Documentation for WIMSD-formatted libraries based on ENDF/B-VII.1 evaluated nuclear data files with extended actinide burn-up chains and cross section data up to 2000 K for fuel materials.

Prepared by

Daniel López Aldama

November 2014
Selected INDC documents may be downloaded in electronic form from

http://www-nds.iaea.org/publications

or sent as an e-mail attachment.

Requests for hardcopy or e-mail transmittal should be directed to

NDS.Contact-Point@iaea.org

or to:

Nuclear Data Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna
Austria

Printed by the IAEA in Austria

November 2014
Contents
1. Introduction ................................................................................................................................. 7
2. Source of data ............................................................................................................................. 7
3. New materials ............................................................................................................................ 7
4. Extended temperature range ..................................................................................................... 8
5. Actinide and fission product burn-up chains .......................................................................... 8
6. Processing methods .................................................................................................................. 15
7. Running benchmarks ............................................................................................................... 15
8. End-user information ............................................................................................................... 15

Tables:
Table 1: Number of material in the WIMSD libraries ................................................................. 8
Table 2: Burn-up and decay data for actinides ............................................................................. 9
Table 3: General data for materials included in the WIMSD-formatted library ...................... 17
Table 4: Resonance data ............................................................................................................... 28
Table 5: Material with P1 matrices ............................................................................................ 31
Table 6: Energy release per fission for fissionable materials ($E_{\text{fiss}}$) .................................. 32
Table 7: Burn-up and decay data ................................................................................................ 33
Table 8: Fission spectrum of the 69-group library ...................................................................... 36
Table 9: Fission spectrum of the 172-group library ................................................................... 37
Table 10: Fission product yields for Th-232, U-233, U-235 and U-238 ....................................... 38
Table 11: Fission product yields for Pu-239, Pu-240, Pu-241 and Pu-242 ............................... 40
1. Introduction

In the frame of WIMS Library Update Project [1] the WIMSD-IAEA-69 and WIMSD-IAEA-172 libraries were prepared and made available at the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA). The main libraries were prepared from different sources of evaluated nuclear data that were available before December 2003. Also others WIMSD libraries were prepared from the major evaluated nuclear data libraries and made available at http://www-nds.iaea.org/wimsd. During the last ten years new libraries have been prepared every time that a major version of an evaluated nuclear data library has been released, namely JEFF-3.1 and ENDF/B-VII.0.

Recently, end-users have requested to extend the temperature ranges of fuel materials included in the libraries and also to extend the burn-up chains to higher actinides up to Cf-254. The inclusion of new structural materials, like bismuth, has been also considered. Therefore, new WIMSD-formatted libraries in the 69- and 172-energy structure have been prepared with more materials, extended actinides burn-up chains and higher temperatures in thermal and resonance range.

2. Source of data

A new WIMSD-formatted library was generated from the ENDF/B-VII.1 evaluated nuclear data library [2] at the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA). Particularly, reaction data for incident neutrons, decay constants and thermal scattering laws were retrieved from the ENDF/B-VII.1 evaluated nuclear data library for all materials included in the WIMSD libraries.

Fission product yields induced by neutrons were also taken from the ENDF/B-VII.1 library for most actinides, but in case of lack of data the values were adopted from the TENDL-2009 evaluated nuclear data library [3], if available. It was the case for six minor actinides, namely Np-239, Cm-247, Bk-249, Cf-251, Cf-252 and Cf-253.

The dosimetry materials included in the WIMSD-formatted library were also updated from the IRDFF-v.1.05 evaluated nuclear data files [4]. For those dosimetry reactions that were not available in the IRDFF-v.1.05 evaluated nuclear data library, the ENDF/B-VII.1 data were applied.

3. New materials

The bismuth (Bi-209) was added as a new structural material and the actinide burn-up chains were extended to higher actinides from Cm-245 up to Cf-254.

The library based on ENDF/B-VII.1 data, includes eleven new minor actinides compared to the previous versions of WIMSD-formatted libraries prepared at the IAEA. They are Cm-245, Cm-246, Cm-247, Cm-248, Bk-249, Cf-249, Cf-250, Cf-251, Cf-252, Cf-253 and Cf-254. Table 1 summarizes the number of materials in the libraries.
Table 1: Number of material in the WIMSD libraries

<table>
<thead>
<tr>
<th>Item</th>
<th>ENDF/B-VII.1-WIMSD</th>
<th>IAEA-WIMSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of materials</td>
<td>185</td>
<td>173</td>
</tr>
<tr>
<td>Moderators</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Actinides</td>
<td>35</td>
<td>24</td>
</tr>
<tr>
<td>Fission products</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Dosimetry reactions</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Structural materials</td>
<td>41</td>
<td>40</td>
</tr>
<tr>
<td>Other materials</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Resonant materials</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

4. Extended temperature range

The temperature range was extended up to 2000 K for all actinides. For the major actinides the cross section data are available at 293 K, 600 K, 900 K, 1200 K, 1600 K and 2000 K. Data for the minor actinides are given at 293 K, 700 K, 1100 K, 1500 K and 2000 K.

For graphite, silicon and zirconium, that could be used in some fuel design, the temperature range was also extended up to 2000 K. The same was applied to burnable absorber materials such as gadolinium, erbium, hafnium, dysprosium and holmium as well as to the resonant fission products technetium, silver and cesium.

5. Actinide and fission product burn-up chains.

The actinide burn-up chains were extended including minor actinides from Cm-245 up to Cf-254. Table 2 shows the burn-up and decay data for actinides. Actinides explicitly included in the burn-up chains decay with a half-life greater than 51 hours, except Am-242 that is important in the production mechanism of curium 242. If the half-life is greater than 33 000 years, then the nuclide was considered stable.

