th-227	X	296.5	2.50E+00	Th-227	980.3	4.45E-01	Pa-234
100.13	2.42E-01	Th-230	X	299.98	1.26E+01	Th-227	980.3	2.93E-01	Pa-234
100.27	4.78E-01	Th-227		300.07	2.87E+01	Pa-231	981.6	1.21E-01	Pa-234
100.84	3.48E-01	Pa-231		301.7	5.50E+01	U-235	984.2	2.70E-01	Pa-234
102.1	1.74E+00	Pa-231	X	302.65	2.55E+01	Pa-231	996.1	5.55E-01	Pa-234m
102.27	4.80E+03	Th-231		302.65	7.89E+00	Pa-231	1001.03	8.34E+01	Pa-234m
102.5	1.10E+00	Th-227	X	304.5	6.54E+00	Th-227	1032.38	1.03E-01	Bi-214
102.84	3.32E+00	Pa-231	X	308.78	3.96E+00	Th-231	1041.7	1.23E-01	Pa-234m
103.35	3.17E-01	Th-234		311	3.41E+01	Th-231	1051.96	5.13E-01	Bi-214
104.23	1.09E-01	Ra-223		312.69	2.96E+00	Th-227	1059.4	2.26E-01	Pa-234m
104.82	7.54E+03	U-235	X	312.92	1.18E+00	Pa-231	1061.86	2.12E-01	Pa-234m

Table A2.16. Input peak intensities for the 1 year old reactor grade plutonium between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
8.22	1.07E-01	Np-237		111.3	1.76E+00	Pu-240	X	332.35	1.06E+01	Am-241
12.98	5.28E+03	Pu-239		113.3	3.25E+03	U-237	X	332.85	7.06E+01	Pu-239
13	1.76E+01	U-234	X	113.3	1.61E+01	Am-241	X	335.37	1.01E+02	U-237
13.3	5.87E-01	Np-237	X	114	3.51E+03	Pu-241		335.37	3.53E+01	Am-241
13.6	6.34E+06	Pu-238	X	114.23	6.16E+03	U-237	X	336.11	1.60E+01	Pu-239
13.6	1.76E+06	Pu-240	X	114.23	3.06E+01	Am-241	X	337.7	9.43E+00	U-237
13.6	6.14E+05	Pu-239	X	114.44	1.99E+03	Pu-241	X	337.7	3.05E-01	Am-241
13.6	5.41E+04	Pu-241	X	114.44	7.44E+01	Pu-239	X	341.51	9.47E+00	Pu-239
13.6	3.68E+03	Pu-242	X	114.44	5.30E+00	Pu-238	X	345.01	7.95E+01	Pu-239
13.6	4.17E-01	Pa-233	X	114.44	6.83E-01	Pu-240	X	345.01	4.29E+00	Pu-239
13.81	1.05E+02	U-237		115.38	6.58E+01	Pu-239		354	1.00E-01	Pu-239
13.9	2.63E+06	Am-241	X	116.26	8.11E+01	Pu-239		361.89	1.75E+00	Pu-239
13.9	6.57E+04	U-237	X	117.46	2.41E+03	U-237	X	367.07	1.27E+01	Pu-239
26.34	1.61E+05	Am-241		117.46	1.19E+01	Am-241	X	368.55	1.26E+01	Pu-239
26.34	2.58E+03	U-237		119.7	3.00E+00	Pu-239		368.62	4.16E+01	U-237
26.7	4.33E+03	Pu-241		119.7	1.36E+00	Pu-239		368.65	1.54E+01	Am-241
29.37	1.68E-01	Np-237		120.36	3.20E-01	Am-241		370.94	1.14E+02	U-237
30.04	3.10E+01	Pu-239		121.2	2.97E+01	Pu-241		370.94	3.72E+00	Am-241
33.2	8.96E+03	Am-241		122.35	1.36E-01	Pu-239		375.05	2.22E+02	Pu-239
33.2	1.38E+02	U-237		123.05	7.11E+01	Am-241		376.65	9.81E+00	Am-241
38.54	4.24E+02	U-237		123.62	3.39E+00	Pu-239		380.19	4.36E+01	Pu-239
38.66	1.49E+03	Pu-239		124.51	9.74E+00	Pu-239		382.75	3.70E+01	Pu-239
41.93	2.09E+01	Pu-239		125.21	8.05E+00	Pu-239		383.81	2.01E+00	Am-241
42.7	3.91E+02	Am-241		125.3	2.90E+02	Am-241		392.53	2.93E+01	Pu-239
43.42	5.19E+03	Am-241		129.3	9.02E+02	Pu-239		393.14	5.01E+01	Pu-239
43.42	2.54E+01	U-237		139.44	3.77E-01	Am-241		398.64	1.42E-01	Am-241
43.5	2.44E+04	Pu-238		141.66	4.58E+00	Pu-239		399.53	8.44E-01	Pu-239
44.2	1.80E+02	Pu-241		143.35	2.47E+00	Pu-239		406.35	1.03E-01	Am-241
44.86	3.61E+01	Pu-241		144.2	4.05E+01	Pu-239		406.8	3.58E-01	Pu-239
44.92	1.62E+01	Pu-242		146.09	1.70E+01	Pu-239		411.2	1.00E+00	Pu-239
45.24	8.18E+03	Pu-240		146.55	3.28E+01	Am-241		413.71	2.10E+02	Pu-239
46.21	1.03E+01	Pu-239		148.57	8.05E+03	Pu-241		419.33	2.04E+00	Am-241
46.68	6.65E+00	Pu-239		150.04	5.26E+00	Am-241		422.6	1.75E+01	Pu-239
47.6	8.94E+00	Pu-239		152.72	5.78E+02	Pu-238		426.47	1.75E+00	Am-241
51.01	3.60E+02	U-237		158.1	1.43E-01	Pu-239		426.68	3.33E+00	Pu-239
51.01	1.85E+00	Am-241		158.8	1.30E-01	Pu-242		428.4	1.43E-01	Pu-239
51.62	3.89E+03	Pu-239		159.96	2.83E+02	Pu-241		430.08	6.15E-01	Pu-239
53.2	2.17E-01	U-234		160.19	8.87E-01	Pu-239		445.72	1.26E+00	Pu-239
54.04	2.78E+01	Pu-239		160.31	7.36E+01	Pu-240		451.48	2.71E+01	Pu-239
55.56	1.29E+03	Am-241		161.45	1.76E+01	Pu-239		452.6	1.71E-01	Am-241
56.32	1.08E+02	Pu-241		161.54	1.07E-01	Am-241		454.66	6.90E-01	Am-241
56.76	4.24E+01	Pu-241		164.61	1.97E+03	U-237		457.61	2.13E-01	Pu-239
56.83	1.65E+02	Pu-239		164.69	4.74E+00	Am-241		459.68	2.56E-01	Am-241
59.54	2.55E+06	Am-241		165.81	1.65E+00	Am-241		461.25	3.25E-01	Pu-239
59.54	3.66E+04	U-237		167.81	4.15E-01	Pu-239		468.12	2.05E-01	Am-241
64.83	1.36E+03	U-237		169.56	1.23E+01	Am-241		481.66	6.58E-01	Pu-239
64.83	1.03E+01	Am-241		171.39	1.57E+01	Pu-239		493.08	1.24E-01	Pu-239
65.71	7.44E+00	Pu-239		173.7	4.43E-01	Pu-239		514	1.85E-01	Am-241
67.45	2.99E+01	Am-241		175.07	1.29E+00	Am-241		590.28	2.03E-01	Am-241
67.67	2.17E+01	Pu-239		179.22	9.44E+00	Pu-239		597.48	5.26E-01	Am-241
68.7	5.15E+01	Pu-239		188.23	1.56E+00	Pu-239		597.99	2.39E-01	Pu-239
68.74	1.86E+01	Pu-239		189.36	1.19E+01	Pu-239		612.83	1.36E-01	Pu-239
69.76	2.06E+02	Am-241		191.96	1.54E+00	Am-241		617.1	1.92E-01	Pu-239
69.76	1.01E+00	U-237		195.68	1.53E+01	Pu-239		618.28	2.92E-01	Pu-239
71.6	1.24E+02	Pu-241		200.97	2.43E+00	Pu-238		619.01	4.22E+00	Am-241
75.8	4.20E+01	Am-241		203.55	8.14E+01	Pu-239		619.21	1.73E-01	Pu-239
77.1	8.92E+02	Pu-241		204.06	2.06E-01	Am-241		633.15	3.62E-01	Pu-239
77.59	5.43E+01	Pu-239		208.01	2.25E+04	U-237		637.7	3.66E-01	Pu-239
78.43	2.21E+01	Pu-239		208.01	5.62E+01	Am-241		637.8	3.66E-01	Pu-239
86.48	1.48E-01	Np-237		212.46	5.31E+00	Pu-240		639.99	1.24E+00	Pu-239
89.64	3.86E+00	Pu-239		218	1.72E-01	Pu-239		641.47	5.05E-01	Am-241
89.7	2.86E-01	Pu-239		221.46	3.02E+00	Am-241		642.35	2.38E+00	Pu-240
94.65	1.35E+04	Pu-241	X	221.8	2.25E+01	U-237		645.94	2.17E+00	Pu-239
94.65	5.01E+02	Pu-239	X	225.42	2.16E+00	Pu-239		649.32	1.02E-01	Pu-239
94.65	3.60E+01	Pu-238	X	232.81	3.27E-01	Am-241		652.05	9.44E-01	Pu-239

94.65	4.65E+00	Pu-240	X	234.4	2.17E+01	U-237	653.02	2.68E+00	Am-241
94.65	1.02E-01	Pa-233	X	237.77	2.06E+00	Pu-239	654.88	3.22E-01	Pu-239
96.14	5.42E+00	Pu-239		242.08	1.04E+00	Pu-239	658.86	1.39E+00	Pu-239
97.07	1.63E+04	U-237	X	243.38	3.62E+00	Pu-239	662.4	2.59E+01	Am-241
97.07	8.11E+01	Am-241	X	244.92	7.29E-01	Pu-239	664.58	2.37E-01	Pu-239
97.6	1.29E+01	Pu-239		246.73	1.71E-01	Am-241	680.1	2.23E-01	Am-241
98.43	2.16E+04	Pu-241	X	248.95	1.03E+00	Pu-239	687.57	6.41E-01	Pu-240
98.43	8.01E+02	Pu-239	X	255.38	1.14E+01	Pu-239	688.72	2.31E+00	Am-241
98.43	5.75E+01	Pu-238	X	263.95	3.79E+00	Pu-239	690.81	1.29E-01	Pu-239
98.43	7.41E+00	Pu-240	X	264.89	6.40E-01	Am-241	696.6	3.80E-01	Am-241
98.43	1.64E-01	Pa-233	X	265.7	2.29E-01	Pu-239	703.68	5.65E-01	Pu-239
98.78	2.10E+02	Pu-239		267.54	7.55E+02	U-237	708.42	2.55E-01	Pu-238
98.97	1.44E+03	Am-241		267.58	1.87E+00	Am-241	718	4.00E-01	Pu-239
99.85	4.53E+03	Pu-238		275.77	4.69E-01	Am-241	722.01	1.39E+01	Am-241
101	3.07E+00	Pu-241		281.2	3.00E-01	Pu-239	737.34	5.69E-01	Am-241
101.06	2.60E+04	U-237	X	285.3	2.72E-01	Pu-239	742.81	3.23E+00	Pu-238
101.06	1.29E+02	Am-241	X	291.3	2.20E-01	Am-241	755.9	5.40E-01	Am-241
102.98	1.39E+03	Am-241		292.77	2.65E+00	U-237	756.4	4.00E-01	Pu-239
102.98	6.78E+00	U-237		292.77	1.01E+00	Am-241	766.39	1.37E+01	Pu-238
103.06	3.09E+01	Pu-239		297.46	7.12E+00	Pu-239	767	3.56E-01	Am-241
103.5	1.10E+00	Pu-242		302.87	7.29E-01	Pu-239	769.15	7.29E-01	Pu-239
103.68	4.38E+03	Pu-241		307.85	7.87E-01	Pu-239	769.37	9.72E-01	Pu-239
104.23	1.31E+03	Pu-240		309.1	2.86E-01	U-237	770.57	3.37E-01	Am-241
109.7	3.48E-01	Am-241		311.78	3.69E+00	Pu-239	772.4	1.89E-01	Am-241
110.42	2.71E+03	Pu-241	X	311.9	3.73E-01	Pa-233	786.3	1.99E+00	Pu-238
110.42	1.00E+02	Pu-239	X	316.41	1.89E+00	Pu-239	808.25	4.91E-01	Pu-238
110.42	7.22E+00	Pu-238	X	319.68	6.86E-01	Pu-239	851.7	7.71E-01	Pu-238
110.42	9.30E-01	Pu-240	X	320.86	7.75E+00	Pu-239	873.92	1.06E-01	Pu-240
111.3	5.11E+03	Pu-241	X	322.52	1.08E+01	Am-241	883.23	4.73E-01	Pu-238
111.3	1.90E+02	Pu-239	X	323.84	7.71E+00	Pu-239	926.72	3.61E-01	Pu-238
111.3	1.37E+01	Pu-238	X	332.35	1.27E+03	U-237	941.9	2.92E-01	Pu-238

Table A2.17. Input peak intensities for the 10 year old reactor grade plutonium between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
5.18	2.24E-01	Np-237		114.23	2.46E+02	Am-241	X	341.51	9.47E+00	Pu-239
8.22	9.09E+00	Np-237		114.44	1.29E+03	Pu-241	X	345.01	7.95E+01	Pu-239
12.98	5.28E+03	Pu-239		114.44	7.44E+01	Pu-239	X	345.01	4.29E+00	Pu-239
13	1.70E+02	U-234	X	114.44	4.94E+00	Pu-238	X	354	1.00E-01	Pu-239
13	4.87E-01	U-236	X	114.44	1.53E+00	Pa-233	X	358.25	6.88E-01	Am-241
13.3	4.98E+01	Np-237	X	114.44	6.83E-01	Pu-240	X	361.89	1.75E+00	Pu-239
13.6	5.92E+06	Pu-238	X	115.38	6.58E+01	Pu-239		367.07	1.27E+01	Pu-239
13.6	1.76E+06	Pu-240	X	116.26	8.11E+01	Pu-239		368.55	1.26E+01	Pu-239
13.6	6.14E+05	Pu-239	X	117.46	1.56E+03	U-237	X	368.62	2.69E+01	U-237
13.6	3.50E+04	Pu-241	X	117.46	9.63E+01	Am-241	X	368.65	1.24E+02	Am-241
13.6	3.68E+03	Pu-242	X	117.7	1.71E-01	Np-237		370.94	7.37E+01	U-237
13.6	4.24E+01	Pa-233	X	119.7	3.00E+00	Pu-239		370.94	3.00E+01	Am-241
13.81	6.80E+01	U-237		119.7	1.36E+00	Pu-239		375.05	2.22E+02	Pu-239
13.9	2.12E+07	Am-241	X	120.36	2.58E+00	Am-241		375.4	6.70E-01	Pa-233
13.9	4.26E+04	U-237	X	120.9	5.95E-01	U-234		376.65	7.91E+01	Am-241
26.34	1.30E+06	Am-241		121.2	1.92E+01	Pu-241		380.19	4.36E+01	Pu-239
26.34	1.67E+03	U-237		122.35	1.36E-01	Pu-239		382.75	3.70E+01	Pu-239
26.7	2.80E+03	Pu-241		123.05	5.73E+02	Am-241		383.81	1.62E+01	Am-241
29.37	1.43E+01	Np-237		123.62	3.39E+00	Pu-239		392.53	2.93E+01	Pu-239
30.04	3.10E+01	Pu-239		124.51	9.74E+00	Pu-239		393.14	5.01E+01	Pu-239
33.2	7.22E+04	Am-241		125.21	8.05E+00	Pu-239		398.49	1.37E+00	Pa-233
33.2	8.93E+01	U-237		125.3	2.34E+03	Am-241		398.64	1.15E+00	Am-241
38.54	2.75E+02	U-237		129.3	9.02E+02	Pu-239		399.53	8.44E-01	Pu-239
38.66	1.49E+03	Pu-239		139.44	3.04E+00	Am-241		401.3	2.81E-01	Am-241
41.93	2.09E+01	Pu-239		141.66	4.58E+00	Pu-239		406.35	8.31E-01	Am-241
42.7	3.15E+03	Am-241		143.25	4.47E-01	Np-237		406.8	3.58E-01	Pu-239
43.42	4.18E+04	Am-241		143.35	2.47E+00	Pu-239		411.2	1.00E+00	Pu-239
43.42	1.65E+01	U-237		144.2	4.05E+01	Pu-239		413.71	2.10E+02	Pu-239
43.5	2.27E+04	Pu-238		146.09	1.70E+01	Pu-239		415.76	1.71E+00	Pa-233
44.2	1.17E+02	Pu-241		146.55	2.64E+02	Am-241		419.33	1.65E+01	Am-241
44.86	2.33E+01	Pu-241		148.57	5.21E+03	Pu-241		422.6	1.75E+01	Pu-239
44.92	1.62E+01	Pu-242		150.04	4.24E+01	Am-241		426.47	1.41E+01	Am-241
45.24	8.18E+03	Pu-240		151.41	2.34E-01	Np-237		426.68	3.33E+00	Pu-239
46.21	1.03E+01	Pu-239		152.72	5.39E+02	Pu-238		428.4	1.43E-01	Pu-239
46.53	1.05E-01	Np-237		154.27	3.09E-01	Am-241		430.08	6.15E-01	Pu-239
46.68	6.65E+00	Pu-239		158.1	1.43E-01	Pu-239		445.72	1.26E+00	Pu-239
47.6	8.94E+00	Pu-239		158.8	1.30E-01	Pu-242		446.43	2.81E-01	Am-241
51.01	2.34E+02	U-237		159.26	8.02E-01	Am-241		451.48	2.71E+01	Pu-239
51.01	1.49E+01	Am-241		159.96	1.83E+02	Pu-241		452.6	1.38E+00	Am-241
51.62	3.89E+03	Pu-239		160.19	8.87E-01	Pu-239		454.66	5.56E+00	Am-241
53.2	2.09E+00	U-234		160.31	7.36E+01	Pu-240		457.61	2.13E-01	Pu-239
54.04	2.78E+01	Pu-239		161.45	1.76E+01	Pu-239		459.68	2.06E+00	Am-241
55.56	1.04E+04	Am-241		161.54	8.60E-01	Am-241		461.25	3.25E-01	Pu-239
56.32	7.00E+01	Pu-241		164.61	1.28E+03	U-237		463.22	5.73E-01	Am-241
56.76	2.74E+01	Pu-241		164.69	3.82E+01	Am-241		468.12	1.65E+00	Am-241
56.83	1.65E+02	Pu-239		165.81	1.33E+01	Am-241		481.66	6.58E-01	Pu-239
57.1	3.58E-01	Np-237		167.81	4.15E-01	Pu-239		487.3	2.52E-01	Am-241
59.54	2.06E+07	Am-241		169.56	9.91E+01	Am-241		493.08	1.24E-01	Pu-239
59.54	2.37E+04	U-237		171.39	1.57E+01	Pu-239		512.5	6.59E-01	Am-241
64.83	8.81E+02	U-237		173.7	4.43E-01	Pu-239		514	1.49E+00	Am-241
64.83	8.31E+01	Am-241		175.07	1.04E+01	Am-241		522.06	5.73E-01	Am-241
65.71	7.44E+00	Pu-239		179.22	9.44E+00	Pu-239		529.17	2.64E-01	Am-241
67.45	2.41E+02	Am-241		188.23	1.56E+00	Pu-239		545.4	4.24E-01	Am-241
67.67	2.17E+01	Pu-239		189.36	1.19E+01	Pu-239		563.05	4.24E-01	Am-241
68.7	5.15E+01	Pu-239		191.96	1.24E+01	Am-241		573.94	7.16E-01	Am-241
68.74	1.86E+01	Pu-239		194.95	1.79E-01	Np-237		586.59	7.51E-01	Am-241
69.76	1.66E+03	Am-241		195.68	1.53E+01	Pu-239		590.28	1.64E+00	Am-241
69.76	6.53E-01	U-237		197	2.81E-01	Am-241		597.48	4.24E+00	Am-241
71.6	8.04E+01	Pu-241		200.97	2.26E+00	Pu-238		597.99	2.39E-01	Pu-239
75.27	1.30E+00	Pa-233		203.55	8.14E+01	Pu-239		612.83	1.36E-01	Pu-239
75.8	3.38E+02	Am-241		204.06	1.66E+00	Am-241		617.1	1.92E-01	Pu-239
77.1	5.77E+02	Pu-241		208.01	1.46E+04	U-237		618.28	2.92E-01	Pu-239
77.59	5.43E+01	Pu-239		208.01	4.53E+02	Am-241		619.01	3.40E+01	Am-241
78.43	2.21E+01	Pu-239		212.29	1.53E-01	Np-237		619.21	1.73E-01	Pu-239
86.48	1.25E+01	Np-237		212.46	5.31E+00	Pu-240		627.18	3.21E-01	Am-241

86.6	1.93E+00	Pa-233		218	1.72E-01	Pu-239	632.93	7.22E-01	Am-241
87.99	1.69E-01	Np-237		221.46	2.43E+01	Am-241	633.15	3.62E-01	Pu-239
89.64	3.86E+00	Pu-239		221.8	1.46E+01	U-237	637.7	3.66E-01	Pu-239
89.7	2.86E-01	Pu-239		225.42	2.16E+00	Pu-239	637.8	3.66E-01	Pu-239
92.28	1.68E+00	Np-237	X	232.81	2.64E+00	Am-241	639.99	1.24E+00	Pu-239
94.64	6.21E-01	Np-237		234.33	4.01E-01	Am-241	641.47	4.07E+00	Am-241
94.65	8.74E+03	Pu-241	X	234.4	1.41E+01	U-237	642.35	2.38E+00	Pu-240
94.65	5.01E+02	Pu-239	X	237.77	2.06E+00	Pu-239	645.94	2.17E+00	Pu-239
94.65	3.36E+01	Pu-238	X	242.08	1.04E+00	Pu-239	649.32	1.02E-01	Pu-239
94.65	1.04E+01	Pa-233	X	243.38	3.62E+00	Pu-239	652.05	9.44E-01	Pu-239
94.65	4.65E+00	Pu-240	X	244.92	7.29E-01	Pu-239	653.02	2.16E+01	Am-241
95.86	2.71E+00	Np-237	X	246.73	1.38E+00	Am-241	654.88	3.22E-01	Pu-239
96.14	5.42E+00	Pu-239		248.95	1.03E+00	Pu-239	658.86	1.39E+00	Pu-239
97.07	1.06E+04	U-237	X	249	3.09E-01	Am-241	662.4	2.09E+02	Am-241
97.07	6.53E+02	Am-241	X	255.38	1.14E+01	Pu-239	664.58	2.37E-01	Pu-239
97.6	1.29E+01	Pu-239		260.8	6.93E-01	Am-241	666.5	2.81E-01	Am-241
98.43	1.40E+04	Pu-241	X	263.95	3.79E+00	Pu-239	669.83	2.18E-01	Am-241
98.43	8.01E+02	Pu-239	X	264.89	5.16E+00	Am-241	676.03	3.67E-01	Am-241
98.43	5.37E+01	Pu-238	X	265.7	2.29E-01	Pu-239	680.1	1.79E+00	Am-241
98.43	1.67E+01	Pa-233	X	267.54	4.89E+02	U-237	687.57	6.41E-01	Pu-240
98.43	7.41E+00	Pu-240	X	267.58	1.51E+01	Am-241	688.72	1.86E+01	Am-241
98.78	2.10E+02	Pu-239		271.55	3.19E-01	Pa-233	690.81	1.29E-01	Pu-239
98.97	1.16E+04	Am-241		275.77	3.78E+00	Am-241	696.6	3.06E+00	Am-241
99.85	4.23E+03	Pu-238		278.04	2.52E-01	Am-241	703.68	5.65E-01	Pu-239
101	1.99E+00	Pu-241		281.2	3.00E-01	Pu-239	708.42	2.38E-01	Pu-238
101.06	1.68E+04	U-237	X	285.3	2.72E-01	Pu-239	718	4.00E-01	Pu-239
101.06	1.04E+03	Am-241	X	291.3	1.78E+00	Am-241	722.01	1.12E+02	Am-241
102.98	1.12E+04	Am-241		292.77	8.14E+00	Am-241	729.72	7.62E-01	Am-241
102.98	4.40E+00	U-237		292.77	1.72E+00	U-237	737.34	4.58E+00	Am-241
103.06	3.09E+01	Pu-239		297.46	7.12E+00	Pu-239	742.81	3.02E+00	Pu-238
103.5	1.10E+00	Pu-242		300.13	6.54E+00	Pa-233	755.9	4.36E+00	Am-241
103.68	2.83E+03	Pu-241		302.87	7.29E-01	Pu-239	756.4	4.00E-01	Pu-239
103.86	8.43E-01	Pa-233		304.21	5.79E-01	Am-241	766.39	1.28E+01	Pu-238
104.23	1.31E+03	Pu-240		307.85	7.87E-01	Pu-239	767	2.87E+00	Am-241
107.6	3.36E-01	Np-237	X	309.1	8.02E-01	Am-241	769.15	7.29E-01	Pu-239
108.42	6.36E-01	Np-237	X	309.1	1.86E-01	U-237	769.37	9.72E-01	Pu-239
109.7	2.81E+00	Am-241		311.78	3.69E+00	Pu-239	770.57	2.72E+00	Am-241
110.42	1.75E+03	Pu-241	X	311.9	3.80E+01	Pa-233	772.4	1.52E+00	Am-241
110.42	1.00E+02	Pu-239	X	316.41	1.89E+00	Pu-239	786	3.55E-01	Am-241
110.42	6.73E+00	Pu-238	X	319.68	6.86E-01	Pu-239	786.3	1.86E+00	Pu-238
110.42	2.09E+00	Pa-233	X	320.86	7.75E+00	Pu-239	801.94	7.79E-01	Am-241
110.42	9.30E-01	Pu-240	X	322.52	8.71E+01	Am-241	806.26	1.78E-01	Am-241
111.3	3.30E+03	Pu-241	X	323.84	7.71E+00	Pu-239	808.25	4.58E-01	Pu-238
111.3	1.90E+02	Pu-239	X	332.35	8.24E+02	U-237	828.5	1.38E-01	Am-241
111.3	1.28E+01	Pu-238	X	332.35	8.54E+01	Am-241	851.7	7.19E-01	Pu-238
111.3	3.96E+00	Pa-233	X	332.85	7.06E+01	Pu-239	862.7	3.04E-01	Am-241
111.3	1.76E+00	Pu-240	X	335.37	2.84E+02	Am-241	873.92	1.06E-01	Pu-240
111.49	2.46E-01	Np-237	X	335.37	6.53E+01	U-237	883.23	4.41E-01	Pu-238
113.3	2.11E+03	U-237	X	336.11	1.60E+01	Pu-239	887.3	1.26E-01	Am-241
113.3	1.30E+02	Am-241	X	337.7	6.11E+00	U-237	921.5	1.09E-01	Am-241
114	2.27E+03	Pu-241		337.7	2.46E+00	Am-241	926.72	3.36E-01	Pu-238
114.23	3.99E+03	U-237	X	340.48	4.39E+00	Pa-233	941.9	2.73E-01	Pu-238

Table A2.18. Input peak intensities for the 50 year old reactor grade plutonium between 0 and 1000 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
5.18	3.26E+00	Np-237		111.3	1.75E+00	Pu-240	X	319.68	6.86E-01	Pu-239
8.22	1.32E+02	Np-237		111.49	3.59E+00	Np-237	X	320.86	7.75E+00	Pu-239
12.3	1.38E-01	Th-230	X	113.3	3.06E+02	U-237	X	322.52	1.98E+02	Am-241
12.98	5.28E+03	Pu-239		113.3	2.95E+02	Am-241	X	323.84	7.71E+00	Pu-239
13	7.32E+02	U-234	X	114	3.29E+02	Pu-241		332.35	1.94E+02	Am-241
13	2.43E+00	U-236	X	114.23	5.79E+02	U-237	X	332.35	1.20E+02	U-237
13.3	7.25E+02	Np-237	X	114.23	5.59E+02	Am-241	X	332.85	7.06E+01	Pu-239
13.6	4.32E+06	Pu-238	X	114.44	1.86E+02	Pu-241	X	335.37	6.45E+02	Am-241
13.6	1.75E+06	Pu-240	X	114.44	7.44E+01	Pu-239	X	335.37	9.47E+00	U-237
13.6	6.14E+05	Pu-239	X	114.44	2.28E+01	Pa-233	X	336.11	1.60E+01	Pu-239
13.6	5.08E+03	Pu-241	X	114.44	3.60E+00	Pu-238	X	337.7	5.58E+00	Am-241
13.6	3.68E+03	Pu-242	X	114.44	6.79E-01	Pu-240	X	337.7	8.86E-01	U-237
13.6	6.32E+02	Pa-233	X	115.38	6.58E+01	Pu-239		340.48	6.54E+01	Pa-233
13.81	9.86E+00	U-237		116.26	8.11E+01	Pu-239		341.51	9.47E+00	Pu-239
13.9	4.81E+07	Am-241	X	117.46	2.26E+02	U-237	X	345.01	7.95E+01	Pu-239
13.9	6.18E+03	U-237	X	117.46	2.18E+02	Am-241	X	345.01	4.29E+00	Pu-239
18.7	3.38E-01	Pa-233		117.7	2.48E+00	Np-237		354	1.00E-01	Pu-239
18.7	3.38E-01	Pa-233		119.7	3.00E+00	Pu-239		358.25	1.56E+00	Am-241
19.7	6.76E-01	Pa-233		119.7	1.36E+00	Pu-239		361.89	1.75E+00	Pu-239
26.34	2.95E+06	Am-241		120.36	5.85E+00	Am-241		367.07	1.27E+01	Pu-239
26.34	2.42E+02	U-237		120.9	2.56E+00	U-234		368.55	1.26E+01	Pu-239
26.7	4.06E+02	Pu-241		121.2	2.79E+00	Pu-241		368.62	3.90E+00	U-237
28.56	1.04E+00	Pa-233		122.35	1.36E-01	Pu-239		368.65	2.82E+02	Am-241
29.37	2.08E+02	Np-237		123.05	1.30E+03	Am-241		370.94	6.80E+01	Am-241
30.04	3.10E+01	Pu-239		123.62	3.39E+00	Pu-239		370.94	1.07E+01	U-237
33.2	1.64E+05	Am-241		124.51	9.74E+00	Pu-239		374	1.07E-01	Pa-233
33.2	1.30E+01	U-237		125.21	8.05E+00	Pu-239		375.05	2.22E+02	Pu-239
38.54	3.98E+01	U-237		125.3	5.30E+03	Am-241		375.4	9.98E+00	Pa-233
38.66	1.49E+03	Pu-239		129.3	9.02E+02	Pu-239		376.65	1.79E+02	Am-241
40.35	3.47E-01	Pa-233		131.1	1.26E+00	Np-237		380.19	4.36E+01	Pu-239
41.66	2.06E-01	Pa-233		134.29	9.85E-01	Np-237		382.75	3.70E+01	Pu-239
41.7	1.47E-01	Pa-233		139.44	6.89E+00	Am-241		383.81	3.67E+01	Am-241
41.93	2.09E+01	Pu-239		141.66	4.58E+00	Pu-239		392.53	2.93E+01	Pu-239
42.7	7.15E+03	Am-241		143.25	6.51E+00	Np-237		393.14	5.01E+01	Pu-239
43.42	9.49E+04	Am-241		143.35	2.47E+00	Pu-239		398.49	2.05E+01	Pa-233
43.42	2.39E+00	U-237		144.2	4.05E+01	Pu-239		398.64	2.60E+00	Am-241
43.5	1.66E+04	Pu-238		146.09	1.70E+01	Pu-239		399.53	8.44E-01	Pu-239
44.2	1.69E+01	Pu-241		146.55	5.99E+02	Am-241		401.3	6.37E-01	Am-241
44.86	3.38E+00	Pu-241		148.57	7.55E+02	Pu-241		406.35	1.89E+00	Am-241
44.92	1.62E+01	Pu-242		150.04	9.62E+01	Am-241		406.8	3.58E-01	Pu-239
45.24	8.14E+03	Pu-240		151.41	3.41E+00	Np-237		410	1.01E-01	Pa-233
46.21	1.03E+01	Pu-239		152.72	3.93E+02	Pu-238		411.2	1.00E+00	Pu-239
46.53	1.53E+00	Np-237		154.27	7.02E-01	Am-241		413.71	2.10E+02	Pu-239
46.68	6.65E+00	Pu-239		155.24	1.31E+00	Np-237		415.76	2.54E+01	Pa-233
47.6	8.94E+00	Pu-239		158.1	1.43E-01	Pu-239		419.33	3.73E+01	Am-241
51.01	3.39E+01	U-237		158.8	1.30E-01	Pu-242		422.6	1.75E+01	Pu-239
51.01	3.38E+01	Am-241		159.26	1.82E+00	Am-241		426.47	3.20E+01	Am-241
51.62	3.89E+03	Pu-239		159.96	2.66E+01	Pu-241		426.68	3.33E+00	Pu-239
53.2	9.00E+00	U-234		160.19	8.87E-01	Pu-239		428.4	1.43E-01	Pu-239
54.04	2.78E+01	Pu-239		160.31	7.32E+01	Pu-240		430.08	6.15E-01	Pu-239
55.56	2.35E+04	Am-241		161.45	1.76E+01	Pu-239		445.72	1.26E+00	Pu-239
56.32	1.02E+01	Pu-241		161.54	1.95E+00	Am-241		446.43	6.37E-01	Am-241
56.76	3.98E+00	Pu-241		162.41	4.81E-01	Np-237		451.48	2.71E+01	Pu-239
56.83	1.65E+02	Pu-239		164.61	1.85E+02	U-237		452.6	3.12E+00	Am-241
57.1	5.20E+00	Np-237		164.69	8.67E+01	Am-241		454.66	1.26E+01	Am-241
59.54	4.67E+07	Am-241		165.81	3.02E+01	Am-241		457.61	2.13E-01	Pu-239
59.54	3.44E+03	U-237		167.81	4.15E-01	Pu-239		459.68	4.68E+00	Am-241
60.6	1.18E-01	Pa-233		169.16	9.31E-01	Np-237		461.25	3.25E-01	Pu-239
60.6	1.18E-01	Pa-233		169.56	2.25E+02	Am-241		463.22	1.30E+00	Am-241
60.6	1.18E-01	Pa-233		170.59	2.94E-01	Np-237		468.12	3.74E+00	Am-241
63.9	1.59E-01	Np-237		171.39	1.57E+01	Pu-239		481.66	6.58E-01	Pu-239
64.83	1.89E+02	Am-241		173.7	4.43E-01	Pu-239		487.3	5.72E-01	Am-241
64.83	1.28E+02	U-237		175.07	2.37E+01	Am-241		493.08	1.24E-01	Pu-239
65.71	7.44E+00	Pu-239		176.12	1.76E-01	Np-237		512.5	1.50E+00	Am-241
67.45	5.46E+02	Am-241		179.22	9.44E+00	Pu-239		514	3.38E+00	Am-241
67.67	2.17E+01	Pu-239		180.81	2.32E-01	Np-237		522.06	1.30E+00	Am-241
68.7	5.15E+01	Pu-239		188.23	1.56E+00	Pu-239		529.17	5.98E-01	Am-241
68.74	1.86E+01	Pu-239		189.36	1.19E+01	Pu-239		545.4	9.62E-01	Am-241
69.76	3.77E+03	Am-241		191.46	2.82E-01	Np-237		563.05	9.62E-01	Am-241
70.49	1.59E-01	Np-237		191.96	2.81E+01	Am-241		573.94	1.63E+00	Am-241