The burn-up chains for fission products were not modified or extended compared to the original WIMSD-IAEA libraries [1]. For the sake of completeness, Figure 1 and 2 show the actinide and fission product burn-up chains.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Th-232</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Pa-233</td>
<td>Th-233 is assumed to produce instantly Pa-233 by β- decay. The production of Th-231 from (n, 2n) is modeled by means of a pseudo fission product, which produce instantly Pa-231 by β- decay. The fission yield is equal to the ratio (n,2n)/(n,f). A value of 0.185 was adopted.</td>
</tr>
<tr>
<td>Pa-231</td>
<td>6.7047-13</td>
<td>Null</td>
<td>1.00</td>
<td>U-232</td>
<td>Pa-232 is assumed to produce instantly U-232 by β- decay.</td>
</tr>
<tr>
<td>Pa-233</td>
<td>2.9741-07</td>
<td>U-233</td>
<td>1.00</td>
<td>U-234</td>
<td>Pa-234 is assumed to produce instantly U-234 by β- decay.</td>
</tr>
<tr>
<td>U-232</td>
<td>3.1879-10</td>
<td>Null</td>
<td>1.00</td>
<td>U-233</td>
<td></td>
</tr>
<tr>
<td>U-233</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>U-234</td>
<td>The production of U-232 from (n, 2n) was simulated by means of a pseudo fission product, which decay instantly to U-232. The fission yield is equal to the ratio (n,2n)/(n,f). This ratio is spectrum dependent. A value of 0.0000075 was chosen.</td>
</tr>
<tr>
<td>U-234</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>U-235</td>
<td></td>
</tr>
<tr>
<td>U-235</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>U-236</td>
<td></td>
</tr>
<tr>
<td>U-236</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>U-237</td>
<td></td>
</tr>
<tr>
<td>U-237</td>
<td>1.1885-06</td>
<td>Np-237</td>
<td>1.00</td>
<td>U-238</td>
<td></td>
</tr>
<tr>
<td>U-238</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Np-239</td>
<td>U-239 is assumed to produce instantly Np-239 by β- decay. The production of U-237 from (n, 2n) was simulated by means of a pseudo fission product, which decay instantly to U-237. The fission yield is equal to the ratio (n,2n)/(n,f). This ratio is spectrum dependent. A value of 0.06 was chosen.</td>
</tr>
<tr>
<td>Np-237</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Pu-238</td>
<td>Np-238 is assumed to produce instantly Pu-238 by β- decay.</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-----------------------------</td>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Np-239</td>
<td>3.4052-06</td>
<td>Pu-239</td>
<td>1.00</td>
<td>Pu-240</td>
<td>Np-240 is assumed to produce instantly Pu-240 by β⁻ decay.</td>
</tr>
<tr>
<td>Pu-238</td>
<td>2.5045-10</td>
<td>U-234</td>
<td>1.00</td>
<td>Pu-239</td>
<td></td>
</tr>
<tr>
<td>Pu-239</td>
<td>9.1101-13</td>
<td>U-235</td>
<td>1.00</td>
<td>Pu-240</td>
<td></td>
</tr>
<tr>
<td>Pu-240</td>
<td>3.3477-12</td>
<td>U-236</td>
<td>1.00</td>
<td>Pu-241</td>
<td></td>
</tr>
<tr>
<td>Pu-241</td>
<td>1.5371-09</td>
<td>Am-241</td>
<td>1.00</td>
<td>Pu-242</td>
<td>β⁻ decay branching ratio equal to 99.998%, 100% implicitly assumed.</td>
</tr>
<tr>
<td>Pu-242</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Am-243</td>
<td>Pu-243 is assumed to produce instantly Am-243 by β⁻ decay.</td>
</tr>
<tr>
<td>Am-241</td>
<td>5.0773-11</td>
<td>Np-237</td>
<td>0.12</td>
<td>Am-242m</td>
<td>Capture in Am-241 results in Am-242m with a branching ratio of 0.12. Actually, the branching ratio is spectrum dependent. Calculations performed under the WIMSD Library Update Project produce values ranging from 0.132 for plutonium recycling benchmark to 0.109 for metal uranium lattices.</td>
</tr>
<tr>
<td>Am-242m</td>
<td>1.5578-10</td>
<td>Am-242g</td>
<td>1.00</td>
<td>Am-243</td>
<td>Am-242m decays by isomeric transition (IT) to Am-242g (99.55%). Unfortunately, due to WIMSD library limitations a branching ratio cannot be specified for decays. IT=100% is implicitly assumed.</td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
<td>--------------------</td>
<td>------------------------------</td>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Am-242g</td>
<td>1.2019-05</td>
<td>Cm-242</td>
<td>0.80</td>
<td>Am-243</td>
<td>Reduced Am-242g is produced from Am-241 capture. Since only one nuclide can be specified as the capture product (Am-242m was previously chosen with T_{1/2}=141 years), then Am-242g is treated as a fission product of Am-241 with an effective yield proportional to the capture to fission rate (c/f). The effective yield is calculated by the expression: $Y_{Am-242g}^{1}=(c/f)(1-0.12)0.827$ Where, 0.12 is the capture branching ratio for Am-242m production. The value 0.827 is the branching decay ratio to produce Cm-242 from Am-242g by $\beta$ emission. It is the way used to overcome the limitations of WIMSD library format. The (c/f) ratio depends strongly on lattice spectrum. Calculations performed under WIMSD Library Update Project produce values of (c/f) ranging from 42 for plutonium recycling benchmark to 124 metal uranium lattices. A value of (c/f)=92 was adopted, it implied that $Y_{Am-242g}^{1} \approx 67$ atoms/fission. Additionally, as Am-241 is not an important contributor to fission events, the fission cross section of Am-241 is forced to be proportional to the absorption cross section, normalized to conserve the selected (c/f) ratio. A branching ratio of 0.80 was assumed to produce Am-243 by neutron capture.</td>
</tr>
<tr>
<td>Am-243</td>
<td>2.9803-12</td>
<td>Np-239</td>
<td>1.00</td>
<td>Cm-244</td>
<td>Am-244 is assumed to produce instantly Cm-244 by $\beta$ decay.</td>
</tr>
<tr>
<td>Cm-242</td>
<td>4.9236-08</td>
<td>Pu-238</td>
<td>1.00</td>
<td>Cm-243</td>
<td></td>
</tr>
<tr>
<td>Cm-243</td>
<td>7.5479-10</td>
<td>Pu-239</td>
<td>1.00</td>
<td>Cm-244</td>
<td>$\alpha$ decay branching ratio equal to 99.71%, 100% implicitly assumed.</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------</td>
<td>----------------------------</td>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Cm-244</td>
<td>1.2128-09</td>
<td>Pu-240</td>
<td>1.00</td>
<td>Cm-245</td>
<td></td>
</tr>
<tr>
<td>Cm-245</td>
<td>2.5841-12</td>
<td>Pu-241</td>
<td>1.00</td>
<td>Cm-246</td>
<td></td>
</tr>
<tr>
<td>Cm-246</td>
<td>4.6144-12</td>
<td>Pu-242</td>
<td>1.00</td>
<td>Cm-247</td>
<td>α decay branching ratio equal to 99.9785%, 100% implicitly assumed.</td>
</tr>
<tr>
<td>Cm-247</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Cm-248</td>
<td></td>
</tr>
<tr>
<td>Cm-248</td>
<td>Stable*</td>
<td>-</td>
<td>1.00</td>
<td>Bk-249</td>
<td>Cm-249 is assumed to produce instantly Bk-249 by β⁻ decay.</td>
</tr>
<tr>
<td>Bk-249</td>
<td>2.5070-08</td>
<td>Cf-249</td>
<td>1.00</td>
<td>Cf-250</td>
<td>β⁻ decay branching ratio equal to 99.9985%, 100% implicitly assumed. Bk-249 is assumed to produce instantly Cf-250 by β⁻ decay.</td>
</tr>
<tr>
<td>Cf-249</td>
<td>6.2577-11</td>
<td>Cm-245</td>
<td>1.00</td>
<td>Cf-250</td>
<td></td>
</tr>
<tr>
<td>Cf-250</td>
<td>1.6792-09</td>
<td>Cm-246</td>
<td>1.00</td>
<td>Cf-251</td>
<td>α decay branching ratio equal to 99.923%, 100% implicitly assumed.</td>
</tr>
<tr>
<td>Cf-251</td>
<td>2.4459-11</td>
<td>Cm-247</td>
<td>1.00</td>
<td>Cf-252</td>
<td></td>
</tr>
<tr>
<td>Cf-252</td>
<td>8.3043-09</td>
<td>Cm-248</td>
<td>1.00</td>
<td>Cf-253</td>
<td>α decay = 96.908%. Spontaneous fission = 3.092%. 100% α decay assumed.</td>
</tr>
<tr>
<td>Cf-253</td>
<td>4.5045-07</td>
<td>Null</td>
<td>1.00</td>
<td>Cf-254</td>
<td></td>
</tr>
<tr>
<td>Cf-254</td>
<td>1.3260-07</td>
<td>Null</td>
<td>1.00</td>
<td>Null</td>
<td></td>
</tr>
</tbody>
</table>

* Stable means half-life > 33000 years
Figure 1: Actinide burn-up chains
Figure 2: Fission product chains
6. Processing methods

The evaluated nuclear data files for all materials were processed using the NJOY-99.396 modular system [4]. The input options were similar to those developed in the frame of WIMS Library Update Project and described in reference [1]. In the case of chlorine 35 it was necessary to pre-process the evaluated data file using the PREPRO-2012 code system (https://www-nds.iaea.org/public/endf/prepro/) [5], because the processing of R-Matrix limited format (LRF=7) for the resonance data is not implemented in this version of NJOY.

For the added minor actinides the processing options are similar to the ones used for Cm-242, Cm-243 and Cm-244 in the original WIMSD-IAEA libraries. Similarly, for bismuth the processing was performed in the same way that for lead isotopes.

All the processing inputs, data, procedures and auxiliary programs applied to generate the new library are freely available on http://www-nds.iaea.org/wimsd/ hosting by the Nuclear Data Section.

7. Running benchmarks

More than 200 benchmarks analyzed in the frame of the WIMS Library Update Project were calculated using the new libraries based on ENDF/B-VII.1 evaluated nuclear data files. The results and plots are published on http://www-nds.iaea.org/wimsd/ web site.

8. End-user information

The libraries in the 69- and 172-energy group structures are available on the website of the WIMS Library Update Project (http://www-nds.iaea.org/wimsd/). Tables 3 to Table 11 summarize the information to use the WIMSD libraries based on ENDF/B-VII.1 evaluated nuclear data files, namely:

- Table 3: General data for materials included in the WIMSD-formatted library
- Table 4: Resonance data
- Table 5: Materials with P1 matrices
- Table 6: Energy release per fission for fissionable materials
- Table 7: Burn-up and decay data
- Table 8: Fission spectrum of the 69-group library
- Table 9: Fission spectrum of the 172-group library
- Table 10: Fission product yields for Th-232, U-233, U-235 and U-238
- Table 11: Fission product yields for Pu-239, Pu-240, Pu-241 and Pu-242

As was mentioned above, the libraries include new materials, extended actinide burn-up chains and higher temperatures for the most important nuclides. The conventions and symbols follow the definitions of reference [1].

To use the library:

1. Download the WIMSD-formatted libraries from the WLUP web page.
   a. endfb7.lib with 69 energy groups (WIMS energy structure)
   b. endfb7gx.lib with 172 energy groups (XMAS energy structure)
2. Download the code WILLIE.FOR included in the for.src package.
3. Prepare a WILLIE executable
4. Prepare a WIMSD binary library using the option FOBI of WILLIE.
A binary library in 69- or 172-groups should be ready for use with the WIMSD-family of lattice codes.