71.6	1.17E+01	Pu-241		193.26	6.42E-01	Np-237	586.59	1.70E+00	Am-241
74.54	1.76E-01	Np-237		194.67	4.85E-01	Np-237	590.28	3.72E+00	Am-241
75.27	1.94E+01	Pa-233		194.95	2.60E+00	Np-237	597.48	9.62E+00	Am-241
75.8	7.67E+02	Am-241		195.68	1.53E+01	Pu-239	597.99	2.39E-01	Pu-239
77.1	8.36E+01	Pu-241		196.86	3.06E-01	Np-237	612.83	1.36E-01	Pu-239
77.59	5.43E+01	Pu-239		197	6.37E-01	Am-241	617.1	1.92E-01	Pu-239
78.4	1.13E-01	Pa-233		200.97	1.65E+00	Pu-238	618.28	2.92E-01	Pu-239
78.43	2.21E+01	Pu-239		201.62	5.78E-01	Np-237	619.01	7.72E+01	Am-241
84.8	1.03E-01	Pa-233		203.55	8.14E+01	Pu-239	619.21	1.73E-01	Pu-239
85.2	1.03E-01	Pa-233		204.06	3.77E+00	Am-241	627.18	7.28E-01	Am-241
85.2	1.03E-01	Pa-233		208.01	2.11E+03	U-237	632.93	1.64E+00	Am-241
86.48	1.82E+02	Np-237		208.01	1.03E+03	Am-241	633.15	3.62E-01	Pu-239
86.6	2.87E+01	Pa-233		209.19	2.09E-01	Np-237	637.7	3.66E-01	Pu-239
87.99	2.46E+00	Np-237		212.29	2.22E+00	Np-237	637.8	3.66E-01	Pu-239
89	1.03E-01	Pa-233		212.46	5.28E+00	Pu-240	639.99	1.24E+00	Pu-239
89.3	1.03E-01	Pa-233		214.01	5.32E-01	Np-237	641.47	9.23E+00	Am-241
89.64	3.86E+00	Pu-239		218	1.72E-01	Pu-239	642.35	2.37E+00	Pu-240
89.7	2.86E-01	Pu-239		221.46	5.51E+01	Am-241	645.94	2.17E+00	Pu-239
89.96	1.90E-01	U-234	X	221.8	2.11E+00	U-237	649.32	1.02E-01	Pu-239
92.28	2.44E+01	Np-237	X	225.42	2.16E+00	Pu-239	652.05	9.44E-01	Pu-239
93.35	3.00E-01	U-234	X	229.94	1.62E-01	Np-237	653.02	4.90E+01	Am-241
94.64	9.04E+00	Np-237		232.81	5.98E+00	Am-241	654.88	3.22E-01	Pu-239
94.65	1.27E+03	Pu-241	X	234.33	9.10E-01	Am-241	658.86	1.39E+00	Pu-239
94.65	5.01E+02	Pu-239	X	234.4	2.04E+00	U-237	662.4	4.73E+02	Am-241
94.65	1.55E+02	Pa-233	X	237.77	2.06E+00	Pu-239	664.58	2.37E-01	Pu-239
94.65	2.45E+01	Pu-238	X	237.86	8.36E-01	Np-237	666.5	6.37E-01	Am-241
94.65	4.62E+00	Pu-240	X	242.08	1.04E+00	Pu-239	669.83	4.94E-01	Am-241
95.86	3.94E+01	Np-237	X	243.38	3.62E+00	Pu-239	676.03	8.32E-01	Am-241
96.14	5.42E+00	Pu-239		244.92	7.29E-01	Pu-239	680.1	4.07E+00	Am-241
97.07	1.53E+03	U-237	X	246.73	3.12E+00	Am-241	687.57	6.37E-01	Pu-240
97.07	1.48E+03	Am-241	X	248.38	8.95E-01	Pa-233	688.72	4.23E+01	Am-241
97.6	1.29E+01	Pu-239		248.95	1.03E+00	Pu-239	690.81	1.29E-01	Pu-239
98.43	2.03E+03	Pu-241	X	249	7.02E-01	Am-241	696.6	6.94E+00	Am-241
98.43	8.01E+02	Pu-239	X	255.38	1.14E+01	Pu-239	703.68	5.65E-01	Pu-239
98.43	2.48E+02	Pa-233	X	258.45	4.03E-01	Pa-233	708.42	1.73E-01	Pu-238
98.43	3.91E+01	Pu-238	X	260.8	1.57E+00	Am-241	718	4.00E-01	Pu-239
98.43	7.37E+00	Pu-240	X	263.95	3.79E+00	Pu-239	722.01	2.55E+02	Am-241
98.78	2.10E+02	Pu-239		264.89	1.17E+01	Am-241	729.72	1.73E+00	Am-241
98.97	2.64E+04	Am-241		265.7	2.29E-01	Pu-239	737.34	1.04E+01	Am-241
99.85	3.08E+03	Pu-238		267.54	7.09E+01	U-237	742.81	2.20E+00	Pu-238
101	2.88E-01	Pu-241		267.58	3.42E+01	Am-241	755.9	9.88E+00	Am-241
101.06	2.44E+03	U-237	X	271.55	4.75E+00	Pa-233	756.4	4.00E-01	Pu-239
101.06	2.35E+03	Am-241	X	275.77	8.58E+00	Am-241	766.39	9.31E+00	Pu-238
102.98	2.54E+04	Am-241		278.04	5.72E-01	Am-241	767	6.50E+00	Am-241
102.98	6.37E-01	U-237		279.65	1.60E-01	Np-237	769.15	7.29E-01	Pu-239
103.06	3.09E+01	Pu-239		280.61	1.62E-01	Pa-233	769.37	9.72E-01	Pu-239
103.5	1.10E+00	Pu-242		281.2	3.00E-01	Pu-239	770.57	6.16E+00	Am-241
103.68	4.11E+02	Pu-241		285.3	2.72E-01	Pu-239	772.4	3.46E+00	Am-241
103.86	1.26E+01	Pa-233		288.42	2.35E-01	Pa-233	786	8.06E-01	Am-241
104.23	1.30E+03	Pu-240		291.3	4.03E+00	Am-241	786.3	1.35E+00	Pu-238
106.15	7.20E-01	Np-237		292.77	1.85E+01	Am-241	801.94	1.77E+00	Am-241
107.6	4.90E+00	Np-237	X	292.77	2.49E-01	U-237	806.26	4.03E-01	Am-241
108.42	9.26E+00	Np-237	X	297.46	7.12E+00	Pu-239	808.25	3.34E-01	Pu-238
108.7	1.00E+00	Np-237		298.81	1.29E+00	Pa-233	828.5	3.12E-01	Am-241
109.7	6.37E+00	Am-241		300.13	9.75E+01	Pa-233	851.7	5.25E-01	Pu-238
110.42	2.54E+02	Pu-241	X	301.99	1.47E-01	Pa-233	860.7	1.04E-01	Am-241
110.42	1.00E+02	Pu-239	X	302.87	7.29E-01	Pu-239	862.7	6.89E-01	Am-241
110.42	3.12E+01	Pa-233	X	304.21	1.31E+00	Am-241	873.92	1.06E-01	Pu-240
110.42	4.91E+00	Pu-238	X	307.85	7.87E-01	Pu-239	883.23	3.22E-01	Pu-238
110.42	9.25E-01	Pu-240	X	309.1	1.82E+00	Am-241	887.3	2.86E-01	Am-241
111.3	4.79E+02	Pu-241	X	311.78	3.69E+00	Pu-239	921.5	2.47E-01	Am-241
111.3	1.90E+02	Pu-239	X	311.9	5.66E+02	Pa-233	926.72	2.45E-01	Pu-238
111.3	5.90E+01	Pa-233	X	313.5	2.04E-01	Pa-233	941.9	1.99E-01	Pu-238
111.3	9.31E+00	Pu-238	X	316.41	1.89E+00	Pu-239	1001.03	4.15E-01	Pu-238

Table A2.19. Input peak intensities for the 1 year old 5 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
12.98	7.97E+03	Pu-239		104.23	3.42E+02	Pu-240		302.87	1.10E+00	Pu-239
13	5.35E-01	U-234	X	110.42	1.51E+02	Pu-239	X	307.85	1.19E+00	Pu-239
13.6	9.27E+05	Pu-239	X	110.42	7.31E+01	Pu-241	X	311.78	5.57E+00	Pu-239
13.6	4.59E+05	Pu-240	X	110.42	2.43E-01	Pu-240	X	316.41	2.85E+00	Pu-239
13.6	1.93E+05	Pu-238	X	110.42	2.19E-01	Pu-238	X	319.68	1.04E+00	Pu-239
13.6	1.46E+03	Pu-241	X	111.3	2.87E+02	Pu-239	X	320.86	1.17E+01	Pu-239
13.6	3.72E+01	Pu-242	X	111.3	1.38E+02	Pu-241	X	322.52	2.90E-01	Am-241
13.81	2.83E+00	U-237		111.3	4.59E-01	Pu-240	X	323.84	1.16E+01	Pu-239
13.9	7.07E+04	Am-241	X	111.3	4.16E-01	Pu-238	X	332.35	3.43E+01	U-237
13.9	1.77E+03	U-237	X	113.3	8.78E+01	U-237	X	332.35	2.85E-01	Am-241
26.34	4.34E+03	Am-241		113.3	4.34E-01	Am-241	X	332.85	1.07E+02	Pu-239
26.34	6.95E+01	U-237		114	9.48E+01	Pu-241		335.37	2.72E+00	U-237
26.7	1.17E+02	Pu-241		114.23	1.66E+02	U-237	X	335.37	9.47E-01	Am-241
30.04	4.69E+01	Pu-239		114.23	8.21E-01	Am-241	X	336.11	2.42E+01	Pu-239
33.2	2.41E+02	Am-241		114.44	1.12E+02	Pu-239	X	337.7	2.55E-01	U-237
33.2	3.72E+00	U-237		114.44	5.37E+01	Pu-241	X	341.51	1.43E+01	Pu-239
38.54	1.14E+01	U-237		114.44	1.79E-01	Pu-240	X	345.01	1.20E+02	Pu-239
38.66	2.26E+03	Pu-239		114.44	1.61E-01	Pu-238	X	345.01	6.48E+00	Pu-239
41.93	3.15E+01	Pu-239		115.38	9.94E+01	Pu-239		354	1.51E-01	Pu-239
42.7	1.05E+01	Am-241		116.26	1.23E+02	Pu-239		361.89	2.64E+00	Pu-239
43.42	1.39E+02	Am-241		117.46	6.49E+01	U-237	X	367.07	1.92E+01	Pu-239
43.42	6.86E-01	U-237		117.46	3.21E-01	Am-241	X	368.55	1.90E+01	Pu-239
43.5	7.41E+02	Pu-238		119.7	4.54E+00	Pu-239		368.62	1.12E+00	U-237
44.2	4.87E+00	Pu-241		119.7	2.05E+00	Pu-239		368.65	4.15E-01	Am-241
44.86	9.75E-01	Pu-241		121.2	8.03E-01	Pu-241		370.94	3.07E+00	U-237
44.92	1.63E-01	Pu-242		122.35	2.05E-01	Pu-239		375.05	3.36E+02	Pu-239
45.24	2.14E+03	Pu-240		123.05	1.91E+00	Am-241		376.65	2.64E-01	Am-241
46.21	1.56E+01	Pu-239		123.62	5.12E+00	Pu-239		380.19	6.59E+01	Pu-239
46.68	1.00E+01	Pu-239		124.51	1.47E+01	Pu-239		382.75	5.59E+01	Pu-239
47.6	1.35E+01	Pu-239		125.21	1.22E+01	Pu-239		392.53	4.43E+01	Pu-239
51.01	9.72E+00	U-237		125.3	7.79E+00	Am-241		393.14	7.56E+01	Pu-239
51.62	5.88E+03	Pu-239		129.3	1.36E+03	Pu-239		399.53	1.27E+00	Pu-239
54.04	4.20E+01	Pu-239		141.66	6.91E+00	Pu-239		406.8	5.40E-01	Pu-239
55.56	3.46E+01	Am-241		143.35	3.74E+00	Pu-239		411.2	1.51E+00	Pu-239
56.32	2.92E+00	Pu-241		144.2	6.11E+01	Pu-239		413.71	3.17E+02	Pu-239
56.76	1.15E+00	Pu-241		146.09	2.57E+01	Pu-239		422.6	2.64E+01	Pu-239
56.83	2.49E+02	Pu-239		146.55	8.81E-01	Am-241		426.68	5.03E+00	Pu-239
59.54	6.86E+04	Am-241		148.57	2.18E+02	Pu-241		428.4	2.16E-01	Pu-239
59.54	9.87E+02	U-237		150.04	1.41E-01	Am-241		430.08	9.29E-01	Pu-239
64.83	3.67E+01	U-237		152.72	1.76E+01	Pu-238		445.72	1.90E+00	Pu-239
64.83	2.77E-01	Am-241		158.1	2.16E-01	Pu-239		451.48	4.09E+01	Pu-239
65.71	1.12E+01	Pu-239		159.96	7.65E+00	Pu-241		457.61	3.22E-01	Pu-239
67.45	8.02E-01	Am-241		160.19	1.34E+00	Pu-239		461.25	4.90E-01	Pu-239
67.67	3.28E+01	Pu-239		160.31	1.92E+01	Pu-240		481.66	9.94E-01	Pu-239
68.7	7.78E+01	Pu-239		161.45	2.66E+01	Pu-239		493.08	1.88E-01	Pu-239
68.74	2.81E+01	Pu-239		164.61	5.32E+01	U-237		582.89	1.33E-01	Pu-239
69.76	5.54E+00	Am-241		164.69	1.27E-01	Am-241		597.99	3.61E-01	Pu-239
71.6	3.36E+00	Pu-241		167.81	6.26E-01	Pu-239		612.83	2.05E-01	Pu-239
75.8	1.13E+00	Am-241		169.56	3.30E-01	Am-241		617.1	2.89E-01	Pu-239
77.1	2.41E+01	Pu-241		171.39	2.38E+01	Pu-239		618.28	4.41E-01	Pu-239
77.59	8.21E+01	Pu-239		173.7	6.70E-01	Pu-239		619.01	1.14E-01	Am-241
78.43	3.33E+01	Pu-239		179.22	1.43E+01	Pu-239		619.21	2.61E-01	Pu-239
89.64	5.83E+00	Pu-239		188.23	2.35E+00	Pu-239		633.15	5.47E-01	Pu-239
89.7	4.32E-01	Pu-239		189.36	1.79E+01	Pu-239		637.7	5.53E-01	Pu-239
94.65	7.56E+02	Pu-239	X	195.68	2.31E+01	Pu-239		637.8	5.53E-01	Pu-239
94.65	3.65E+02	Pu-241	X	203.55	1.23E+02	Pu-239		639.99	1.88E+00	Pu-239
94.65	1.22E+00	Pu-240	X	208.01	6.06E+02	U-237		642.35	6.22E-01	Pu-240
94.65	1.09E+00	Pu-238	X	208.01	1.51E+00	Am-241		645.94	3.28E+00	Pu-239
96.14	8.19E+00	Pu-239		212.46	1.39E+00	Pu-240		649.32	1.53E-01	Pu-239
97.07	4.40E+02	U-237	X	218	2.59E-01	Pu-239		652.05	1.43E+00	Pu-239
97.07	2.18E+00	Am-241	X	221.8	6.06E-01	U-237		654.88	4.86E-01	Pu-239
97.6	1.94E+01	Pu-239		225.42	3.26E+00	Pu-239		658.86	2.10E+00	Pu-239
98.43	1.21E+03	Pu-239	X	234.4	5.86E-01	U-237		662.4	6.95E-01	Am-241
98.43	5.84E+02	Pu-241	X	237.77	3.11E+00	Pu-239		664.58	3.59E-01	Pu-239
98.43	1.94E+00	Pu-240	X	242.08	1.58E+00	Pu-239		674.05	1.11E-01	Pu-239

98.43	1.75E+00	Pu-238	X	243.38	5.47E+00	Pu-239	674.4	1.11E-01	Pu-239
98.78	3.18E+02	Pu-239		244.92	1.10E+00	Pu-239	687.57	1.68E-01	Pu-240
98.97	3.88E+01	Am-241		248.95	1.56E+00	Pu-239	690.81	1.94E-01	Pu-239
99.85	1.38E+02	Pu-238		255.38	1.73E+01	Pu-239	701.1	1.11E-01	Pu-239
101.06	7.01E+02	U-237	X	263.95	5.72E+00	Pu-239	703.68	8.53E-01	Pu-239
101.06	3.46E+00	Am-241	X	265.7	3.46E-01	Pu-239	718	6.05E-01	Pu-239
102.98	3.73E+01	Am-241		267.54	2.04E+01	U-237	722.01	3.74E-01	Am-241
102.98	1.83E-01	U-237		281.2	4.54E-01	Pu-239	756.4	6.05E-01	Pu-239
103.06	4.67E+01	Pu-239		285.3	4.10E-01	Pu-239	756.4	1.45E-01	Pu-239
103.68	1.18E+02	Pu-241		297.46	1.08E+01	Pu-239	766.39	4.16E-01	Pu-238