References

Table 3: General data for materials included in the WIMSD-formatted library

<table>
<thead>
<tr>
<th>Material ID</th>
<th>Description</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-H –H2O</td>
<td>Hydrogen bound in water</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>1-H –ZrH</td>
<td>Hydrogen bound in ZrH</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>1-D-D2O</td>
<td>Deuterium bound in D2O. HWR spectrum</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>2-He-3</td>
<td>Helium-3</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>2-He-4</td>
<td>Helium-4</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>3-Li-6</td>
<td>Lithium-6</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>3-Li-7</td>
<td>Lithium-7</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>4-Be-nat</td>
<td>Beryllium</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>5-B –10</td>
<td>Boron-10 (burnable)</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>5-B –10</td>
<td>Boron-10 (unburnable)</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>5-B –11</td>
<td>Boron-11 (burnable)</td>
<td>ENDF/B-VII.1</td>
</tr>
<tr>
<td>5-B –nat</td>
<td>Natural boron (unburnable)</td>
<td>ENDF/B-VII.1 (From isotopes)</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>6-C–nat</td>
<td>2012</td>
<td>12.0011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-N–nat</td>
<td>14</td>
<td>14.0067</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-O–nat</td>
<td>6016</td>
<td>15.9905</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-F–nat</td>
<td>19</td>
<td>18.9982</td>
</tr>
<tr>
<td>11-Na-nat</td>
<td>23</td>
<td>22.9895</td>
</tr>
<tr>
<td>12-Mg-nat</td>
<td>24</td>
<td>24.3051</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-Al-nat</td>
<td>27</td>
<td>26.9815</td>
</tr>
<tr>
<td>14-Si-nat</td>
<td>29</td>
<td>28.0859</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-P–nat</td>
<td>31</td>
<td>30.9741</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-S–nat</td>
<td>32</td>
<td>32.0637</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-Cl-nat</td>
<td>35</td>
<td>35.4526</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-Ca-nat</td>
<td>40</td>
<td>40.0803</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22-Ti-nat</td>
<td>48</td>
<td>47.8789</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23-V–nat</td>
<td>51</td>
<td>50.9416</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24-Cr-nat</td>
<td>52</td>
<td>51.9959</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-Mn-nat</td>
<td>55</td>
<td>54.9381</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-Fe-nat</td>
<td>2056</td>
<td>55.8464</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28-Ni-nat</td>
<td>58</td>
<td>58.6936</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>----------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>27-Co-59</td>
<td>1059</td>
<td>58.9332</td>
</tr>
<tr>
<td>29-Cu-nat</td>
<td>3063</td>
<td>63.5456</td>
</tr>
<tr>
<td>40-Zr-nat</td>
<td>91</td>
<td>91.2196</td>
</tr>
<tr>
<td>41-Nb-93</td>
<td>93</td>
<td>92.9032</td>
</tr>
<tr>
<td>42-Mo-nat</td>
<td>96</td>
<td>95.9402</td>
</tr>
<tr>
<td>47-Ag-nat</td>
<td>3109</td>
<td>107.868</td>
</tr>
<tr>
<td>48-Cd-nat</td>
<td>2113</td>
<td>112.411</td>
</tr>
<tr>
<td>49-In-nat</td>
<td>2115</td>
<td>114.82</td>
</tr>
<tr>
<td>50-Sn-nat</td>
<td>118</td>
<td>117.241</td>
</tr>
<tr>
<td>51-Sb-121</td>
<td>121</td>
<td>120.904</td>
</tr>
<tr>
<td>51-Sb-123</td>
<td>123</td>
<td>122.904</td>
</tr>
<tr>
<td>63-Eu-nat</td>
<td>152</td>
<td>151.965</td>
</tr>
<tr>
<td>64-Gd-154</td>
<td>2154</td>
<td>153.921</td>
</tr>
<tr>
<td>64-Gd-155</td>
<td>2155</td>
<td>154.923</td>
</tr>
<tr>
<td>64-Gd-156</td>
<td>2156</td>
<td>155.923</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>--------------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>64-Gd-157</td>
<td>2157</td>
<td>156.924</td>
</tr>
<tr>
<td>64-Gd-158</td>
<td>2158</td>
<td>157.924</td>
</tr>
<tr>
<td>66-Dy-160</td>
<td>160</td>
<td>159.925</td>
</tr>
<tr>
<td>66-Dy-161</td>
<td>161</td>
<td>160.927</td>
</tr>
<tr>
<td>66-Dy-162</td>
<td>162</td>
<td>161.927</td>
</tr>
<tr>
<td>66-Dy-163</td>
<td>163</td>
<td>162.929</td>
</tr>
<tr>
<td>66-Dy-164</td>
<td>164</td>
<td>163.928</td>
</tr>
<tr>
<td>67-Ho-165</td>
<td>165</td>
<td>164.93</td>
</tr>
<tr>
<td>68-Er-166</td>
<td>2166</td>
<td>165.93</td>
</tr>
<tr>
<td>68-Er-167</td>
<td>2167</td>
<td>166.932</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>72-Hf-176</td>
<td>2176</td>
<td>175.941</td>
</tr>
<tr>
<td>72-Hf-177</td>
<td>2177</td>
<td>176.943</td>
</tr>
<tr>
<td>72-Hf-178</td>
<td>2178</td>
<td>177.944</td>
</tr>
<tr>
<td>72-Hf-179</td>
<td>2179</td>
<td>178.946</td>
</tr>
<tr>
<td>72-Hf-180</td>
<td>2180</td>
<td>179.947</td>
</tr>
<tr>
<td>72-Hf-nat</td>
<td>178</td>
<td>178.487</td>
</tr>
<tr>
<td>73-Ta-nat</td>
<td>181</td>
<td>180.955</td>
</tr>
<tr>
<td>74-W-nat</td>
<td>183</td>
<td>183.856</td>
</tr>
<tr>
<td>82-Pb-nat</td>
<td>207</td>
<td>207.262</td>
</tr>
<tr>
<td>83-Bi-nat</td>
<td>209</td>
<td>208.980</td>
</tr>
<tr>
<td>36-Kr-83</td>
<td>4083</td>
<td>82.9141</td>
</tr>
<tr>
<td>42-Mo-95</td>
<td>4095</td>
<td>94.9059</td>
</tr>
<tr>
<td>43-Tc-99</td>
<td>4099</td>
<td>99.0005</td>
</tr>
<tr>
<td>44-Ru-101</td>
<td>4101</td>
<td>100.906</td>
</tr>
<tr>
<td>44-Ru-103</td>
<td>5103</td>
<td>102.906</td>
</tr>
<tr>
<td>44-Ru-106</td>
<td>4106</td>
<td>105.908</td>
</tr>
<tr>
<td>45-Rh-103</td>
<td>4103</td>
<td>102.905</td>
</tr>
<tr>
<td>45-Rh-105</td>
<td>4105</td>
<td>104.906</td>
</tr>
<tr>
<td>46-Pd-105</td>
<td>5105</td>
<td>104.905</td>
</tr>
<tr>
<td>46-Pd-107</td>
<td>4107</td>
<td>106.905</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>-----------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>46-Pd-108</td>
<td>4108</td>
<td>107.904</td>
</tr>
<tr>
<td>47-Ag-109</td>
<td>4109</td>
<td>108.905</td>
</tr>
<tr>
<td>48-Cd-113</td>
<td>4113</td>
<td>112.9</td>
</tr>
<tr>
<td>49-In-115</td>
<td>4115</td>
<td>114.82</td>
</tr>
<tr>
<td>51-Sb-125</td>
<td>4125</td>
<td>124.905</td>
</tr>
<tr>
<td>52-Te-127m</td>
<td>5127</td>
<td>126.905</td>
</tr>
<tr>
<td>53-I–127</td>
<td>4127</td>
<td>126.905</td>
</tr>
<tr>
<td>54-Xe-131</td>
<td>4131</td>
<td>130.906</td>
</tr>
<tr>
<td>55-Cs-133</td>
<td>4133</td>
<td>132.906</td>
</tr>
<tr>
<td>55-Cs-134</td>
<td>4134</td>
<td>133.907</td>
</tr>
<tr>
<td>55-Cs-137</td>
<td>4137</td>
<td>136.907</td>
</tr>
<tr>
<td>53-I–135</td>
<td>6135</td>
<td>134.91</td>
</tr>
<tr>
<td>54-Xe-134</td>
<td>5134</td>
<td>133.905</td>
</tr>
<tr>
<td>54-Xe-135</td>
<td>4135</td>
<td>134.907</td>
</tr>
<tr>
<td>55-Cs-135</td>
<td>5135</td>
<td>134.906</td>
</tr>
<tr>
<td>54-Xe-136</td>
<td>4136</td>
<td>135.908</td>
</tr>
<tr>
<td>60-Nd-143</td>
<td>4143</td>
<td>142.91</td>
</tr>
<tr>
<td>60-Nd-145</td>
<td>4145</td>
<td>144.913</td>
</tr>
<tr>
<td>61-Pm-147</td>
<td>4147</td>
<td>146.915</td>
</tr>
<tr>
<td>61-Pm-147</td>
<td>5147</td>
<td>146.915</td>
</tr>
<tr>
<td>62-Sm-147</td>
<td>6147</td>
<td>146.915</td>
</tr>
<tr>
<td>61-Pm-148m</td>
<td>4148</td>
<td>147.918</td>
</tr>
<tr>
<td>61-Pm-148</td>
<td>5148</td>
<td>147.918</td>
</tr>
<tr>
<td>62-Sm-148</td>
<td>6148</td>
<td>147.915</td>
</tr>
<tr>
<td>61-Pm-149</td>
<td>5149</td>
<td>148.918</td>
</tr>
<tr>
<td>62-Sm-149</td>
<td>4149</td>
<td>148.917</td>
</tr>
<tr>
<td>62-Sm-150</td>
<td>4150</td>
<td>149.917</td>
</tr>
<tr>
<td>62-Sm-151</td>
<td>4151</td>
<td>150.92</td>
</tr>
<tr>
<td>62-Sm-152</td>
<td>4152</td>
<td>151.92</td>
</tr>
<tr>
<td>63-Eu-151</td>
<td>5151</td>
<td>150.92</td>
</tr>
<tr>
<td>63-Eu-152</td>
<td>5152</td>
<td>151.925</td>
</tr>
<tr>
<td>63-Eu-153</td>
<td>4153</td>
<td>152.922</td>
</tr>
<tr>
<td>63-Eu-154</td>
<td>4154</td>
<td>153.922</td>
</tr>
<tr>
<td>63-Eu-155</td>
<td>4155</td>
<td>154.923</td>
</tr>
<tr>
<td>Pseudo FP</td>
<td>4902</td>
<td>114.675</td>
</tr>
<tr>
<td>90-Th-232</td>
<td>2323</td>
<td>232.033</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>--------------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>92-U –232</td>
<td>4232</td>
<td>232.033</td>
</tr>
<tr>
<td>92-U –232</td>
<td>232</td>
<td>232.033</td>
</tr>
<tr>
<td>92-U –233</td>
<td>9233</td>
<td>233.045</td>
</tr>
<tr>
<td>91-Pa-231</td>
<td>1231</td>
<td>231.035</td>
</tr>
<tr>
<td>91-Pa-233</td>
<td>1233</td>
<td>233.04</td>
</tr>
<tr>
<td>92-U –234</td>
<td>234</td>
<td>234.041</td>
</tr>
<tr>
<td>92-U –235</td>
<td>2235</td>
<td>235.044</td>
</tr>
<tr>
<td>92-U –236</td>
<td>236</td>
<td>236.046</td>
</tr>
<tr>
<td>92-U –237</td>
<td>4927</td>
<td>237.049</td>
</tr>
<tr>
<td>92-U –237</td>
<td>927</td>
<td>237.048</td>
</tr>
<tr>
<td>92-U –238</td>
<td>8238</td>
<td>238.051</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
<td>--------</td>
</tr>
<tr>
<td>93-Np-237</td>
<td>937</td>
<td>237.048</td>
</tr>
<tr>
<td>93-Np-239</td>
<td>1939</td>
<td>239.053</td>
</tr>
<tr>
<td>94-Pu-238</td>
<td>948</td>
<td>238.05</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>6239</td>
<td>239.052</td>
</tr>
<tr>
<td>94-Pu-240</td>
<td>1240</td>
<td>240.054</td>
</tr>
<tr>
<td>94-Pu-241</td>
<td>1241</td>
<td>241.049</td>
</tr>
<tr>
<td>94-Pu-242</td>
<td>242</td>
<td>242.058</td>
</tr>
<tr>
<td>94-Pu-242</td>
<td>1242</td>
<td>242.058</td>
</tr>
<tr>
<td>95-Am-241</td>
<td>951</td>
<td>241.057</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td>95-Am-242</td>
<td>1952</td>
<td>242.059</td>
</tr>
<tr>
<td>95-Am242m</td>
<td>952</td>
<td>242.059</td>
</tr>
<tr>
<td>95-Am-243</td>
<td>953</td>
<td>243.061</td>
</tr>
<tr>
<td>96-Cm-242</td>
<td>962</td>
<td>242.058</td>
</tr>
<tr>
<td>96-Cm-243</td>
<td>963</td>
<td>243.061</td>
</tr>
<tr>
<td>96-Cm-244</td>
<td>964</td>
<td>244.063</td>
</tr>
<tr>
<td>96-Cm-245</td>
<td>965</td>
<td>245.065</td>
</tr>
<tr>
<td>96-Cm-246</td>
<td>966</td>
<td>246.067</td>
</tr>
<tr>
<td>96-Cm-247</td>
<td>967</td>
<td>247.070</td>
</tr>
<tr>
<td>96-Cm-248</td>
<td>968</td>
<td>248.072</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
<td>--------</td>
</tr>
<tr>
<td>97-Bk-249</td>
<td>9749</td>
<td>249.075</td>
</tr>
<tr>
<td>98-Cf-249</td>
<td>9849</td>
<td>249.075</td>
</tr>
<tr>
<td>98-Cf-250</td>
<td>9850</td>
<td>250.076</td>
</tr>
<tr>
<td>98-Cf-251</td>
<td>9851</td>
<td>251.080</td>
</tr>
<tr>
<td>98-Cf-252</td>
<td>9852</td>
<td>252.081</td>
</tr>
<tr>
<td>98-Cf-253</td>
<td>9853</td>
<td>253.085</td>
</tr>
<tr>
<td>98-Cf-254</td>
<td>9854</td>
<td>254.088</td>
</tr>
<tr>
<td>1/v</td>
<td>1000</td>
<td>1</td>
</tr>
<tr>
<td>Res.(1/v)</td>
<td>1999</td>
<td>1</td>
</tr>
<tr>
<td>-1/v</td>
<td>2000</td>
<td>1</td>
</tr>
<tr>
<td>abs</td>
<td>3000</td>
<td>1</td>
</tr>
<tr>
<td>1/Au</td>
<td>4000</td>
<td>1</td>
</tr>
<tr>
<td>6-C</td>
<td>2212</td>
<td>12.0011</td>
</tr>
<tr>
<td>40-Zr</td>
<td>1091</td>
<td>91.2196</td>
</tr>
<tr>
<td>25-Mn</td>
<td>1055</td>
<td>54.938</td>
</tr>
<tr>
<td>26-Fe</td>
<td>1054</td>
<td>53.9396</td>
</tr>
<tr>
<td>26-Fe</td>
<td>3058</td>
<td>57.9333</td>
</tr>
<tr>
<td>27-Co</td>
<td>2059</td>
<td>58.9332</td>
</tr>
<tr>
<td>28-Ni</td>
<td>1058</td>
<td>57.9354</td>
</tr>
<tr>
<td>29-Cu</td>
<td>1063</td>
<td>62.9296</td>
</tr>
<tr>
<td>36-Kr</td>
<td>84</td>
<td>83.9114</td>
</tr>
<tr>
<td>45-Rh</td>
<td>2103</td>
<td>102.904</td>
</tr>
<tr>
<td>Material</td>
<td>ID</td>
<td>At.Wt.</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>49-In-115</td>
<td>1115</td>
<td>114.904</td>
</tr>
<tr>
<td>49-In-115</td>
<td>311</td>
<td>114.904</td>
</tr>
<tr>
<td>63-Eu-151</td>
<td>1151</td>
<td>150.922</td>
</tr>
<tr>
<td>66-Dy-164</td>
<td>1164</td>
<td>163.928</td>
</tr>
<tr>
<td>71-Lu-176</td>
<td>176</td>
<td>175.941</td>
</tr>
<tr>
<td>79-Au-197</td>
<td>197</td>
<td>196.967</td>
</tr>
<tr>
<td>90-Th-232</td>
<td>1232</td>
<td>232.038</td>
</tr>
<tr>
<td>90-Th-232</td>
<td>1232</td>
<td>232.038</td>
</tr>
<tr>
<td>92-U-235</td>
<td>1235</td>
<td>235.044</td>
</tr>
<tr>
<td>92-U-235</td>
<td>1003</td>
<td>235.044</td>
</tr>
<tr>
<td>92-U-238</td>
<td>1238</td>
<td>238.051</td>
</tr>
<tr>
<td>92-U-238</td>
<td>3238</td>
<td>238.051</td>
</tr>
<tr>
<td>93-Np-237</td>
<td>1237</td>
<td>237.048</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>1239</td>
<td>239.053</td>
</tr>
<tr>
<td>90-Th-232</td>
<td>1632</td>
<td>232.033</td>
</tr>
<tr>
<td>92-U-233</td>
<td>1633</td>
<td>233.045</td>
</tr>
<tr>
<td>92-U-235</td>
<td>1635</td>
<td>235.044</td>
</tr>
<tr>
<td>92-U-238</td>
<td>1638</td>
<td>238.051</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>1639</td>
<td>239.052</td>
</tr>
<tr>
<td>94-Pu-240</td>
<td>1640</td>
<td>240.054</td>
</tr>
<tr>
<td>94-Pu-241</td>
<td>1641</td>
<td>241.049</td>
</tr>
<tr>
<td>94-Pu-242</td>
<td>1642</td>
<td>242.058</td>
</tr>
</tbody>
</table>