Table A.2.20. Input peak intensities for the 10 year old 5 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
8.22	2.44E-01	Np-237		110.42	1.51E+02	Pu-239	X	311.78	5.55E+00	Pu-239
12.98	7.93E+03	Pu-239		110.42	4.72E+01	Pu-241	X	311.9	1.02E+00	Pa-233
13	5.16E+00	U-234	X	110.42	2.43E-01	Pu-240	X	316.41	2.84E+00	Pu-239
13	1.28E-01	U-236	X	110.42	2.04E-01	Pu-238	X	319.68	1.03E+00	Pu-239
13.3	1.34E+00	Np-237	X	111.3	2.86E+02	Pu-239	X	320.86	1.17E+01	Pu-239
13.3	1.25E-01	Th-231	X	111.3	8.91E+01	Pu-241	X	322.52	2.34E+00	Am-241
13.6	9.22E+05	Pu-239	X	111.3	4.59E-01	Pu-240	X	323.84	1.16E+01	Pu-239
13.6	4.59E+05	Pu-240	X	111.3	3.87E-01	Pu-238	X	332.35	2.22E+01	U-237
13.6	1.80E+05	Pu-238	X	111.3	1.07E-01	Pa-233	X	332.35	2.30E+00	Am-241
13.6	9.44E+02	Pu-241	X	113.3	5.68E+01	U-237	X	332.85	1.06E+02	Pu-239
13.6	3.72E+01	Pu-242	X	113.3	3.50E+00	Am-241	X	335.37	7.64E+00	Am-241
13.6	1.14E+00	Pa-233	X	114	6.12E+01	Pu-241		335.37	1.76E+00	U-237
13.81	1.83E+00	U-237		114.23	1.08E+02	U-237	X	336.11	2.41E+01	Pu-239
13.9	5.70E+05	Am-241	X	114.23	6.62E+00	Am-241	X	337.7	1.65E-01	U-237
13.9	1.15E+03	U-237	X	114.44	1.12E+02	Pu-239	X	340.48	1.18E-01	Pa-233
19.55	1.34E-01	U-235		114.44	3.47E+01	Pu-241	X	341.51	1.42E+01	Pu-239
26.34	3.50E+04	Am-241		114.44	1.78E-01	Pu-240	X	345.01	1.20E+02	Pu-239
26.34	4.50E+01	U-237		114.44	1.50E-01	Pu-238	X	345.01	6.45E+00	Pu-239
26.7	7.55E+01	Pu-241		115.38	9.89E+01	Pu-239		354	1.51E-01	Pu-239
29.37	3.83E-01	Np-237		116.26	1.22E+02	Pu-239		361.89	2.62E+00	Pu-239
30.04	4.67E+01	Pu-239		117.46	4.20E+01	U-237	X	367.07	1.91E+01	Pu-239
33.2	1.94E+03	Am-241		117.46	2.59E+00	Am-241	X	368.55	1.89E+01	Pu-239
33.2	2.41E+00	U-237		119.7	4.52E+00	Pu-239		368.62	7.25E-01	U-237
38.54	7.40E+00	U-237		119.7	2.04E+00	Pu-239		368.65	3.34E+00	Am-241
38.66	2.25E+03	Pu-239		121.2	5.18E-01	Pu-241		370.94	1.99E+00	U-237
41.93	3.14E+01	Pu-239		122.35	2.04E-01	Pu-239		370.94	8.05E-01	Am-241
42.7	8.47E+01	Am-241		123.05	1.54E+01	Am-241		375.05	3.34E+02	Pu-239
43.42	1.12E+03	Am-241		123.62	5.10E+00	Pu-239		376.65	2.13E+00	Am-241
43.42	4.44E-01	U-237		124.51	1.46E+01	Pu-239		380.19	6.56E+01	Pu-239
43.5	6.90E+02	Pu-238		125.21	1.21E+01	Pu-239		382.75	5.57E+01	Pu-239
44.2	3.15E+00	Pu-241		125.3	6.28E+01	Am-241		383.81	4.34E-01	Am-241
44.86	6.29E-01	Pu-241		129.3	1.36E+03	Pu-239		392.53	4.41E+01	Pu-239
44.92	1.63E-01	Pu-242		141.66	6.88E+00	Pu-239		393.14	7.53E+01	Pu-239
45.24	2.14E+03	Pu-240		143.35	3.72E+00	Pu-239		399.53	1.27E+00	Pu-239
46.21	1.55E+01	Pu-239		144.2	6.09E+01	Pu-239		406.8	5.38E-01	Pu-239
46.68	1.00E+01	Pu-239		146.09	2.56E+01	Pu-239		411.2	1.51E+00	Pu-239
47.6	1.34E+01	Pu-239		146.55	7.10E+00	Am-241		413.71	3.15E+02	Pu-239
51.01	6.29E+00	U-237		148.57	1.40E+02	Pu-241		419.33	4.42E-01	Am-241
51.01	4.00E-01	Am-241		150.04	1.14E+00	Am-241		422.6	2.62E+01	Pu-239
51.62	5.85E+03	Pu-239		152.72	1.64E+01	Pu-238		426.47	3.79E-01	Am-241
54.04	4.18E+01	Pu-239		158.1	2.15E-01	Pu-239		426.68	5.01E+00	Pu-239
55.56	2.79E+02	Am-241		159.96	4.94E+00	Pu-241		428.4	2.15E-01	Pu-239
56.32	1.89E+00	Pu-241		160.19	1.33E+00	Pu-239		430.08	9.25E-01	Pu-239
56.76	7.40E-01	Pu-241		160.31	1.92E+01	Pu-240		445.72	1.89E+00	Pu-239
56.83	2.48E+02	Pu-239		161.45	2.64E+01	Pu-239		451.48	4.07E+01	Pu-239
59.54	5.53E+05	Am-241		164.61	3.44E+01	U-237		454.66	1.49E-01	Am-241
59.54	6.38E+02	U-237		164.69	1.03E+00	Am-241		457.61	3.20E-01	Pu-239
64.83	2.37E+01	U-237		165.81	3.57E-01	Am-241		461.25	4.88E-01	Pu-239
64.83	2.23E+00	Am-241		167.81	6.24E-01	Pu-239		481.66	9.89E-01	Pu-239
65.71	1.12E+01	Pu-239		169.56	2.66E+00	Am-241		493.08	1.87E-01	Pu-239
67.45	6.47E+00	Am-241		171.39	2.37E+01	Pu-239		582.89	1.32E-01	Pu-239
67.67	3.26E+01	Pu-239		173.7	6.67E-01	Pu-239		597.48	1.14E-01	Am-241
68.7	7.74E+01	Pu-239		175.07	2.80E-01	Am-241		597.99	3.59E-01	Pu-239
68.74	2.80E+01	Pu-239		179.22	1.42E+01	Pu-239		612.83	2.04E-01	Pu-239
69.76	4.47E+01	Am-241		185.71	1.21E-01	U-235		617.1	2.88E-01	Pu-239
71.6	2.17E+00	Pu-241		188.23	2.34E+00	Pu-239		618.28	4.39E-01	Pu-239
75.8	9.09E+00	Am-241		189.36	1.78E+01	Pu-239		619.01	9.15E-01	Am-241
77.1	1.56E+01	Pu-241		191.96	3.33E-01	Am-241		619.21	2.60E-01	Pu-239
77.59	8.17E+01	Pu-239		195.68	2.30E+01	Pu-239		633.15	5.44E-01	Pu-239
78.43	3.32E+01	Pu-239		203.55	1.22E+02	Pu-239		637.7	5.50E-01	Pu-239
86.48	3.36E-01	Np-237		208.01	3.92E+02	U-237		637.8	5.50E-01	Pu-239
89.64	5.81E+00	Pu-239		208.01	1.22E+01	Am-241		639.99	1.87E+00	Pu-239
89.7	4.30E-01	Pu-239		212.46	1.39E+00	Pu-240		641.47	1.09E-01	Am-241
94.65	7.53E+02	Pu-239	X	218	2.58E-01	Pu-239		642.35	6.21E-01	Pu-240
94.65	2.36E+02	Pu-241	X	221.46	6.53E-01	Am-241		645.94	3.27E+00	Pu-239

94.65	1.21E+00	Pu-240	X	221.8	3.92E-01	U-237	649.32	1.53E-01	Pu-239
94.65	1.02E+00	Pu-238	X	225.42	3.25E+00	Pu-239	652.05	1.42E+00	Pu-239
94.65	2.81E-01	Pa-233	X	234.4	3.79E-01	U-237	653.02	5.81E-01	Am-241
96.14	8.15E+00	Pu-239		237.77	3.10E+00	Pu-239	654.88	4.84E-01	Pu-239
97.07	2.85E+02	U-237	X	242.08	1.57E+00	Pu-239	658.86	2.09E+00	Pu-239
97.07	1.76E+01	Am-241	X	243.38	5.44E+00	Pu-239	662.4	5.61E+00	Am-241
97.6	1.94E+01	Pu-239		244.92	1.10E+00	Pu-239	664.58	3.57E-01	Pu-239
98.43	1.20E+03	Pu-239	X	248.95	1.55E+00	Pu-239	674.05	1.11E-01	Pu-239
98.43	3.77E+02	Pu-241	X	255.38	1.72E+01	Pu-239	674.4	1.11E-01	Pu-239
98.43	1.94E+00	Pu-240	X	263.95	5.70E+00	Pu-239	687.57	1.67E-01	Pu-240
98.43	1.63E+00	Pu-238	X	264.89	1.39E-01	Am-241	688.72	5.01E-01	Am-241
98.43	4.50E-01	Pa-233	X	265.7	3.44E-01	Pu-239	690.81	1.94E-01	Pu-239
98.78	3.16E+02	Pu-239		267.54	1.32E+01	U-237	701.1	1.10E-01	Pu-239
98.97	3.13E+02	Am-241		267.58	4.05E-01	Am-241	703.68	8.49E-01	Pu-239
99.85	1.28E+02	Pu-238		275.77	1.02E-01	Am-241	718	6.02E-01	Pu-239
101.06	4.53E+02	U-237	X	281.2	4.52E-01	Pu-239	722.01	3.02E+00	Am-241
101.06	2.79E+01	Am-241	X	285.3	4.09E-01	Pu-239	737.34	1.23E-01	Am-241
102.98	3.00E+02	Am-241		292.77	2.19E-01	Am-241	755.9	1.17E-01	Am-241
102.98	1.18E-01	U-237		297.46	1.07E+01	Pu-239	756.4	6.02E-01	Pu-239
103.06	4.64E+01	Pu-239		300.13	1.76E-01	Pa-233	756.4	1.44E-01	Pu-239
103.68	7.64E+01	Pu-241		302.87	1.10E+00	Pu-239	766.39	3.87E-01	Pu-238
104.23	3.41E+02	Pu-240		307.85	1.18E+00	Pu-239	769.15	1.10E+00	Pu-239

Table A.2.21. Input peak intensities for the 50 year old 5 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
8.22	3.57E+00	Np-237		109.7	1.72E-01	Am-241		311.9	1.53E+01	Pa-233
12.98	7.93E+03	Pu-239		110.42	1.51E+02	Pu-239	X	316.41	2.84E+00	Pu-239
13	2.22E+01	U-234	X	110.42	6.81E+00	Pu-241	X	319.68	1.03E+00	Pu-239
13	6.35E-01	U-236	X	110.42	8.40E-01	Pa-233	X	320.86	1.17E+01	Pu-239
13	2.86E-01	U-235	X	110.42	2.42E-01	Pu-240	X	322.52	5.32E+00	Am-241
13.3	1.96E+01	Np-237	X	110.42	1.49E-01	Pu-238	X	323.84	1.16E+01	Pu-239
13.3	6.25E-01	Th-231	X	111.3	2.86E+02	Pu-239	X	332.35	5.22E+00	Am-241
13.6	9.22E+05	Pu-239	X	111.3	1.29E+01	Pu-241	X	332.35	3.22E+00	U-237
13.6	4.57E+05	Pu-240	X	111.3	1.59E+00	Pa-233	X	332.85	1.06E+02	Pu-239
13.6	1.31E+05	Pu-238	X	111.3	4.57E-01	Pu-240	X	335.37	1.74E+01	Am-241
13.6	1.36E+02	Pu-241	X	111.3	2.82E-01	Pu-238	X	335.37	2.55E-01	U-237
13.6	3.72E+01	Pu-242	X	113.3	8.23E+00	U-237	X	336.11	2.41E+01	Pu-239
13.6	1.70E+01	Pa-233	X	113.3	7.95E+00	Am-241	X	337.7	1.50E-01	Am-241
13.81	2.65E-01	U-237		114	8.83E+00	Pu-241		340.48	1.76E+00	Pa-233
13.9	1.30E+06	Am-241	X	114.23	1.56E+01	U-237	X	341.51	1.42E+01	Pu-239
13.9	1.66E+02	U-237	X	114.23	1.51E+01	Am-241	X	345.01	1.20E+02	Pu-239
19.55	6.68E-01	U-235		114.44	1.12E+02	Pu-239	X	345.01	6.45E+00	Pu-239
25.64	1.50E-01	Th-231		114.44	5.00E+00	Pu-241	X	354	1.51E-01	Pu-239
26.34	7.95E+04	Am-241		114.44	6.14E-01	Pa-233	X	361.89	2.62E+00	Pu-239
26.34	6.51E+00	U-237		114.44	1.78E-01	Pu-240	X	367.07	1.91E+01	Pu-239
26.7	1.09E+01	Pu-241		114.44	1.09E-01	Pu-238	X	368.55	1.89E+01	Pu-239
29.37	5.61E+00	Np-237		115.38	9.89E+01	Pu-239		368.62	1.05E-01	U-237
30.04	4.67E+01	Pu-239		116.26	1.22E+02	Pu-239		368.65	7.60E+00	Am-241
33.2	4.41E+03	Am-241		117.46	6.08E+00	U-237	X	370.94	1.83E+00	Am-241
33.2	3.48E-01	U-237		117.46	5.88E+00	Am-241	X	370.94	2.88E-01	U-237
38.54	1.07E+00	U-237		119.7	4.52E+00	Pu-239		375.05	3.34E+02	Pu-239
38.66	2.25E+03	Pu-239		119.7	2.04E+00	Pu-239		375.4	2.69E-01	Pa-233
41.93	3.14E+01	Pu-239		120.36	1.58E-01	Am-241		376.65	4.83E+00	Am-241
42.7	1.93E+02	Am-241		122.35	2.04E-01	Pu-239		380.19	6.56E+01	Pu-239
43.42	2.56E+03	Am-241		123.05	3.50E+01	Am-241		382.75	5.57E+01	Pu-239
43.5	5.02E+02	Pu-238		123.62	5.10E+00	Pu-239		383.81	9.87E-01	Am-241
44.2	4.54E-01	Pu-241		124.51	1.46E+01	Pu-239		392.53	4.41E+01	Pu-239
44.92	1.63E-01	Pu-242		125.21	1.21E+01	Pu-239		393.14	7.53E+01	Pu-239
45.24	2.13E+03	Pu-240		125.3	1.43E+02	Am-241		398.49	5.51E-01	Pa-233
46.21	1.55E+01	Pu-239		129.3	1.36E+03	Pu-239		399.53	1.27E+00	Pu-239
46.68	1.00E+01	Pu-239		139.44	1.86E-01	Am-241		406.8	5.38E-01	Pu-239
47.6	1.34E+01	Pu-239		141.66	6.88E+00	Pu-239		411.2	1.51E+00	Pu-239
51.01	9.11E-01	U-237		143.25	1.76E-01	Np-237		413.71	3.15E+02	Pu-239
51.01	9.10E-01	Am-241		143.35	3.72E+00	Pu-239		415.76	6.85E-01	Pa-233
51.62	5.85E+03	Pu-239		143.76	1.16E-01	U-235		419.33	1.01E+00	Am-241
53.2	2.73E-01	U-234		144.2	6.09E+01	Pu-239		422.6	2.62E+01	Pu-239
54.04	4.18E+01	Pu-239		146.09	2.56E+01	Pu-239		426.47	8.61E-01	Am-241
55.56	6.34E+02	Am-241		146.55	1.61E+01	Am-241		426.68	5.01E+00	Pu-239
56.32	2.72E-01	Pu-241		148.57	2.03E+01	Pu-241		428.4	2.15E-01	Pu-239
56.76	1.07E-01	Pu-241		150.04	2.59E+00	Am-241		430.08	9.25E-01	Pu-239
56.83	2.48E+02	Pu-239		152.72	1.19E+01	Pu-238		445.72	1.89E+00	Pu-239
57.1	1.41E-01	Np-237		158.1	2.15E-01	Pu-239		451.48	4.07E+01	Pu-239
59.54	1.26E+06	Am-241		159.96	7.13E-01	Pu-241		454.66	3.40E-01	Am-241
59.54	9.25E+01	U-237		160.19	1.33E+00	Pu-239		457.61	3.20E-01	Pu-239
64.83	5.08E+00	Am-241		160.31	1.91E+01	Pu-240		459.68	1.26E-01	Am-241
64.83	3.44E+00	U-237		161.45	2.64E+01	Pu-239		461.25	4.88E-01	Pu-239
65.71	1.12E+01	Pu-239		164.61	4.99E+00	U-237		468.12	1.01E-01	Am-241
67.45	1.47E+01	Am-241		164.69	2.33E+00	Am-241		481.66	9.89E-01	Pu-239
67.67	3.26E+01	Pu-239		165.81	8.12E-01	Am-241		493.08	1.87E-01	Pu-239
68.7	7.74E+01	Pu-239		167.81	6.24E-01	Pu-239		582.89	1.32E-01	Pu-239
68.74	2.80E+01	Pu-239		169.56	6.06E+00	Am-241		590.28	1.00E-01	Am-241
69.76	1.02E+02	Am-241		171.39	2.37E+01	Pu-239		597.48	2.59E-01	Am-241
71.6	3.13E-01	Pu-241		173.7	6.67E-01	Pu-239		597.99	3.59E-01	Pu-239
75.27	5.23E-01	Pa-233		175.07	6.37E-01	Am-241		612.83	2.04E-01	Pu-239
75.8	2.07E+01	Am-241		179.22	1.42E+01	Pu-239		617.1	2.88E-01	Pu-239
77.1	2.25E+00	Pu-241		185.71	6.04E-01	U-235		618.28	4.39E-01	Pu-239
77.59	8.17E+01	Pu-239		188.23	2.34E+00	Pu-239		619.01	2.08E+00	Am-241
78.43	3.32E+01	Pu-239		189.36	1.78E+01	Pu-239		619.21	2.60E-01	Pu-239
86.48	4.92E+00	Np-237		191.96	7.56E-01	Am-241		633.15	5.44E-01	Pu-239

86.6	7.72E-01	Pa-233		195.68	2.30E+01	Pu-239	637.7	5.50E-01	Pu-239
89.64	5.81E+00	Pu-239		203.55	1.22E+02	Pu-239	637.8	5.50E-01	Pu-239
89.7	4.30E-01	Pu-239		204.06	1.02E-01	Am-241	639.99	1.87E+00	Pu-239
92.28	6.59E-01	Np-237	X	208.01	5.68E+01	U-237	641.47	2.49E-01	Am-241
94.64	2.44E-01	Np-237		208.01	2.77E+01	Am-241	642.35	6.19E-01	Pu-240
94.65	7.53E+02	Pu-239	X	212.46	1.38E+00	Pu-240	645.94	3.27E+00	Pu-239
94.65	3.40E+01	Pu-241	X	218	2.58E-01	Pu-239	649.32	1.53E-01	Pu-239
94.65	4.18E+00	Pa-233	X	221.46	1.48E+00	Am-241	652.05	1.42E+00	Pu-239
94.65	1.21E+00	Pu-240	X	225.42	3.25E+00	Pu-239	653.02	1.32E+00	Am-241
94.65	7.41E-01	Pu-238	X	232.81	1.61E-01	Am-241	654.88	4.84E-01	Pu-239
95.86	1.06E+00	Np-237	X	237.77	3.10E+00	Pu-239	658.86	2.09E+00	Pu-239
96.14	8.15E+00	Pu-239		242.08	1.57E+00	Pu-239	662.4	1.27E+01	Am-241
97.07	4.13E+01	U-237	X	243.38	5.44E+00	Pu-239	664.58	3.57E-01	Pu-239
97.07	3.99E+01	Am-241	X	244.92	1.10E+00	Pu-239	674.05	1.11E-01	Pu-239
97.6	1.94E+01	Pu-239		248.95	1.55E+00	Pu-239	674.4	1.11E-01	Pu-239
98.43	1.20E+03	Pu-239	X	255.38	1.72E+01	Pu-239	680.1	1.10E-01	Am-241
98.43	5.44E+01	Pu-241	X	263.95	5.70E+00	Pu-239	687.57	1.67E-01	Pu-240
98.43	6.69E+00	Pa-233	X	264.89	3.15E-01	Am-241	688.72	1.14E+00	Am-241
98.43	1.93E+00	Pu-240	X	265.7	3.44E-01	Pu-239	690.81	1.94E-01	Pu-239
98.43	1.18E+00	Pu-238	X	267.54	1.91E+00	U-237	696.6	1.87E-01	Am-241
98.78	3.16E+02	Pu-239		267.58	9.21E-01	Am-241	701.1	1.10E-01	Pu-239
98.97	7.11E+02	Am-241		271.55	1.28E-01	Pa-233	703.68	8.49E-01	Pu-239
99.85	9.33E+01	Pu-238		275.77	2.31E-01	Am-241	718	6.02E-01	Pu-239
101.06	6.57E+01	U-237	X	281.2	4.52E-01	Pu-239	722.01	6.86E+00	Am-241
101.06	6.34E+01	Am-241	X	285.3	4.09E-01	Pu-239	737.34	2.80E-01	Am-241
102.98	6.83E+02	Am-241		291.3	1.09E-01	Am-241	755.9	2.66E-01	Am-241
103.06	4.64E+01	Pu-239		292.77	4.97E-01	Am-241	756.4	6.02E-01	Pu-239
103.68	1.10E+01	Pu-241		297.46	1.07E+01	Pu-239	756.4	1.44E-01	Pu-239
103.86	3.38E-01	Pa-233		300.13	2.63E+00	Pa-233	766.39	2.82E-01	Pu-238
104.23	3.40E+02	Pu-240		302.87	1.10E+00	Pu-239	767	1.75E-01	Am-241
107.6	1.32E-01	Np-237	X	307.85	1.18E+00	Pu-239	769.15	1.10E+00	Pu-239
108.42	2.50E-01	Np-237	X	311.78	5.55E+00	Pu-239	769.37	1.46E+00	Pu-239