Material: Material identification
ID: WIMSD identification number
At. Wt.: Atomic weight [amu]
NF: WIMSD resonance trigger (0-4)
0: Material has no resonance tables.
1: Material is non-fissile with absorption resonance integral tables.
2: Material is fissile with absorption resonance integral tables.
3: Material is fissile with absorption and fission resonance integral tables.
4: Material is fissile without resonance integral tables.
T: Temperature in thermal range [K]
Typ: Type of material (M, S, D, FP, A, B)
M: Moderators.
S: Structural materials and other components
D: Dosimetry reactions (to calculate reaction rates only).
FP: Fission products.
A: Actinides.
B: Burnable materials.
$\sigma_0$: Reference Bondarenko background cross section. The value defines the dilution at which the cross-section data are tabulated, and corresponds to the dilution commonly encountered in practical problems for this material. An asterisk means that the material was prepared from isotope data and the isotopes were self-shielded individually.
Table 4: Resonance data

<table>
<thead>
<tr>
<th>Material</th>
<th>ID&lt;sub&gt;r&lt;/sub&gt;</th>
<th>NF</th>
<th>T&lt;sub&gt;res&lt;/sub&gt;</th>
<th>λ</th>
<th>σ&lt;sub&gt;pot&lt;/sub&gt;</th>
<th>σ&lt;sub&gt;0res&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-Sb-121</td>
<td>121.0</td>
<td>1</td>
<td>293 600 900</td>
<td>0.29</td>
<td>4.9381</td>
<td>1.0E10 5.0E5 5.0E4 1.0E4 1.0E3 5.0E2 1.0E2 10.</td>
</tr>
<tr>
<td>51-Sb-123</td>
<td>123.0</td>
<td>1</td>
<td>293 600 900</td>
<td>0.29</td>
<td>4.3701</td>
<td>1.0E10 5.0E5 5.0E4 1.0E4 1.0E3 5.0E2 1.0E2 10.</td>
</tr>
<tr>
<td>64-Gd-154</td>
<td>2154.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.24</td>
<td>6.6723</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>64-Gd-155</td>
<td>2155.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.24</td>
<td>6.3376</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>64-Gd-156</td>
<td>2156.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.24</td>
<td>7.3792</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>64-Gd-157</td>
<td>2157.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.24</td>
<td>7.8427</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>64-Gd-158</td>
<td>2158.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.24</td>
<td>7.6454</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>68-Er-166</td>
<td>2166.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.23</td>
<td>8.2448</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>68-Er-167</td>
<td>2167.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.23</td>
<td>7.9704</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>72-Hf-176</td>
<td>2176.0</td>
<td>1</td>
<td>293 700 1100 1600 2000</td>
<td>0.22</td>
<td>7.8720</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>72-Hf-177</td>
<td>2177.0</td>
<td>1</td>
<td>293 700 1100 1600 2000</td>
<td>0.22</td>
<td>6.3780</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>Material</td>
<td>ID&lt;sub&gt;r&lt;/sub&gt;</td>
<td>NF</td>
<td>T&lt;sub&gt;res&lt;/sub&gt;</td>
<td>λ</td>
<td>σ&lt;sub&gt;pot&lt;/sub&gt;</td>
<td>σ&lt;sub&gt;0res&lt;/sub&gt;</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>----</td>
<td>----------------</td>
<td>----</td>
<td>--------------</td>
<td>---------------</td>
</tr>
<tr>
<td>72-Hf-178</td>
<td>2178.0</td>
<td>1</td>
<td>293 700 1100 1600 2000</td>
<td>0.22</td>
<td>7.9154</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>72-Hf-179</td>
<td>2179.0</td>
<td>1</td>
<td>293 700 1100 1600 2000</td>
<td>0.22</td>
<td>7.5973</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>72-Hf-180</td>
<td>2180.0</td>
<td>1</td>
<td>293 700 1100 1600 2000</td>
<td>0.22</td>
<td>8.1241</td>
<td>1.0E10 5.0E6 5.0E5 1.0E5 5.0E4 1.0E4 5.0E3 1.0E3 5.0E2 50.</td>
</tr>
<tr>
<td>43-Tc-99</td>
<td>4099.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.35</td>
<td>6.4242</td>
<td>1E10, 1E6, 5E5, 1E5, 3E4, 1E4, 1E3, 500</td>
</tr>
<tr>
<td>47-Ag-109</td>
<td>4109.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.32</td>
<td>5.5051</td>
<td>1.0E10 1.0E6 5.0E5 1.0E5 5.0E4 1.0E4 1.0E3 5.0E2</td>
</tr>
<tr>
<td>55-Cs-133</td>
<td>4133.0</td>
<td>1</td>
<td>293 700 1100 1500 2000</td>
<td>0.27</td>
<td>3.5299</td>
<td>1.0E10 1.0E6 5.0E5 1.0E5 2.5E4 1.0E4 1.0E3 5.0E2</td>
</tr>
<tr>
<td>90-Th-232</td>
<td>2232.1</td>
<td>2</td>
<td>293 600 900 1200 1600 2000</td>
<td>0.20</td>
<td>11.8194</td>
<td>1.E10 2.E4 3600. 1000. 260. 140. 64. 46. 28. 10.</td>
</tr>
<tr>
<td>Material</td>
<td>IDr</td>
<td>NF</td>
<td>T_{res}</td>
<td>λ</td>
<td>σ_{pot}</td>
<td>σ_{0res}</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
<td>----</td>
<td>------------------</td>
<td>-----</td>
<td>---------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>92-U -238</td>
<td>8238.0</td>
<td>2</td>
<td>293 600 900 1200 1600 2000</td>
<td>0.20</td>
<td>11.2934</td>
<td>1E10, 2E4, 3.6E3, 1E3, 260, 140, 64, 52, 28, 10</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>6239.0</td>
<td>3</td>
<td>293 600 900 1200 1600 2000</td>
<td>0.20</td>
<td>11.1471</td>
<td>1.E10 3.E4 7000. 5000. 3000. 1800. 1200. 700. 450. 175.</td>
</tr>
<tr>
<td>Order</td>
<td>Material</td>
<td>WIMS ID</td>
<td>Temperature [K]</td>
<td>Description</td>
<td>Data Source</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>--------</td>
<td>-----------------</td>
<td>--------------------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1-H –H2O</td>
<td>3001</td>
<td>293.6</td>
<td>Hydrogen bound in water; PWR spectrum</td>
<td>ENDF/B-VII.1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1-D –D2O</td>
<td>3002</td>
<td>293.6</td>
<td>Deuterium bound in D2O; HWR spectrum</td>
<td>ENDF/B-VII.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6-C –nat</td>
<td>2012</td>
<td>296.0</td>
<td>Graphite; PWR spectrum</td>
<td>ENDF/B-VII.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8-O –nat</td>
<td>6016</td>
<td>293.0</td>
<td>Oxygen; PWR spectrum</td>
<td>ENDF/B-VII.1</td>
<td></td>
</tr>
</tbody>
</table>
Table 6: Energy release per fission for fissionable materials ($E_{\text{fiss}}$)

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>WIMS ID</th>
<th>$E_{\text{fiss}}$ [J/mole]</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-Th-232</td>
<td>2232</td>
<td>1.9260E-11</td>
</tr>
<tr>
<td>91-Pa-233(*)</td>
<td>1233</td>
<td>1.9186E-11</td>
</tr>
<tr>
<td>92-U –232</td>
<td>232</td>
<td>1.8692E-11</td>
</tr>
<tr>
<td>92-U –233</td>
<td>9233</td>
<td>1.9312E-11</td>
</tr>
<tr>
<td>92-U –234</td>
<td>234</td>
<td>1.9619E-11</td>
</tr>
<tr>
<td>92-U –235</td>
<td>2235</td>
<td>1.9511E-11</td>
</tr>
<tr>
<td>92-U –236</td>
<td>236</td>
<td>1.9836E-11</td>
</tr>
<tr>
<td>92-U –237</td>
<td>927</td>
<td>1.9096E-11</td>
</tr>
<tr>
<td>92-U –238</td>
<td>8238</td>
<td>2.0434E-11</td>
</tr>
<tr>
<td>93-Np-237</td>
<td>937</td>
<td>2.0278E-11</td>
</tr>
<tr>
<td>93-Np-239</td>
<td>1939</td>
<td>1.9667E-11</td>
</tr>
<tr>
<td>94-Pu-238</td>
<td>948</td>
<td>2.0528E-11</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>6239</td>
<td>2.0292E-11</td>
</tr>
<tr>
<td>94-Pu-240</td>
<td>1240</td>
<td>2.0645E-11</td>
</tr>
<tr>
<td>94-Pu-241</td>
<td>1241</td>
<td>2.0637E-11</td>
</tr>
<tr>
<td>94-Pu-242</td>
<td>242,1242</td>
<td>2.1041E-11</td>
</tr>
<tr>
<td>95-Am-241</td>
<td>951</td>
<td>2.0933E-11</td>
</tr>
<tr>
<td>95-Am242m</td>
<td>952</td>
<td>2.1180E-11</td>
</tr>
<tr>
<td>95-Am-243</td>
<td>953</td>
<td>2.1431E-11</td>
</tr>
<tr>
<td>96-Cm-242</td>
<td>962</td>
<td>2.0610E-11</td>
</tr>
<tr>
<td>96-Cm-243</td>
<td>963</td>
<td>2.0568E-11</td>
</tr>
<tr>
<td>96-Cm-244</td>
<td>964</td>
<td>2.1084E-11</td>
</tr>
<tr>
<td>96-Cm-245</td>
<td>965</td>
<td>2.0683E-11</td>
</tr>
<tr>
<td>96-Cm-246</td>
<td>966</td>
<td>2.1292E-11</td>
</tr>
<tr>
<td>96-Cm-247</td>
<td>967</td>
<td>2.1083E-11</td>
</tr>
<tr>
<td>96-Cm-248</td>
<td>968</td>
<td>2.1434E-11</td>
</tr>
<tr>
<td>97-Bk-249</td>
<td>9749</td>
<td>2.1616E-11</td>
</tr>
<tr>
<td>98-Cf-249</td>
<td>9849</td>
<td>2.1311E-11</td>
</tr>
<tr>
<td>98-Cf-250</td>
<td>9850</td>
<td>2.2121E-11</td>
</tr>
<tr>
<td>98-Cf-251</td>
<td>9851</td>
<td>2.1471E-11</td>
</tr>
<tr>
<td>98-Cf-252</td>
<td>9852</td>
<td>2.2172E-11</td>
</tr>
<tr>
<td>98-Cf-253</td>
<td>9853</td>
<td>2.2208E-11</td>
</tr>
<tr>
<td>98-Cf-254</td>
<td>9854</td>
<td>2.2205E-11</td>
</tr>
</tbody>
</table>

(*) No fission product yields
Pa-231 and Am-242 are treated as fission products
Table 7: Burn-up and decay data