Table A2.22. Input peak intensities for the 1 year old 11 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
12.98	7.31E+03	Pu-239		110.42	4.99E-01	Pu-240	X	316.41	2.61E+00	Pu-239
13	1.59E+00	U-234	X	111.3	7.93E+02	Pu-241	X	319.68	9.50E-01	Pu-239
13.6	9.44E+05	Pu-240	X	111.3	2.63E+02	Pu-239	X	320.86	1.07E+01	Pu-239
13.6	8.49E+05	Pu-239	X	111.3	1.23E+00	Pu-238	X	322.52	1.67E+00	Am-241
13.6	5.72E+05	Pu-238	X	111.3	9.44E-01	Pu-240	X	323.84	1.07E+01	Pu-239
13.6	8.40E+03	Pu-241	X	113.3	5.07E+02	U-237	X	332.35	1.98E+02	U-237
13.6	2.09E+02	Pu-242	X	113.3	2.50E+00	Am-241	X	332.35	1.64E+00	Am-241
13.81	1.63E+01	U-237		114	5.44E+02	Pu-241		332.85	9.78E+01	Pu-239
13.9	4.07E+05	Am-241	X	114.23	9.59E+02	U-237	X	335.37	1.57E+01	U-237
13.9	1.02E+04	U-237	X	114.23	4.73E+00	Am-241	X	335.37	5.46E+00	Am-241
26.34	2.50E+04	Am-241		114.44	3.08E+02	Pu-241	X	336.11	2.22E+01	Pu-239
26.34	4.01E+02	U-237		114.44	1.03E+02	Pu-239	X	337.7	1.47E+00	U-237
26.7	6.72E+02	Pu-241		114.44	4.78E-01	Pu-238	X	341.51	1.31E+01	Pu-239
30.04	4.30E+01	Pu-239		114.44	3.67E-01	Pu-240	X	345.01	1.10E+02	Pu-239
33.2	1.39E+03	Am-241		115.38	9.11E+01	Pu-239		345.01	5.94E+00	Pu-239
33.2	2.15E+01	U-237		116.26	1.12E+02	Pu-239		354	1.39E-01	Pu-239
38.54	6.60E+01	U-237		117.46	3.75E+02	U-237	X	361.89	2.42E+00	Pu-239
38.66	2.07E+03	Pu-239		117.46	1.85E+00	Am-241	X	367.07	1.76E+01	Pu-239
41.93	2.89E+01	Pu-239		119.7	4.16E+00	Pu-239		368.55	1.74E+01	Pu-239
42.7	6.05E+01	Am-241		119.7	1.88E+00	Pu-239		368.62	6.47E+00	U-237
43.42	8.03E+02	Am-241		121.2	4.61E+00	Pu-241		368.65	2.39E+00	Am-241
43.42	3.96E+00	U-237		122.35	1.88E-01	Pu-239		370.94	1.77E+01	U-237
43.5	2.20E+03	Pu-238		123.05	1.10E+01	Am-241		370.94	5.75E-01	Am-241
44.2	2.80E+01	Pu-241		123.62	4.69E+00	Pu-239		375.05	3.08E+02	Pu-239
44.86	5.60E+00	Pu-241		124.51	1.35E+01	Pu-239		376.65	1.52E+00	Am-241
44.92	9.18E-01	Pu-242		125.21	1.12E+01	Pu-239		380.19	6.04E+01	Pu-239
45.24	4.39E+03	Pu-240		125.3	4.49E+01	Am-241		382.75	5.13E+01	Pu-239
46.21	1.43E+01	Pu-239		129.3	1.25E+03	Pu-239		383.81	3.10E-01	Am-241
46.68	9.21E+00	Pu-239		141.66	6.34E+00	Pu-239		392.53	4.06E+01	Pu-239
47.6	1.24E+01	Pu-239		143.35	3.43E+00	Pu-239		393.14	6.93E+01	Pu-239
51.01	5.61E+01	U-237		144.2	5.60E+01	Pu-239		399.53	1.17E+00	Pu-239
51.01	2.86E-01	Am-241		146.09	2.36E+01	Pu-239		406.8	4.95E-01	Pu-239
51.62	5.39E+03	Pu-239		146.55	5.07E+00	Am-241		411.2	1.39E+00	Pu-239
54.04	3.85E+01	Pu-239		148.57	1.25E+03	Pu-241		413.71	2.90E+02	Pu-239
55.56	1.99E+02	Am-241		150.04	8.14E-01	Am-241		419.33	3.16E-01	Am-241
56.32	1.68E+01	Pu-241		152.72	5.21E+01	Pu-238		422.6	2.42E+01	Pu-239
56.76	6.59E+00	Pu-241		158.1	1.98E-01	Pu-239		426.47	2.71E-01	Am-241
56.83	2.28E+02	Pu-239		159.96	4.40E+01	Pu-241		426.68	4.61E+00	Pu-239
59.54	3.95E+05	Am-241		160.19	1.23E+00	Pu-239		428.4	1.98E-01	Pu-239
59.54	5.69E+03	U-237		160.31	3.95E+01	Pu-240		430.08	8.51E-01	Pu-239
64.83	2.12E+02	U-237		161.45	2.44E+01	Pu-239		445.72	1.74E+00	Pu-239
64.83	1.60E+00	Am-241		164.61	3.07E+02	U-237		451.48	3.75E+01	Pu-239
65.71	1.03E+01	Pu-239		164.69	7.34E-01	Am-241		454.66	1.07E-01	Am-241
67.45	4.62E+00	Am-241		165.81	2.55E-01	Am-241		457.61	2.95E-01	Pu-239
67.67	3.00E+01	Pu-239		167.81	5.74E-01	Pu-239		461.25	4.50E-01	Pu-239
68.7	7.13E+01	Pu-239		169.56	1.90E+00	Am-241		481.66	9.11E-01	Pu-239
68.74	2.57E+01	Pu-239		171.39	2.18E+01	Pu-239		493.08	1.72E-01	Pu-239
69.76	3.19E+01	Am-241		173.7	6.14E-01	Pu-239		582.89	1.22E-01	Pu-239
69.76	1.57E-01	U-237		175.07	2.00E-01	Am-241		597.99	3.31E-01	Pu-239
71.6	1.93E+01	Pu-241		179.22	1.31E+01	Pu-239		612.83	1.88E-01	Pu-239
75.8	6.49E+00	Am-241		188.23	2.16E+00	Pu-239		617.1	2.65E-01	Pu-239
77.1	1.38E+02	Pu-241		189.36	1.64E+01	Pu-239		618.28	4.04E-01	Pu-239
77.59	7.52E+01	Pu-239		191.96	2.38E-01	Am-241		619.01	6.53E-01	Am-241
78.43	3.05E+01	Pu-239		195.68	2.12E+01	Pu-239		619.21	2.40E-01	Pu-239
89.64	5.35E+00	Pu-239		200.97	2.19E-01	Pu-238		633.15	5.01E-01	Pu-239
89.7	3.96E-01	Pu-239		203.55	1.13E+02	Pu-239		637.7	5.07E-01	Pu-239
94.65	2.10E+03	Pu-241	X	208.01	3.50E+03	U-237		637.8	5.07E-01	Pu-239
94.65	6.93E+02	Pu-239	X	208.01	8.70E+00	Am-241		639.99	1.72E+00	Pu-239
94.65	3.25E+00	Pu-238	X	212.46	2.85E+00	Pu-240		642.35	1.28E+00	Pu-240
94.65	2.50E+00	Pu-240	X	218	2.38E-01	Pu-239		645.94	3.01E+00	Pu-239
96.14	7.50E+00	Pu-239		221.46	4.66E-01	Am-241		649.32	1.41E-01	Pu-239
97.07	2.54E+03	U-237	X	221.8	3.50E+00	U-237		652.05	1.31E+00	Pu-239
97.07	1.25E+01	Am-241	X	225.42	2.99E+00	Pu-239		653.02	4.15E-01	Am-241
97.6	1.78E+01	Pu-239		234.4	3.38E+00	U-237		654.88	4.46E-01	Pu-239
98.43	3.35E+03	Pu-241	X	237.77	2.85E+00	Pu-239		658.86	1.92E+00	Pu-239

98.43	1.11E+03	Pu-239	X	242.08	1.45E+00	Pu-239	662.4	4.00E+00	Am-241
98.43	5.19E+00	Pu-238	X	243.38	5.01E+00	Pu-239	664.58	3.29E-01	Pu-239
98.43	3.98E+00	Pu-240	X	244.92	1.01E+00	Pu-239	674.05	1.02E-01	Pu-239
98.78	2.91E+02	Pu-239		248.95	1.43E+00	Pu-239	674.4	1.02E-01	Pu-239
98.97	2.23E+02	Am-241		255.38	1.58E+01	Pu-239	687.57	3.44E-01	Pu-240
99.85	4.09E+02	Pu-238		263.95	5.25E+00	Pu-239	688.72	3.58E-01	Am-241
101	4.77E-01	Pu-241		265.7	3.17E-01	Pu-239	690.81	1.78E-01	Pu-239
101.06	4.04E+03	U-237	X	267.54	1.18E+02	U-237	701.1	1.01E-01	Pu-239
101.06	1.99E+01	Am-241	X	267.58	2.89E-01	Am-241	703.68	7.82E-01	Pu-239
102.98	2.15E+02	Am-241		281.2	4.16E-01	Pu-239	718	5.54E-01	Pu-239
102.98	1.06E+00	U-237		285.3	3.76E-01	Pu-239	722.01	2.16E+00	Am-241
103.06	4.28E+01	Pu-239		292.77	4.13E-01	U-237	742.81	2.92E-01	Pu-238
103.68	6.80E+02	Pu-241		292.77	1.56E-01	Am-241	756.4	5.54E-01	Pu-239
104.23	7.02E+02	Pu-240		297.46	9.86E+00	Pu-239	756.4	1.33E-01	Pu-239
110.42	4.20E+02	Pu-241	X	302.87	1.01E+00	Pu-239	766.39	1.23E+00	Pu-238
110.42	1.39E+02	Pu-239	X	307.85	1.09E+00	Pu-239	769.15	1.01E+00	Pu-239
110.42	6.51E-01	Pu-238	X	311.78	5.11E+00	Pu-239	769.37	1.35E+00	Pu-239

Table A2.23. Input peak intensities for the 10 year old 11 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
8.22	1.40E+00	Np-237		111.3	1.15E+00	Pu-238	X	332.85	9.78E+01	Pu-239
12.98	7.31E+03	Pu-239		111.3	9.43E-01	Pu-240	X	335.37	4.41E+01	Am-241
13	1.53E+01	U-234	X	111.3	6.14E-01	Pa-233	X	335.37	1.02E+01	U-237
13	2.62E-01	U-236	X	113.3	3.29E+02	U-237	X	336.11	2.22E+01	Pu-239
13.3	7.69E+00	Np-237	X	113.3	2.02E+01	Am-241	X	337.7	9.52E-01	U-237
13.3	1.15E-01	Th-231	X	114	3.52E+02	Pu-241		337.7	3.81E-01	Am-241
13.6	9.43E+05	Pu-240	X	114.23	6.22E+02	U-237	X	340.48	6.81E-01	Pa-233
13.6	8.49E+05	Pu-239	X	114.23	3.82E+01	Am-241	X	341.51	1.31E+01	Pu-239
13.6	5.32E+05	Pu-238	X	114.44	2.00E+02	Pu-241	X	345.01	1.10E+02	Pu-239
13.6	5.44E+03	Pu-241	X	114.44	1.03E+02	Pu-239	X	345.01	5.94E+00	Pu-239
13.6	2.09E+02	Pu-242	X	114.44	4.45E-01	Pu-238	X	354	1.39E-01	Pu-239
13.6	6.58E+00	Pa-233	X	114.44	3.66E-01	Pu-240	X	358.25	1.07E-01	Am-241
13.81	1.06E+01	U-237		114.44	2.37E-01	Pa-233	X	361.89	2.42E+00	Pu-239
13.9	3.29E+06	Am-241	X	115.38	9.11E+01	Pu-239		367.07	1.76E+01	Pu-239
13.9	6.63E+03	U-237	X	116.26	1.12E+02	Pu-239		368.55	1.74E+01	Pu-239
19.55	1.23E-01	U-235		117.46	2.43E+02	U-237	X	368.62	4.19E+00	U-237
26.34	2.02E+05	Am-241		117.46	1.49E+01	Am-241	X	368.65	1.93E+01	Am-241
26.34	2.60E+02	U-237		119.7	4.16E+00	Pu-239		370.94	1.15E+01	U-237
26.7	4.35E+02	Pu-241		119.7	1.88E+00	Pu-239		370.94	4.65E+00	Am-241
29.37	2.20E+00	Np-237		120.36	4.00E-01	Am-241		375.05	3.08E+02	Pu-239
30.04	4.30E+01	Pu-239		121.2	2.98E+00	Pu-241		375.4	1.04E-01	Pa-233
33.2	1.12E+04	Am-241		122.35	1.88E-01	Pu-239		376.65	1.23E+01	Am-241
33.2	1.39E+01	U-237		123.05	8.89E+01	Am-241		380.19	6.04E+01	Pu-239
38.54	4.28E+01	U-237		123.62	4.69E+00	Pu-239		382.75	5.13E+01	Pu-239
38.66	2.07E+03	Pu-239		124.51	1.35E+01	Pu-239		383.81	2.51E+00	Am-241
41.93	2.89E+01	Pu-239		125.21	1.12E+01	Pu-239		392.53	4.06E+01	Pu-239
42.7	4.89E+02	Am-241		125.3	3.63E+02	Am-241		393.14	6.93E+01	Pu-239
43.42	6.49E+03	Am-241		129.3	1.25E+03	Pu-239		398.49	2.13E-01	Pa-233
43.42	2.57E+00	U-237		139.44	4.71E-01	Am-241		398.64	1.78E-01	Am-241
43.5	2.05E+03	Pu-238		141.66	6.34E+00	Pu-239		399.53	1.17E+00	Pu-239
44.2	1.81E+01	Pu-241		143.35	3.43E+00	Pu-239		406.35	1.29E-01	Am-241
44.86	3.62E+00	Pu-241		144.2	5.60E+01	Pu-239		406.8	4.95E-01	Pu-239
44.92	9.18E-01	Pu-242		146.09	2.36E+01	Pu-239		411.2	1.39E+00	Pu-239
45.24	4.39E+03	Pu-240		146.55	4.10E+01	Am-241		413.71	2.90E+02	Pu-239
46.21	1.43E+01	Pu-239		148.57	8.09E+02	Pu-241		415.76	2.65E-01	Pa-233
46.68	9.21E+00	Pu-239		150.04	6.58E+00	Am-241		419.33	2.55E+00	Am-241
47.6	1.24E+01	Pu-239		152.72	4.85E+01	Pu-238		422.6	2.42E+01	Pu-239
51.01	3.64E+01	U-237		158.1	1.98E-01	Pu-239		426.47	2.19E+00	Am-241
51.01	2.31E+00	Am-241		159.26	1.25E-01	Am-241		426.68	4.61E+00	Pu-239
51.62	5.39E+03	Pu-239		159.96	2.85E+01	Pu-241		428.4	1.98E-01	Pu-239
53.2	1.88E-01	U-234		160.19	1.23E+00	Pu-239		430.08	8.51E-01	Pu-239
54.04	3.85E+01	Pu-239		160.31	3.95E+01	Pu-240		445.72	1.74E+00	Pu-239
55.56	1.61E+03	Am-241		161.45	2.44E+01	Pu-239		451.48	3.75E+01	Pu-239
56.32	1.09E+01	Pu-241		161.54	1.33E-01	Am-241		452.6	2.13E-01	Am-241
56.76	4.26E+00	Pu-241		164.61	1.99E+02	U-237		454.66	8.62E-01	Am-241
56.83	2.28E+02	Pu-239		164.69	5.93E+00	Am-241		457.61	2.95E-01	Pu-239
59.54	3.19E+06	Am-241		165.81	2.06E+00	Am-241		459.68	3.20E-01	Am-241
59.54	3.69E+03	U-237		167.81	5.74E-01	Pu-239		461.25	4.50E-01	Pu-239
64.83	1.37E+02	U-237		169.56	1.54E+01	Am-241		468.12	2.56E-01	Am-241
64.83	1.29E+01	Am-241		171.39	2.18E+01	Pu-239		481.66	9.11E-01	Pu-239
65.71	1.03E+01	Pu-239		173.7	6.14E-01	Pu-239		493.08	1.72E-01	Pu-239
67.45	3.73E+01	Am-241		175.07	1.62E+00	Am-241		512.5	1.02E-01	Am-241
67.67	3.00E+01	Pu-239		179.22	1.31E+01	Pu-239		514	2.31E-01	Am-241
68.7	7.13E+01	Pu-239		185.71	1.11E-01	U-235		573.94	1.11E-01	Am-241
68.74	2.57E+01	Pu-239		188.23	2.16E+00	Pu-239		582.89	1.22E-01	Pu-239
69.76	2.58E+02	Am-241		189.36	1.64E+01	Pu-239		586.59	1.17E-01	Am-241
69.76	1.02E-01	U-237		191.96	1.92E+00	Am-241		590.28	2.54E-01	Am-241
71.6	1.25E+01	Pu-241		195.68	2.12E+01	Pu-239		597.48	6.58E-01	Am-241
75.27	2.02E-01	Pa-233		200.97	2.04E-01	Pu-238		597.99	3.31E-01	Pu-239
75.8	5.25E+01	Am-241		203.55	1.13E+02	Pu-239		612.83	1.88E-01	Pu-239
77.1	8.96E+01	Pu-241		204.06	2.58E-01	Am-241		617.1	2.65E-01	Pu-239
77.59	7.52E+01	Pu-239		208.01	2.27E+03	U-237		618.28	4.04E-01	Pu-239
78.43	3.05E+01	Pu-239		208.01	7.03E+01	Am-241		619.01	5.28E+00	Am-241
86.48	1.93E+00	Np-237		212.46	2.85E+00	Pu-240		619.21	2.40E-01	Pu-239
86.6	2.98E-01	Pa-233		218	2.38E-01	Pu-239		632.93	1.12E-01	Am-241

89.64	5.35E+00	Pu-239		221.46	3.77E+00	Am-241	633.15	5.01E-01	Pu-239
89.7	3.96E-01	Pu-239		221.8	2.27E+00	U-237	637.7	5.07E-01	Pu-239
92.28	2.59E-01	Np-237	X	225.42	2.99E+00	Pu-239	637.8	5.07E-01	Pu-239
94.65	1.36E+03	Pu-241	X	232.81	4.09E-01	Am-241	639.99	1.72E+00	Pu-239
94.65	6.93E+02	Pu-239	X	234.4	2.19E+00	U-237	641.47	6.31E-01	Am-241
94.65	3.02E+00	Pu-238	X	237.77	2.85E+00	Pu-239	642.35	1.28E+00	Pu-240
94.65	2.49E+00	Pu-240	X	242.08	1.45E+00	Pu-239	645.94	3.01E+00	Pu-239
94.65	1.62E+00	Pa-233	X	243.38	5.01E+00	Pu-239	649.32	1.41E-01	Pu-239
95.86	4.18E-01	Np-237	X	244.92	1.01E+00	Pu-239	652.05	1.31E+00	Pu-239
96.14	7.50E+00	Pu-239		246.73	2.13E-01	Am-241	653.02	3.35E+00	Am-241
97.07	1.65E+03	U-237	X	248.95	1.43E+00	Pu-239	654.88	4.46E-01	Pu-239
97.07	1.01E+02	Am-241	X	255.38	1.58E+01	Pu-239	658.86	1.92E+00	Pu-239
97.6	1.78E+01	Pu-239		260.8	1.08E-01	Am-241	662.4	3.24E+01	Am-241
98.43	2.17E+03	Pu-241	X	263.95	5.25E+00	Pu-239	664.58	3.29E-01	Pu-239
98.43	1.11E+03	Pu-239	X	264.89	8.00E-01	Am-241	674.05	1.02E-01	Pu-239
98.43	4.83E+00	Pu-238	X	265.7	3.17E-01	Pu-239	674.4	1.02E-01	Pu-239
98.43	3.98E+00	Pu-240	X	267.54	7.62E+01	U-237	680.1	2.78E-01	Am-241
98.43	2.59E+00	Pa-233	X	267.58	2.34E+00	Am-241	687.57	3.44E-01	Pu-240
98.78	2.91E+02	Pu-239		275.77	5.87E-01	Am-241	688.72	2.89E+00	Am-241
98.97	1.81E+03	Am-241		281.2	4.16E-01	Pu-239	690.81	1.78E-01	Pu-239
99.85	3.81E+02	Pu-238		285.3	3.76E-01	Pu-239	696.6	4.75E-01	Am-241
101	3.09E-01	Pu-241		291.3	2.76E-01	Am-241	701.1	1.01E-01	Pu-239
101.06	2.62E+03	U-237	X	292.77	1.26E+00	Am-241	703.68	7.82E-01	Pu-239
101.06	1.61E+02	Am-241	X	292.77	2.68E-01	U-237	718	5.54E-01	Pu-239
102.98	1.73E+03	Am-241		297.46	9.86E+00	Pu-239	722.01	1.74E+01	Am-241
102.98	6.85E-01	U-237		300.13	1.01E+00	Pa-233	729.72	1.18E-01	Am-241
103.06	4.28E+01	Pu-239		302.87	1.01E+00	Pu-239	737.34	7.11E-01	Am-241
103.68	4.40E+02	Pu-241		307.85	1.09E+00	Pu-239	742.81	2.71E-01	Pu-238
103.86	1.31E-01	Pa-233		309.1	1.25E-01	Am-241	755.9	6.76E-01	Am-241
104.23	7.01E+02	Pu-240		311.78	5.11E+00	Pu-239	756.4	5.54E-01	Pu-239
109.7	4.36E-01	Am-241		311.9	5.89E+00	Pa-233	756.4	1.33E-01	Pu-239
110.42	2.72E+02	Pu-241	X	316.41	2.61E+00	Pu-239	766.39	1.15E+00	Pu-238
110.42	1.39E+02	Pu-239	X	319.68	9.50E-01	Pu-239	767	4.45E-01	Am-241
110.42	6.06E-01	Pu-238	X	320.86	1.07E+01	Pu-239	769.15	1.01E+00	Pu-239
110.42	4.99E-01	Pu-240	X	322.52	1.35E+01	Am-241	769.37	1.35E+00	Pu-239
110.42	3.24E-01	Pa-233	X	323.84	1.07E+01	Pu-239	770.57	4.21E-01	Am-241
111.3	5.13E+02	Pu-241	X	332.35	1.28E+02	U-237	772.4	2.37E-01	Am-241
111.3	2.63E+02	Pu-239	X	332.35	1.33E+01	Am-241	786.3	1.67E-01	Pu-238

Table A2.24. Input peak intensities for the 50 year old 11 % weapons grade plutonium between 0 and 800 keV. Only peaks with intensities greater than 0.01 photons/second are shown. X-rays denoted by X.

keV	Photons/s	isotope		keV	Photons/s	isotope		keV	Photons/s	isotope
5.18	5.08E-01	Np-237		111.49	5.59E-01	Np-237	X	322.52	3.07E+01	Am-241
8.22	2.06E+01	Np-237		113.3	4.76E+01	U-237	X	323.84	1.07E+01	Pu-239
12.98	7.31E+03	Pu-239		113.3	4.59E+01	Am-241	X	332.35	3.01E+01	Am-241
13	6.59E+01	U-234	X	114	5.10E+01	Pu-241		332.35	1.86E+01	U-237
13	1.31E+00	U-236	X	114.23	9.01E+01	U-237	X	332.85	9.78E+01	Pu-239
13	2.63E-01	U-235	X	114.23	8.69E+01	Am-241	X	335.37	1.00E+02	Am-241
13.3	1.13E+02	Np-237	X	114.44	1.03E+02	Pu-239	X	335.37	1.47E+00	U-237
13.3	5.74E-01	Th-231	X	114.44	2.89E+01	Pu-241	X	336.11	2.22E+01	Pu-239
13.6	9.39E+05	Pu-240	X	114.44	3.53E+00	Pa-233	X	337.7	8.67E-01	Am-241
13.6	8.49E+05	Pu-239	X	114.44	3.65E-01	Pu-240	X	337.7	1.38E-01	U-237
13.6	3.89E+05	Pu-238	X	114.44	3.25E-01	Pu-238	X	340.48	1.02E+01	Pa-233
13.6	7.88E+02	Pu-241	X	115.38	9.11E+01	Pu-239		341.51	1.31E+01	Pu-239
13.6	2.09E+02	Pu-242	X	116.26	1.12E+02	Pu-239		345.01	1.10E+02	Pu-239
13.6	9.80E+01	Pa-233	X	117.46	3.52E+01	U-237	X	345.01	5.94E+00	Pu-239
13.81	1.53E+00	U-237		117.46	3.39E+01	Am-241	X	354	1.39E-01	Pu-239
13.9	7.47E+06	Am-241	X	117.7	3.87E-01	Np-237		358.25	2.42E-01	Am-241
13.9	9.61E+02	U-237	X	119.7	4.16E+00	Pu-239		361.89	2.42E+00	Pu-239
19.55	6.13E-01	U-235		119.7	1.88E+00	Pu-239		367.07	1.76E+01	Pu-239
19.7	1.05E-01	Pa-233		120.36	9.09E-01	Am-241		368.55	1.74E+01	Pu-239
25.64	1.37E-01	Th-231		120.9	2.31E-01	U-234		368.62	6.08E-01	U-237
26.34	4.59E+05	Am-241		121.2	4.32E-01	Pu-241		368.65	4.38E+01	Am-241
26.34	3.77E+01	U-237		122.35	1.88E-01	Pu-239		370.94	1.06E+01	Am-241
26.7	6.30E+01	Pu-241		123.05	2.02E+02	Am-241		370.94	1.66E+00	U-237
28.56	1.62E-01	Pa-233		123.62	4.69E+00	Pu-239		375.05	3.08E+02	Pu-239
29.37	3.23E+01	Np-237		124.51	1.35E+01	Pu-239		375.4	1.55E+00	Pa-233
30.04	4.30E+01	Pu-239		125.21	1.12E+01	Pu-239		376.65	2.79E+01	Am-241
33.2	2.55E+04	Am-241		125.3	8.24E+02	Am-241		380.19	6.04E+01	Pu-239
33.2	2.02E+00	U-237		129.3	1.25E+03	Pu-239		382.75	5.13E+01	Pu-239
38.54	6.20E+00	U-237		131.1	1.96E-01	Np-237		383.81	5.70E+00	Am-241
38.66	2.07E+03	Pu-239		134.29	1.53E-01	Np-237		392.53	4.06E+01	Pu-239
41.93	2.89E+01	Pu-239		139.44	1.07E+00	Am-241		393.14	6.93E+01	Pu-239
42.7	1.11E+03	Am-241		141.66	6.34E+00	Pu-239		398.49	3.17E+00	Pa-233
43.42	1.48E+04	Am-241		143.25	1.01E+00	Np-237		398.64	4.04E-01	Am-241
43.42	3.72E-01	U-237		143.35	3.43E+00	Pu-239		399.53	1.17E+00	Pu-239
43.5	1.49E+03	Pu-238		143.76	1.07E-01	U-235		406.35	2.93E-01	Am-241
44.2	2.62E+00	Pu-241		144.2	5.60E+01	Pu-239		406.8	4.95E-01	Pu-239
44.86	5.25E-01	Pu-241		146.09	2.36E+01	Pu-239		411.2	1.39E+00	Pu-239
44.92	9.18E-01	Pu-242		146.55	9.31E+01	Am-241		413.71	2.90E+02	Pu-239
45.24	4.37E+03	Pu-240		148.57	1.17E+02	Pu-241		415.76	3.94E+00	Pa-233
46.21	1.43E+01	Pu-239		150.04	1.50E+01	Am-241		419.33	5.80E+00	Am-241
46.53	2.38E-01	Np-237		151.41	5.31E-01	Np-237		422.6	2.42E+01	Pu-239
46.68	9.21E+00	Pu-239		152.72	3.54E+01	Pu-238		426.47	4.97E+00	Am-241
47.6	1.24E+01	Pu-239		154.27	1.09E-01	Am-241		426.68	4.61E+00	Pu-239
51.01	5.27E+00	U-237		155.24	2.04E-01	Np-237		428.4	1.98E-01	Pu-239
51.01	5.25E+00	Am-241		158.1	1.98E-01	Pu-239		430.08	8.51E-01	Pu-239
51.62	5.39E+03	Pu-239		159.26	2.83E-01	Am-241		445.72	1.74E+00	Pu-239
53.2	8.11E-01	U-234		159.96	4.12E+00	Pu-241		451.48	3.75E+01	Pu-239
54.04	3.85E+01	Pu-239		160.19	1.23E+00	Pu-239		452.6	4.85E-01	Am-241
55.56	3.66E+03	Am-241		160.31	3.93E+01	Pu-240		454.66	1.96E+00	Am-241
56.32	1.57E+00	Pu-241		161.45	2.44E+01	Pu-239		457.61	2.95E-01	Pu-239
56.76	6.17E-01	Pu-241		161.54	3.03E-01	Am-241		459.68	7.27E-01	Am-241
56.83	2.28E+02	Pu-239		164.61	2.88E+01	U-237		461.25	4.50E-01	Pu-239
57.1	8.11E-01	Np-237		164.69	1.35E+01	Am-241		463.22	2.02E-01	Am-241
59.54	7.25E+06	Am-241		165.81	4.69E+00	Am-241		468.12	5.82E-01	Am-241
59.54	5.35E+02	U-237		167.81	5.74E-01	Pu-239		481.66	9.11E-01	Pu-239
64.83	2.93E+01	Am-241		169.16	1.45E-01	Np-237		493.08	1.72E-01	Pu-239
64.83	1.99E+01	U-237		169.56	3.50E+01	Am-241		512.5	2.32E-01	Am-241
65.71	1.03E+01	Pu-239		171.39	2.18E+01	Pu-239		514	5.25E-01	Am-241
67.45	8.48E+01	Am-241		173.7	6.14E-01	Pu-239		522.06	2.02E-01	Am-241
67.67	3.00E+01	Pu-239		175.07	3.68E+00	Am-241		545.4	1.50E-01	Am-241
68.7	7.13E+01	Pu-239		179.22	1.31E+01	Pu-239		563.05	1.50E-01	Am-241
68.74	2.57E+01	Pu-239		185.71	5.55E-01	U-235		573.94	2.53E-01	Am-241
69.76	5.86E+02	Am-241		188.23	2.16E+00	Pu-239		582.89	1.22E-01	Pu-239
71.6	1.81E+00	Pu-241		189.36	1.64E+01	Pu-239		586.59	2.65E-01	Am-241
75.27	3.01E+00	Pa-233		191.96	4.36E+00	Am-241		590.28	5.78E-01	Am-241

75.8	1.19E+02	Am-241		193.26	1.00E-01	Np-237	597.48	1.50E+00	Am-241
77.1	1.30E+01	Pu-241		194.95	4.05E-01	Np-237	597.99	3.31E-01	Pu-239
77.59	7.52E+01	Pu-239		195.68	2.12E+01	Pu-239	612.83	1.88E-01	Pu-239
78.43	3.05E+01	Pu-239		200.97	1.49E-01	Pu-238	617.1	2.65E-01	Pu-239
86.48	2.84E+01	Np-237		203.55	1.13E+02	Pu-239	618.28	4.04E-01	Pu-239
86.6	4.45E+00	Pa-233		204.06	5.86E-01	Am-241	619.01	1.20E+01	Am-241
87.99	3.82E-01	Np-237		208.01	3.29E+02	U-237	619.21	2.40E-01	Pu-239
89.64	5.35E+00	Pu-239		208.01	1.60E+02	Am-241	627.18	1.13E-01	Am-241
89.7	3.96E-01	Pu-239		212.29	3.46E-01	Np-237	632.93	2.55E-01	Am-241
92.28	3.80E+00	Np-237	X	212.46	2.84E+00	Pu-240	633.15	5.01E-01	Pu-239
94.64	1.41E+00	Np-237		218	2.38E-01	Pu-239	637.7	5.07E-01	Pu-239
94.65	6.93E+02	Pu-239	X	221.46	8.57E+00	Am-241	637.8	5.07E-01	Pu-239
94.65	1.97E+02	Pu-241	X	221.8	3.29E-01	U-237	639.99	1.72E+00	Pu-239
94.65	2.41E+01	Pa-233	X	225.42	2.99E+00	Pu-239	641.47	1.43E+00	Am-241
94.65	2.48E+00	Pu-240	X	232.81	9.29E-01	Am-241	642.35	1.27E+00	Pu-240
94.65	2.21E+00	Pu-238	X	234.33	1.41E-01	Am-241	645.94	3.01E+00	Pu-239
95.86	6.14E+00	Np-237	X	234.4	3.18E-01	U-237	649.32	1.41E-01	Pu-239
96.14	7.50E+00	Pu-239		237.77	2.85E+00	Pu-239	652.05	1.31E+00	Pu-239
97.07	2.39E+02	U-237	X	237.86	1.30E-01	Np-237	653.02	7.62E+00	Am-241
97.07	2.30E+02	Am-241	X	242.08	1.45E+00	Pu-239	654.88	4.46E-01	Pu-239
97.6	1.78E+01	Pu-239		243.38	5.01E+00	Pu-239	658.86	1.92E+00	Pu-239
98.43	1.11E+03	Pu-239	X	244.92	1.01E+00	Pu-239	662.4	7.35E+01	Am-241
98.43	3.14E+02	Pu-241	X	246.73	4.85E-01	Am-241	664.58	3.29E-01	Pu-239
98.43	3.85E+01	Pa-233	X	248.38	1.39E-01	Pa-233	674.05	1.02E-01	Pu-239
98.43	3.96E+00	Pu-240	X	248.95	1.43E+00	Pu-239	674.4	1.02E-01	Pu-239
98.43	3.52E+00	Pu-238	X	249	1.09E-01	Am-241	676.03	1.29E-01	Am-241
98.78	2.91E+02	Pu-239		255.38	1.58E+01	Pu-239	680.1	6.32E-01	Am-241
98.97	4.10E+03	Am-241		260.8	2.44E-01	Am-241	687.57	3.42E-01	Pu-240
99.85	2.78E+02	Pu-238		263.95	5.25E+00	Pu-239	688.72	6.57E+00	Am-241
101.06	3.80E+02	U-237	X	264.89	1.82E+00	Am-241	690.81	1.78E-01	Pu-239
101.06	3.66E+02	Am-241	X	265.7	3.17E-01	Pu-239	696.6	1.08E+00	Am-241
102.98	3.94E+03	Am-241		267.54	1.10E+01	U-237	701.1	1.01E-01	Pu-239
103.06	4.28E+01	Pu-239		267.58	5.31E+00	Am-241	703.68	7.82E-01	Pu-239
103.68	6.38E+01	Pu-241		271.55	7.36E-01	Pa-233	718	5.54E-01	Pu-239
103.86	1.95E+00	Pa-233		275.77	1.33E+00	Am-241	722.01	3.96E+01	Am-241
104.23	6.98E+02	Pu-240		281.2	4.16E-01	Pu-239	729.72	2.69E-01	Am-241
106.15	1.12E-01	Np-237		285.3	3.76E-01	Pu-239	737.34	1.62E+00	Am-241
107.6	7.63E-01	Np-237	X	291.3	6.26E-01	Am-241	742.81	1.98E-01	Pu-238
108.42	1.44E+00	Np-237	X	292.77	2.87E+00	Am-241	755.9	1.54E+00	Am-241
108.7	1.56E-01	Np-237		297.46	9.86E+00	Pu-239	756.4	5.54E-01	Pu-239
109.7	9.90E-01	Am-241		298.81	2.01E-01	Pa-233	756.4	1.33E-01	Pu-239
110.42	1.39E+02	Pu-239	X	300.13	1.51E+01	Pa-233	766.39	8.38E-01	Pu-238
110.42	3.94E+01	Pu-241	X	302.87	1.01E+00	Pu-239	767	1.01E+00	Am-241
110.42	4.83E+00	Pa-233	X	304.21	2.04E-01	Am-241	769.15	1.01E+00	Pu-239
110.42	4.97E-01	Pu-240	X	307.85	1.09E+00	Pu-239	769.37	1.35E+00	Pu-239
110.42	4.42E-01	Pu-238	X	309.1	2.83E-01	Am-241	770.57	9.58E-01	Am-241
111.3	2.63E+02	Pu-239	X	311.78	5.11E+00	Pu-239	772.4	5.37E-01	Am-241
111.3	7.43E+01	Pu-241	X	311.9	8.78E+01	Pa-233	786	1.25E-01	Am-241
111.3	9.14E+00	Pa-233	X	316.41	2.61E+00	Pu-239	786.3	1.22E-01	Pu-238
111.3	9.39E-01	Pu-240	X	319.68	9.50E-01	Pu-239	801.94	2.75E-01	Am-241
111.3	8.38E-01	Pu-238	X	320.86	1.07E+01	Pu-239	862.7	1.07E-01	Am-241

Appendix 3 – Example Input Deck

```
c MCNP Input deck generated on 12/1/2019 @ 6:44 AM
c
c
c ************************** Cell definition cards **************************
c
c Coaxial Germanium Detector Assembly
c
c Coaxial Germanium Detector Cell Definition Cards
c
c Germanium Crystal
c
   1    32  -5.32   ((2 -17 -18) (-2 :7 :8) (10 :-8)) : &
                    (2 -17 -5 18) : (17 -4 -18) : &
                    (-16 17 18)                  imp:p 1 $ Ge Crystal Core
   2    32  -5.32   (2 -17 -3 5) : (-1 4 -18 ) : &
                    (-15 16 17 18)            imp:p 1 $ Outer [P] Dead Layer
   3    32  -5.32   (2 -8 6 -7 ) : (9 -10 8 )  imp:p 1 $ Inner [N] Dead Layer
c
c  Detector Cup Assembly
c
  10    13  -2.70   (-61 30 -31 32 ):(-32 33 -31 ) imp:p 1 $ Al Inner Can Side and bottom
  11    13  -2.70   (31 -34 -35 36 )               imp:p 1 $ Al Inner Can top ring
  12    13  -2.70   (31 -34 -37 38 )               imp:p 1 $ Al Inner Can bottom ring
  13     6  -1.01   (61 -60 -34 ):(31 -34 63 -61 ) imp:p 1 $ Thin Inner Can cap
c
c  End Cap
c
  20    13  -2.70   (84 -85 -82)                  imp:p 1 $ Al EndCap Window
  21    13  -2.70   (82 -83 -85 81 ):(-80 81 -82 ) imp:p 1 $ Al EndCap
c
c  Vacuum
c
  30     0 (-8 2 -6):(-9 8)                      imp:p 1 $ Vacuum
  31     0 ((-2 32 -30):(2 -1 3 -30)):(1 -61 -30)  imp:p 1 $ Vacuum
  32     0 (-33 80 -82)                          imp:p 1 $ Vacuum
  33     0 (60 -84 -82):(34 -82 -60 33)            imp:p 1 $ Vacuum
  34     0 (31 -34 35 -63)                       imp:p 1 $ Vacuum
  35     0 (31 -34 -36 37)                       imp:p 1 $ Vacuum
  36     0 (-34 31 -38 33)                       imp:p 1 $ Vacuum
  37     0 (15 -1 17 -3 18)                      imp:p 1 $ Vacuum
c
c Disk Source Cell Definition Cards
c
 660   606  -1 (-600 601 -602 )           imp:p 1 $ water Source-disk
c
c
c Absorber Cell Definition Cards
c
 710   710  -8.65  (-710 711 -712 )           imp:p 1 $ Cadmium disk
c
 720   720  -7.31  (-720 721 -722 )           imp:p 1 $ Tin disk
c
c Everything else inside the inner shield...
c
 977 220 -0.0012  (902 -901 -900 )(-81: 83: 85) &
                  (600: -601: 602) &
                  (710: -711: 712) &
                  (720: -721: 722) &
 &
                  imp:p 1 $ Detector environment
c
c Inner Shield
c
 984  801 -8.96  (901 -904 -903)        imp:p 1 $ Inner Ceiling
 985  802 -8.96  (902 -901 900 -903)     imp:p 1 $ Inner wall
 986  803 -8.96  (905 -902 -903)         imp:p 1 $ Inner Floor
c
```

```
c Outer Shield
c
  987  805 -11  (904 -907 -906)         imp:p 1 $ Outer Ceiling
  988  806 -11  (905 -904 903 -906)     imp:p 1 $ Outer wall
  989  807 -11  (908 -905 -906)         imp:p 1 $ Outer Floor
c
c Define the bounds of the problem
c
  999    0        (-908: 907: 906)       imp:p 0 $ Outside world
c
c REQUIRED blank line to separate Cell cards from Surface cards

c ************************* Surface definition cards *************************
c
c Coaxial Germanium Detector Surface Definition Cards
c
c Germanium Crystal
c
    1  1  pz     -0.500 $ Top Face of dead layer [P-type]
    2  1  pz     -7.190 $ Bottom Face
    3  1  cz      3.485 $ Outer Radius of dead layer [P-type]
    4  1  pz     -0.570 $ Top of 'Core Ge' aka thickness of P-Type dead layer
    5  1  cz      3.415 $ Outer Radius of 'Core Ge'
    6  1  cz      0.455 $ Radius of Inner Hole
    7  1  cz      0.525 $ Radius of Inner dead layer [N-Type]
    8  1  pz     -1.945 $ Top of inner cylinder
    9  1  sz     -1.945   0.455 $ Round the bottom of the hole
   10  1  sz     -1.945   0.525 $ Round the bottom of the dead layer
c
c        tz      x  y   z       a       b  =  c
   15  1  tz      0  0 -1.300  2.685  0.800  0.800 $ Radius of Inner Hole
   16  1  tz      0  0 -1.300  2.685  0.730  0.730 $ Radius of Inner Hole - dead layer thickness
   17  1  pz       -1.300  $ Top Face of dead layer - Radius of Inner Hole
   18  1  cz       2.685   $ Outer Radius of dead layer - Radius of Inner Hole
c
c  19  1  kz      -1186.   1.0e-005      1 $ Additional Dead Layer
c
c Detector Cup
c
   30  1  cz      3.485 $ Inner wall radius
   31  1  cz      3.535 $ Outer wall radius
   32  1  pz     -8.390 $ Inside [top] of bottom piece
   33  1  pz     -8.590 $ Outside [bottom] of bottom piece
   34  1  cz      3.635 $ Outer  Flange radius
   35  1  pz     -2.708 $ Top of top  Flange
   36  1  pz     -3.208  $ Bottom of top  flange
   37  1  pz     -4.915 $ Top of bottom  Flange
   38  1  pz     -5.415 $ Bottom of bottom  flange
c
c Cap for Detector Cup
c
   60  1  pz     -0.470 $ Outer face
   61  1  pz     -0.500 $ Inner face, top of detector cup
   63  1  pz     -0.800 $ Lower extent of cap
c
c End Cap and End Cap Window
c
   80  1  pz     -10.590 $ Inside Lower bound of detector end cap
   81  1  pz     -10.690 $ Outside Lower bound of detector end cap
   82  1  cz      4.035 $ Inside radius of end cap
   83  1  cz      4.135 $ Outside radius of end cap
   84  1  pz     -0.100 $ Inside detector Face (Window)
   85  1  pz      0.000 $ Outside detector face (Window)
c
c
c Disk Source Surface Definition Cards
c
  600  2  c/z  0  0.0  0.5  $ Disk x, y, radius
  601  2  pz   10  $ Disk bottom
  602  2  pz   11  $ Disk top
```

```
c
c
c Absorber Surface Definition Cards
c
c Disk
c
  710  3  c/z  0  0.0  4  $ Disk x, y, radius
  711  3  pz   5  $ Disk bottom
  712  3  pz   5.2  $ Disk top
c
c Disk
c
  720  3  c/z  0  0.0  4  $ Disk x, y, radius
  721  3  pz   4.9  $ Disk bottom
  722  3  pz   5  $ Disk top
c
c
c Bounding surfaces
c
  900  4  cz     14.000 $ Bounding cylinder
  901  4  pz     32.000 $ Bounding top Surface
  902  4  pz     -21.790 $ Bounding bottom Surface
c
c Inner Shield
c
  903  4  cz     14.100 $ Inner Bounding cylinder
  904  4  pz     32.100 $ Inner Bounding top Surface
  905  4  pz     -21.890 $ Inner Bounding bottom Surface
c
c Outer Shield
c
  906  4  cz     25.100 $ Outer Bounding cylinder
  907  4  pz     43.100 $ Outer Bounding top Surface
  908  4  pz     -32.890 $ Outer Bounding bottom Surface
c
c REQUIRED blank line to separate Surface cards from Data cards

c ********************************* Data cards *********************************
c
c
c Surface Translation Cards
c
c       x  y  z   xx'  yx'  zx'   xy'  yy'  zy'   xz' yz' zz'
c *tr1  0  0 -8    0   90   90    90  180   90             $ rotate +z to -z
c *tr1 -4  0  0   90   90    0    90    0   90             $ rotate +z to -x
c *tr1  4  0  0   90    0   90    90   90    0             $ rotate +z to +x
c *tr1  0 -4  0    0   90   90    90   90    0             $ rotate +z to -y
c *tr1  0  4  0   90   90    0     0   90   90             $ rotate +z to +y
c *tr1  0  0  4
c
c
Tr1    0.0   0.0   0.0
Tr2    0.0   0.0   0.0
Tr3    0.0   0.0   0.
Tr4    0.0   0.0   0.0
c
c
c Material Cards
c
m32   32000       1 $ Germanium, rho = -5.32 g/cc
m13   13000       1 $ Aluminum,  rho = -2.70 g/cc
m6     6000       1 $ Carbon,    rho = -1.01 g/cc
c
m220   6000      -0.000124 $ C   Air, rho = -0.001205 g/cc
       7000      -0.755267 $ N
       8000      -0.231781 $ O
      18000       -0.012827 $ Ar
c
c Volume Source Material Cards
c
```

```
m606    1000    2         $ Hydrogen   $ water, rho = -1 g/cc
      8000    1         $ Oxygen
c
c Absorber Material Cards
c
m710   48000    1         $ Cadmium, rho = -8.65 g/cc
c
m720   50000    1         $ Tin, rho = -7.31 g/cc
c
c Detector Environment Material Cards
c
m801   29000    1         $ Copper, rho = -8.96 g/cc
c
m802   29000    1         $ Copper   $ copper, rho = -8.96 g/cc
c
m803   29000    1         $ Copper   $ copper, rho = -8.96 g/cc
c
m805   82000    1         $ Lead   $ lead, rho = -11 g/cc
c
m806   82000    1         $ Lead   $ lead, rho = -11 g/cc
c
m807   82000    1         $ Lead   $ lead, rho = -11 g/cc
c
c
c Mode Card
c
Mode P
c
PHYS:P 4j 0 $ ON
c
c Tally definition card(s)
c
f8:p  (1 3)
c  Gaussian Energy Broadening Term
ft8 geb 0.0007  0.00041  2.99589  $ for Ge
c
c  Energy Range and bin width [in MeV]
e0   0  1e-5  1.3E-4  8190i  1.024  $ 0.13 keV bins up to 1.024  MeV
c
c Source definition
c
sdef rad=d1 ext=d2 pos= 0  0  10  axs 0 0 1 erg=d3
si1  0  0.5  $ Disk radius
si2  0  1  $ Disk thickness
c
 #   si3    sp3
    L      D
0.04654    8.925E+05   $  Pb-210    ,  0.00 ,  0 ,  0.00 ,  0 ,  0.00 ,  0 ,  0.00 ,  0 ,  21000000 ,  0.0425000004470348
0.01080    4.767E+06   $  Pb-210   X ,  46.54 ,  0 ,  0.00 ,  0 ,  0.00 ,  0 ,  0.00 ,  0 ,  21000000 ,  0.226999998092651
0.46812    5.760E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  2.88000006065658E-08
0.58659    2.620E-02   $  Am-241    ,  59.54 ,  6.3600000430597E-06 ,  98.97 ,  1.74000001607055E-06 ,  102.98 ,
1.74000001607055E-06 ,  55.56 ,  6.3600000430597E-06 ,  2000000 ,  1.31000001957204E-08
0.51400    5.200E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  2.60000003748928E-08
0.48730    8.800E-03   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  4.39999991996842E-09
0.51250    2.300E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  1.15000000633358E-08
0.52206    2.000E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  9.99999993922529E-09
0.52917    9.200E-03   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  4.5999999365165E-09
0.54540    1.480E-02   $  Am-241    ,  59.54 ,  1.46000002132496E-06 ,  98.97 ,  4.02000011945347E-07 ,  102.98 ,
4.02000011945347E-07 ,  55.56 ,  1.46000002132496E-06 ,  2000000 ,  7.40000016818954E-09
0.57394    2.500E-02   $  Am-241    ,  59.54 ,  6.3600000430597E-06 ,  98.97 ,  1.74000001607055E-06 ,  102.98 ,
1.74000001607055E-06 ,  55.56 ,  6.3600000430597E-06 ,  2000000 ,  1.25000001460762E-08
0.46322    2.000E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  9.99999993922529E-09
0.37094    1.046E+00   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  5.22999982877081E-07
0.56305    1.480E-02   $  Am-241    ,  59.54 ,  1.46000002132496E-06 ,  98.97 ,  4.02000011945347E-07 ,  102.98 ,
4.02000011945347E-07 ,  55.56 ,  1.46000002132496E-06 ,  2000000 ,  7.40000016818954E-09
0.45968    7.200E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  3.59999994259397E-08
0.45466    1.940E-01   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  9.6999997367675E-08
0.45260    4.800E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  2.40000002094121E-08
0.44643    9.800E-03   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  4.89999996133861E-09
0.33770    8.580E-02   $  Am-241    ,  59.54 ,  0 ,  98.97 ,  0 ,  102.98 ,  0 ,  55.56 ,  0 ,  2000000 ,  4.29000017732051E-08
```

0.41933 5.740E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.87000005982918E-07
0.92150 3.800E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.8999999351621E-09
0.40130 9.800E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 4.89999996133861E-09
0.39864 4.000E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.99999998784506E-08
0.59028 5.720E-02 $ Am-241 , 59.54 , 4.97000000905246E-05 , 98.97 , 1.74000001607055E-06 , 102.98 ,
1.74000001607055E-06 , 55.56 , 6.3600000430597E-06 , 2000000 , 2.86000005900178E-08
0.37665 2.760E+00 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.37999995786231E-06
0.68872 6.500E-01 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
3.25000002021625E-07
0.36865 4.340E+00 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.17000001612178E-06
0.35825 2.400E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.2000000104706E-08
0.38381 5.640E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.82000002016503E-07
0.72972 2.660E-02 $ Am-241 , 59.54 , 5.87000022278517E-06 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.33000002122685E-08
0.40635 2.900E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.4500000311557E-08
0.88730 4.400E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.19999995998421E-09
0.86270 1.060E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 5.29999999443476E-09
0.86070 1.600E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 8.00000010681146E-10
0.82850 4.800E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.39999997653229E-09
0.80626 6.200E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 3.10000003445055E-09
0.80194 2.720E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.36000002370906E-08
0.78600 1.240E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 6.20000006890109E-09
0.77240 5.320E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.6600000424537E-08
0.77057 9.480E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 4.74000003691799E-08
0.76700 1.000E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 5.00000005843049E-08
0.67603 1.280E-02 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 9.42999989206328E-08 , 102.98 ,
9.42999989206328E-08 , 55.56 , 0 , 2000000 , 6.40000008544916E-09
0.73734 1.600E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 7.99999995138023E-08
0.59748 1.480E-01 $ Am-241 , 59.54 , 4.97000000905246E-05 , 98.97 , 1.74000001607055E-06 , 102.98 ,
1.74000001607055E-06 , 55.56 , 6.3600000430597E-06 , 2000000 , 7.39999990173601E-08
0.72201 3.920E+00 $ Am-241 , 59.54 , 5.87000022278517E-06 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.95999996321916E-06
0.69660 1.068E-01 $ Am-241 , 59.54 , 5.87000022278517E-06 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
5.34000008656221E-08
0.68010 6.260E-02 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 9.42999989206328E-08 , 102.98 ,
9.42999989206328E-08 , 55.56 , 0 , 2000000 , 3.13000008134168E-08
0.66983 7.600E-03 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 3.7999998703242E-09
0.66650 9.800E-03 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 4.89999996133861E-09
0.66240 7.280E+00 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 3.63999993169273E-06
0.65302 7.540E-01 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 3.76999992113269E-07
0.64147 1.420E-01 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 7.10000023218527E-08
0.63293 2.520E-02 $ Am-241 , 59.54 , 0.000304999994114041 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 1.26000001543503E-08
0.62718 1.120E-02 $ Am-241 , 59.54 , 4.97000000905246E-05 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 5.60000001925687E-09
0.61901 1.188E+00 $ Am-241 , 59.54 , 4.97000000905246E-05 , 98.97 , 3.46999991052144E-06 , 102.98 ,
3.46999991052144E-06 , 55.56 , 1.26000004456728E-05 , 2000000 , 5.94000027831498E-07
0.75590 1.520E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 7.59999991828408E-08
0.07580 1.180E+01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 5.89999990552315E-06
0.01390 7.400E+05 $ Am-241 X , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 0.370000004768372
0.14655 9.220E+00 $ Am-241 , 59.54 , 0.00144999998155981 , 98.97 , 0.000398000003769994 , 102.98 ,
0.000398000003769994 , 55.56 , 0.00144999998155981 , 2000000 , 4.60999990536948E-06
0.12530 8.160E+01 $ Am-241 , 59.54 , 0.00394999980926514 , 98.97 , 9.02000010682968E-06 , 102.98 ,
9.02000010682968E-06 , 55.56 , 0 , 2000000 , 4.08000014431309E-05
0.12305 2.000E+01 $ Am-241 , 59.54 , 0.00394999980926514 , 98.97 , 9.02000010682968E-06 , 102.98 ,
9.02000010682968E-06 , 55.56 , 0 , 2000000 , 9.99999974737875E-06
0.12036 9.000E-02 $ Am-241 , 59.54 , 0.00394999980926514 , 98.97 , 9.02000010682968E-06 , 102.98 ,
9.02000010682968E-06 , 55.56 , 0 , 2000000 , 4.5000000170603E-08
0.11746 3.360E+00 $ Am-241 X , 59.54 , 0.00394999980926514 , 98.97 , 9.02000010682968E-06 , 102.98 ,
9.02000010682968E-06 , 55.56 , 0 , 2000000 , 1.67999996847357E-06
0.11423 8.600E+00 $ Am-241 X , 59.54 , 6.04000015300699E-05 , 98.97 , 7.09999994796817E-06 , 102.98 ,
7.09999994796817E-06 , 55.56 , 2.59000007645227E-05 , 2000000 , 4.30000000051223E-06
0.11330 4.540E+00 $ Am-241 X , 59.54 , 6.04000015300699E-05 , 98.97 , 7.09999994796817E-06 , 102.98 ,
7.09999994796817E-06 , 55.56 , 2.59000007645227E-05 , 2000000 , 2.27000009545009E-06

0.10970 9.800E-02 $ Am-241 , 59.54 , 6.04000015300699E-05 , 98.97 , 7.09999994796817E-06 , 102.98 ,
7.09999994796817E-06 , 55.56 , 2.59000007645227E-05 , 2000000 , 4.90000005015645E-08
0.10298 3.900E+02 $ Am-241 , 59.54 , 0.234999999403954 , 98.97 , 0.234999999403954 , 55.56 ,
0.00194999994710088 , 125.30 , 9.02000010682968E-06 , 2000000 , 0.000195000000530854
0.10106 3.620E+01 $ Am-241 X , 59.54 , 0.234999999403954 , 98.97 , 0.234999999403954 , 102.98 ,
0.234999999403954 , 55.56 , 0.00194999994710088 , 2000000 , 1.80999995791353E-05
0.15427 1.080E-02 $ Am-241 , 59.54 , 5.91999996686354E-05 , 98.97 , 6.95000017003622E-06 , 102.98 ,
6.95000017003622E-06 , 55.56 , 2.52999998338055E-05 , 2000000 , 5.40000000270879E-09
0.09707 2.280E+01 $ Am-241 X , 59.54 , 0.234999999403954 , 98.97 , 0.234999999403954 , 102.98 ,
0.234999999403954 , 55.56 , 0 , 2000000 , 1.14000004032278E-05
0.15004 1.480E+00 $ Am-241 , 59.54 , 0.00144999998155981 , 98.97 , 0.000398000003769994 , 102.98 ,
0.000398000003769994 , 55.56 , 0.00144999998155981 , 2000000 , 7.4000001859531E-07
0.06976 5.800E+01 $ Am-241 , 59.54 , 0.00602999981492758 , 98.97 , 0.0016499999910593 , 102.98 ,
0.0016499999910593 , 55.56 , 0.00602999981492758 , 2000000 , 2.90000007225899E-05
0.06745 8.400E+00 $ Am-241 , 59.54 , 0.00602999981492758 , 98.97 , 0.0016499999910593 , 102.98 ,
0.0016499999910593 , 55.56 , 0.00602999981492758 , 2000000 , 4.20000014855759E-06
0.06483 2.900E+00 $ Am-241 , 59.54 , 0.00602999981492758 , 98.97 , 0.0016499999910593 , 102.98 ,
0.0016499999910593 , 55.56 , 0.00602999981492758 , 2000000 , 1.45000001339213E-06
0.05954 7.180E+05 $ Am-241 , 98.97 , 0.234999999403954 , 102.98 , 0.234999999403954 , 55.56 ,
0.855000019073486 , 125.30 , 0.00394999980926514 , 2000000 , 0.358999997377396
0.05556 3.620E+02 $ Am-241 , 59.54 , 0.855000019073486 , 98.97 , 0.00194999994710088 , 102.98 ,
0.00194999994710088 , 125.30 , 0 , 2000000 , 0.000180999995791353
0.05101 5.200E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.60000007301642E-07
0.04342 1.460E+03 $ Am-241 , 59.54 , 9.98099994659424 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0.855000019073486 ,
2000000 , 0.000730000028852373
0.04270 1.100E+02 $ Am-241 , 59.54 , 9.98099994659424 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0.855000019073486 ,
2000000 , 5.50000004295725E-05
0.03320 2.520E+03 $ Am-241 , 59.54 , 0 , 98.97 , 0.0656000003218651 , 102.98 , 0.0656000003218651 , 55.56 ,
0.238999992609024 , 2000000 , 0.00126000004820526
0.02634 4.540E+04 $ Am-241 , 59.54 , 0 , 98.97 , 0.0656000003218651 , 102.98 , 0.0656000003218651 , 55.56 ,
0.238999992609024 , 2000000 , 0.0227000005543232
0.33537 9.920E+00 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 4.95999984195805E-06
0.42647 4.920E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.46000013248704E-07
0.09897 4.060E+02 $ Am-241 , 59.54 , 0.234999999403954 , 102.98 , 0.234999999403954 , 55.56 ,
0.00194999994710088 , 125.30 , 9.02000010682968E-06 , 2000000 , 0.00020300000323914
0.24900 1.080E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 5.40000000270879E-09
0.33235 2.980E+00 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.49000004512345E-06
0.32252 3.040E+00 $ Am-241 , 59.54 , 8.98999985565752E-07 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.51999995523511E-06
0.31680 6.000E-04 $ Am-241 , 59.54 , 8.98999985565752E-07 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
2.99999997066536E-10
0.30910 2.800E-02 $ Am-241 , 59.54 , 8.98999985565752E-07 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.40000002701868E-08
0.30421 2.020E-02 $ Am-241 , 59.54 , 8.98999985565752E-07 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.00999999474993E-08
0.29277 2.840E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 1.42000004643705E-07
0.29130 6.200E-02 $ Am-241 , 59.54 , 1.36999997266685E-05 , 98.97 , 1.73000003211854E-09 , 102.98 ,
1.73000003211854E-09 , 55.56 , 0 , 2000000 , 3.09999990122378E-08
0.27804 8.800E-03 $ Am-241 , 59.54 , 0.000118000003567431 , 98.97 , 3.2299998565577E-05 , 102.98 ,
3.2299998565577E-05 , 55.56 , 0.000118000003567431 , 2000000 , 4.39999991996842E-09
0.27577 1.320E-01 $ Am-241 , 59.54 , 0.000118000003567431 , 98.97 , 3.2299998565577E-05 , 102.98 ,
3.2299998565577E-05 , 55.56 , 0.000118000003567431 , 2000000 , 6.59999983554371E-08
0.26758 5.260E-01 $ Am-241 , 59.54 , 0.000118000003567431 , 98.97 , 3.2299998565577E-05 , 102.98 ,
3.2299998565577E-05 , 55.56 , 0.000118000003567431 , 2000000 , 2.63000003997149E-07
0.13944 1.060E-01 $ Am-241 , 59.54 , 0.00144999998155981 , 98.97 , 0.000398000003769994 , 102.98 ,
0.000398000003769994 , 55.56 , 0.00144999998155981 , 2000000 , 5.3000000832526E-08
0.26080 2.420E-02 $ Am-241 , 59.54 , 0.000117000003228895 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
1.21000001129801E-08
0.15926 2.800E-02 $ Am-241 , 59.54 , 0.000234999999520369 , 98.97 , 6.45999971311539E-05 , 102.98 ,
6.45999971311539E-05 , 55.56 , 0.000234999999520369 , 2000000 , 1.40000002701868E-08
0.17507 3.640E-01 $ Am-241 , 59.54 , 0.00028000000747852 , 98.97 , 7.67000019550323E-05 , 102.98 ,
7.67000019550323E-05 , 55.56 , 0.00028000000747852 , 2000000 , 1.81999993742465E-07
0.16154 3.000E-02 $ Am-241 , 59.54 , 0.00028000000747852 , 98.97 , 7.67000019550323E-05 , 102.98 ,
7.67000019550323E-05 , 55.56 , 0.00028000000747852 , 2000000 , 1.49999994647487E-08
0.16469 1.334E+00 $ Am-241 , 59.54 , 0.00028000000747852 , 98.97 , 7.67000019550323E-05 , 102.98 ,
7.67000019550323E-05 , 55.56 , 0.00028000000747852 , 2000000 , 6.66999994791695E-07
0.26489 1.800E-01 $ Am-241 , 59.54 , 0.000118000003567431 , 98.97 , 3.2299998565577E-05 , 102.98 ,
3.2299998565577E-05 , 55.56 , 0.000118000003567431 , 2000000 , 9.0000000341206E-08
0.16956 3.460E+00 $ Am-241 , 59.54 , 0.00028000000747852 , 98.97 , 7.67000019550323E-05 , 102.98 ,
7.67000019550323E-05 , 55.56 , 0.00028000000747852 , 2000000 , 1.73000000813772E-06

0.24673 4.800E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.40000002094121E-08
0.19196 4.320E-01 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 2.16000003661065E-07
0.19700 9.800E-03 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 4.89999996133861E-09
0.20406 5.800E-02 $ Am-241 , 59.54 , 0.000364000006811693 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
2.90000006231139E-08
0.20801 1.582E+01 $ Am-241 , 59.54 , 0.000364000006811693 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 ,
7.9100000220933E-06
0.22146 8.480E-01 $ Am-241 , 59.54 , 0.000548999989405274 , 98.97 , 1.24999996842234E-06 , 102.98 ,
1.24999996842234E-06 , 55.56 , 0 , 2000000 , 4.24000006660208E-07
0.23281 9.200E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 4.60000002533434E-08
0.23433 1.400E-02 $ Am-241 , 59.54 , 0 , 98.97 , 0 , 102.98 , 0 , 55.56 , 0 , 2000000 , 7.00000013509339E-09
0.16581 4.640E-01 $ Am-241 , 59.54 , 0.00028000000747852 , 98.97 , 7.67000019550323E-05 , 102.98 ,
7.67000019550323E-05 , 55.56 , 0.00028000000747852 , 2000000 , 2.32000004984911E-07
0.23040 2.360E+00 $ Co-57 , 122.06 , 0.000280999985989183 , 136.47 , 3.89999986509793E-05 , 692.41 , 0 ,
570.09 , 0 , 590000 , 3.99999998990097E-06
0.00640 1.941E+05 $ Co-57 X , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 0.328999996185303
0.70654 2.950E+01 $ Co-57 , 122.06 , 0 , 136.47 , 0 , 692.41 , 0.135000005364418 , 570.09 , 0 , 590000 ,
4.99999987368938E-05
0.69241 8.791E+02 $ Co-57 , 122.06 , 0 , 136.47 , 0 , 570.09 , 0 , 706.54 , 0.135000005364418 , 590000 ,
0.0014900000533089
0.57009 9.322E+01 $ Co-57 , 122.06 , 0.0127999996766448 , 136.47 , 0.00178000004962087 , 692.41 , 0 , 706.54
, 0 , 590000 , 0.000157999995280989
0.36680 7.080E+00 $ Co-57 , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 1.20000004244503E-05
0.35233 1.770E+01 $ Co-57 , 122.06 , 0.000280999985989183 , 136.47 , 3.89999986509793E-05 , 692.41 , 0 ,
570.09 , 0 , 590000 , 2.99999992421363E-05
0.33969 2.183E+01 $ Co-57 , 122.06 , 0.000280999985989183 , 136.47 , 3.89999986509793E-05 , 692.41 , 0 ,
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0.01441 5.404E+04 $ Co-57 , 122.06 , 87.6569976806641 , 136.47 , 0 , 692.41 , 0.135000005364418 , 570.09 ,
0.0127999996766448 , 590000 , 0.0916000008583069
0.00706 2.307E+04 $ Co-57 X , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 0.0390999987721443
0.00639 9.794E+04 $ Co-57 X , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 0.165999993681908
0.00070 8.968E+03 $ Co-57 X , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 0.0152000002563
0.13647 6.301E+04 $ Co-57 , 122.06 , 0 , 692.41 , 0 , 570.09 , 0.00178000004962087 , 706.54 , 0 , 590000 ,
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0.00706 1.180E+04 $ Co-57 X , 122.06 , 0 , 136.47 , 0 , 692.41 , 0 , 570.09 , 0 , 590000 , 0.0199999995529652
0.03772 2.923E+03 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.0395000018179417
0.16586 5.920E+04 $ Ce-139 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.800000011920929
0.03780 5.639E+03 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.0762000009417534
0.03303 1.665E+04 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.224999994039536
0.00465 8.806E+03 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.119000002741814
0.03873 1.820E+03 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.0245999991893768
0.03344 3.034E+04 $ Ce-139 X , 165.86 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 74000 , 0.409999996423721
0.01030 1.203E+03 $ Hg-203 X , 279.20 , 0 , 72.87 , 0 , 70.83 , 0 , 82.57 , 0 , 22200 , 0.0542000010609627
0.27920 1.811E+04 $ Hg-203 , 72.87 , 0 , 70.83 , 0 , 82.57 , 0 , 82.11 , 0 , 22200 , 0.815599977970123
0.08486 1.159E+02 $ Hg-203 X , 279.20 , 0 , 72.87 , 0 , 70.83 , 0 , 82.57 , 0 , 22200 , 0.00522000016644597
0.08257 3.175E+02 $ Hg-203 X , 279.20 , 0 , 72.87 , 0 , 70.83 , 0 , 82.11 , 0 , 22200 , 0.014299999922514
0.08211 1.661E+02 $ Hg-203 X , 279.20 , 0 , 72.87 , 0 , 70.83 , 0 , 82.57 , 0 , 22200 , 0.00748000014573336
0.07287 1.374E+03 $ Hg-203 X , 279.20 , 0 , 70.83 , 0 , 82.57 , 0 , 82.11 , 0 , 22200 , 0.0619000010192394
0.07083 8.192E+02 $ Hg-203 X , 279.20 , 0 , 72.87 , 0 , 82.57 , 0 , 82.11 , 0 , 22200 , 0.0368999987840652
0.02400 7.868E+03 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.280000001192093
0.02421 1.456E+04 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.51800000667572
0.02724 1.309E+03 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.0465999990701675
0.02728 2.529E+03 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.0900000035762787
0.02786 6.716E+02 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.0239000003784895
0.25513 5.929E+02 $ Sn-113 , 391.70 , 1.9099999666214 , 638.03 , 0 , 382.90 , 1.9099999666214 , 646.83 , 0 ,
28100 , 0.0210999995470047
0.38290 1.686E-02 $ Sn-113 , 391.70 , 1.9099999666214 , 255.13 , 1.9099999666214 , 638.03 ,
0.000899999984540045 , 646.83 , 0.000899999984540045 , 28100 , 6.00000021222513E-07
0.39170 1.826E+04 $ Sn-113 , 255.13 , 1.9099999666214 , 638.03 , 0.000899999984540045 , 382.90 ,
1.9099999666214 , 646.83 , 0.000899999984540045 , 28100 , 0.649699985980988
0.00329 2.417E+03 $ Sn-113 X , 391.70 , 0 , 255.13 , 0 , 638.03 , 0 , 382.90 , 0 , 28100 , 0.0860000029206276
0.64683 1.124E-03 $ Sn-113 , 391.70 , 0.000899999984540045 , 255.13 , 0 , 638.03 , 0.000899999984540045 ,
382.90 , 0.000899999984540045 , 28100 , 3.99999997569012E-08
0.63803 2.726E-01 $ Sn-113 , 391.70 , 0.000899999984540045 , 255.13 , 0 , 382.90 , 0.000899999984540045 ,
646.83 , 0.000899999984540045 , 28100 , 9.70000019151485E-06
0.51400 3.408E+04 $ Sr-85 , 868.06 , 0 , 362.82 , 4.79000009363517E-05 , 151.18 , 0 , 354.06 ,
4.79000009363517E-05 , 35500 , 0.959999978542328
0.95100 4.970E-03 $ Sr-85 , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 1.39999997372797E-07

0.01519 2.662E+02 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.00749999983236194
0.35406 1.704E-01 $ Sr-85 , 514.00 , 4.79000009363517E-05 , 868.06 , 0 , 362.82 , 0.000988999963738024 ,
151.18 , 0.000988999963738024 , 35500 , 4.80000016978011E-06
0.23300 6.745E-03 $ Sr-85 , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 1.89999994404388E-07
0.15118 4.260E-01 $ Sr-85 , 514.00 , 0 , 868.06 , 0 , 362.82 , 0.000988999963738024 , 354.06 ,
0.000988999963738024 , 35500 , 1.20000004244503E-05
0.86806 4.260E+00 $ Sr-85 , 514.00 , 0 , 362.82 , 0 , 151.18 , 0 , 354.06 , 0 , 35500 , 0.000119999996968545
0.12980 8.520E-02 $ Sr-85 , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0.00023999999393709 , 35500 ,
2.40000008489005E-06
0.36282 4.863E-01 $ Sr-85 , 514.00 , 4.79000009363517E-05 , 868.06 , 0 , 151.18 , 0.000988999963738024 ,
354.06 , 0.000988999963738024 , 35500 , 1.36999997266685E-05
0.00169 9.195E+02 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.025900000706315
0.01334 6.141E+03 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.172999992966652
0.71687 1.100E-01 $ Sr-85 , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0.000306000001728535 , 35500 ,
3.0999999580672E-06
0.01495 8.662E+02 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.0243999995291233
0.01496 1.668E+03 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.0469999983906746
0.01340 1.186E+04 $ Sr-85 X , 514.00 , 0 , 868.06 , 0 , 362.82 , 0 , 151.18 , 0 , 35500 , 0.333999991416931
0.03630 9.013E+01 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.00347999995574355
0.28350 1.502E-01 $ Cs-137 , 661.66 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 5.80000005356851E-06
0.03726 5.517E+01 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.00212999992072582
0.03182 5.154E+02 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.0198999997228384
0.00447 2.357E+02 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.00910000037401915
0.66166 2.204E+04 $ Cs-137 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.851000010967255
0.03638 1.740E+02 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.00671999994665384
0.03219 9.428E+02 $ Cs-137 X , 661.66 , 0 , 283.50 , 0 , 0.00 , 0 , 0.00 , 0 , 25900 , 0.0364000014960766
c
c Number of particles to follow
c
nps 14000000000
c
c .OR. Minutes to run
c
c ctme 1
c
c
prdmp 2j 1
c
c REQUIRED blank line(s)

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Development of a Resource for the Improvement of National Nuclear Forensics Gamma Spectrometric Core Capabilities (RINFOR)

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Abstract

The objective of RINFOR was provision of a means of enhancing or establishing core capacities of institutes, agencies or entities with respect to gamma spectrometric responses to situations requiring, or potentially requiring, some measure of nuclear forensic analysis through the generation of a suite of fit-for-purpose materials. For the majority of states, the base capability level in addressing an incident involving nuclear material or requiring nuclear forensic approaches is grounded in high resolution gamma spectrometry using high purity germanium detectors (HPGe) in a number of configurations. Gamma spectrometric procedures, on a technical level, are fully capable of providing accurate information in relation to a number of important parameters pertaining to nuclear materials. RINFOR generated a set of synthetic gamma ray spectra for a variety of typical materials of interest in this context, at various ages since last separation. Spectra

were generated for a number of detector types (Plan, LEGe and HPGe) and in a number of different formats.

Key words
Gamma spectrometry, nuclear materials, nuclear forensics.