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>WIMSD ID</th>
<th>Decay constant [1/s]</th>
<th>Decay product (DP)</th>
<th>Capture product (CP)</th>
<th>Capture branching ratio (BR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-B – 10</td>
<td>10</td>
<td>Stable</td>
<td>-</td>
<td>B-11 (11)</td>
<td>1.0</td>
</tr>
<tr>
<td>5-B – 11</td>
<td>11</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>64-Gd-154</td>
<td>2154</td>
<td>Stable</td>
<td>-</td>
<td>Gd-155 (2155)</td>
<td>1.0</td>
</tr>
<tr>
<td>64-Gd-155</td>
<td>2155</td>
<td>Stable</td>
<td>-</td>
<td>Gd-156 (2156)</td>
<td>1.0</td>
</tr>
<tr>
<td>64-Gd-156</td>
<td>2156</td>
<td>Stable</td>
<td>-</td>
<td>Gd-157 (2157)</td>
<td>1.0</td>
</tr>
<tr>
<td>64-Gd-157</td>
<td>2157</td>
<td>Stable</td>
<td>-</td>
<td>Gd-158 (2158)</td>
<td>1.0</td>
</tr>
<tr>
<td>64-Gd-158</td>
<td>2158</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>66-Dy-160</td>
<td>160</td>
<td>Stable</td>
<td>-</td>
<td>Dy-161 (161)</td>
<td>1.0</td>
</tr>
<tr>
<td>66-Dy-161</td>
<td>161</td>
<td>Stable</td>
<td>-</td>
<td>Dy-162 (162)</td>
<td>1.0</td>
</tr>
<tr>
<td>66-Dy-162</td>
<td>162</td>
<td>Stable</td>
<td>-</td>
<td>Dy-163 (163)</td>
<td>1.0</td>
</tr>
<tr>
<td>66-Dy-163</td>
<td>163</td>
<td>Stable</td>
<td>-</td>
<td>Dy-164 (164)</td>
<td>1.0</td>
</tr>
<tr>
<td>66-Dy-164</td>
<td>164</td>
<td>Stable</td>
<td>-</td>
<td>Ho-165 (165)</td>
<td>1.0</td>
</tr>
<tr>
<td>67-Ho-165</td>
<td>165</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>68-Er-166</td>
<td>2166</td>
<td>Stable</td>
<td>-</td>
<td>Er-167 (2167)</td>
<td>1.0</td>
</tr>
<tr>
<td>68-Er-167</td>
<td>2167</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>72-Hf-176</td>
<td>2176</td>
<td>Stable</td>
<td>-</td>
<td>Hf-177 (2177)</td>
<td>1.0</td>
</tr>
<tr>
<td>72-Hf-177</td>
<td>2177</td>
<td>Stable</td>
<td>-</td>
<td>Hf-178 (2178)</td>
<td>1.0</td>
</tr>
<tr>
<td>72-Hf-178</td>
<td>2178</td>
<td>Stable</td>
<td>-</td>
<td>Hf-179 (2179)</td>
<td>1.0</td>
</tr>
<tr>
<td>72-Hf-179</td>
<td>2179</td>
<td>Stable</td>
<td>-</td>
<td>Hf-180 (2180)</td>
<td>1.0</td>
</tr>
<tr>
<td>72-Hf-180</td>
<td>2180</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>36-Kr-83</td>
<td>4083</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>42-Mo-95</td>
<td>4095</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>43-Tc-99</td>
<td>4099</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>44-Ru-101</td>
<td>4101</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>44-Ru-103</td>
<td>5103</td>
<td>2.0441E-07</td>
<td>Rh-103 (4103)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>44-Ru-106</td>
<td>4106</td>
<td>2.1578E-08</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>45-Rh-103</td>
<td>4103</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>45-Rh-105</td>
<td>4105</td>
<td>5.4452E-06</td>
<td>Pd-105 (5105)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>46-Pd-105</td>
<td>5105</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>46-Pd-107</td>
<td>4107</td>
<td>Stable</td>
<td>-</td>
<td>Pd-108 (4108)</td>
<td>1.0</td>
</tr>
<tr>
<td>46-Pd-108</td>
<td>4108</td>
<td>Stable</td>
<td>-</td>
<td>Ag-109 (4109)</td>
<td>1.0</td>
</tr>
<tr>
<td>47-Ag-109</td>
<td>4109</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>48-Cd-113</td>
<td>4113</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>49-In-115</td>
<td>4115</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>51-Sb-125</td>
<td>4125</td>
<td>7.9623E-09</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>52-Te-127m</td>
<td>5127</td>
<td>7.3601E-08</td>
<td>I-127 (4127)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>53-I-127</td>
<td>4127</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>54-Xe-131</td>
<td>4131</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>55-Cs-133</td>
<td>4133</td>
<td>Stable</td>
<td>-</td>
<td>Cs-134 (4134)</td>
<td>1.0</td>
</tr>
<tr>
<td>55-Cs-134</td>
<td>4134</td>
<td>1.0636E-08</td>
<td>Cs-135 (5135)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>55-Cs-137</td>
<td>4137</td>
<td>7.3020E-10</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>53-I-135</td>
<td>6135</td>
<td>2.9306E-5</td>
<td>Xe-135 (4135)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>54-Xe-134</td>
<td>5134</td>
<td>Stable</td>
<td>Xe-135 (4135)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>55-Cs-135</td>
<td>4135</td>
<td>2.1066E-05</td>
<td>Cs-135 (5135)</td>
<td>Xe-136 (4136)</td>
<td>1.0</td>
</tr>
<tr>
<td>55-Cs-135</td>
<td>5135</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nuclide</td>
<td>WIMSD ID</td>
<td>Decay constant [1/s]</td>
<td>Decay product (DP)</td>
<td>Capture product (CP)</td>
<td>Capture branching ratio (BR)</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>---------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>54-Xe-136</td>
<td>4136</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>60-Nd-143</td>
<td>4143</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>60-Nd-145</td>
<td>4145</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>61-Pm-147</td>
<td>4147</td>
<td>8.3725E-09</td>
<td>Sm-147 (6147)</td>
<td>Pm-148m (4148)</td>
<td>1.0 (1)</td>
</tr>
<tr>
<td>61-Pm-147</td>
<td>5147</td>
<td>8.3725E-09</td>
<td>Sm-147 (6147)</td>
<td>Pm-148 (5148)</td>
<td>1.0 (1)</td>
</tr>
<tr>
<td>62-Sm-147</td>
<td>6147</td>
<td>Stable</td>
<td>-</td>
<td>Sm-148 (6148)</td>
<td>1.0</td>
</tr>
<tr>
<td>61-Pm-148m</td>
<td>4148</td>
<td>1.9430E-07</td>
<td>Sm-148 (6148)</td>
<td>Pm-149 (5149)</td>
<td>1.0</td>
</tr>
<tr>
<td>61-Pm-148</td>
<td>5148</td>
<td>1.4945E-06</td>
<td>Sm-148 (6148)</td>
<td>Pm-149 (5149)</td>
<td>1.0</td>
</tr>
<tr>
<td>62-Sm-148</td>
<td>6148</td>
<td>Stable</td>
<td>-</td>
<td>Sm-149 (4149)</td>
<td>1.0</td>
</tr>
<tr>
<td>61-Pm-149</td>
<td>5149</td>
<td>3.6274E-06</td>
<td>Sm-149 (4149)</td>
<td>Sm-150 (4150)</td>
<td>1.0</td>
</tr>
<tr>
<td>62-Sm-149</td>
<td>4149</td>
<td>Stable</td>
<td>-</td>
<td>Sm-150 (4150)</td>
<td>1.0</td>
</tr>
<tr>
<td>62-Sm-150</td>
<td>4150</td>
<td>Stable</td>
<td>-</td>
<td>Sm-151 (4151)</td>
<td>1.0</td>
</tr>
<tr>
<td>62-Sm-151</td>
<td>4151</td>
<td>2.4405E-10</td>
<td>Eu-151 (5151)</td>
<td>Eu-152 (4152)</td>
<td>1.0</td>
</tr>
<tr>
<td>62-Sm-152</td>
<td>4152</td>
<td>Stable</td>
<td>-</td>
<td>Eu-153 (4153)</td>
<td>1.0 (2)</td>
</tr>
<tr>
<td>63-Eu-151</td>
<td>5151</td>
<td>Stable</td>
<td>-</td>
<td>Eu-152 (5152)</td>
<td>1.0</td>
</tr>
<tr>
<td>63-Eu-152</td>
<td>5152</td>
<td>1.6226E-09</td>
<td>Eu-153 (4153)</td>
<td>Eu-154 (4154)</td>
<td>1.0</td>
</tr>
<tr>
<td>63-Eu-154</td>
<td>4154</td>
<td>2.5537E-09</td>
<td>Gd-154 (2154)</td>
<td>Gd-155 (2155)</td>
<td>-</td>
</tr>
<tr>
<td>63-Eu-155</td>
<td>4155</td>
<td>4.6212E-09</td>
<td>Gd-155 (2155)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Pseudo FP</td>
<td>4902</td>
<td>Stable</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>90-Th-232</td>
<td>2232</td>
<td>Stable</td>
<td>-</td>
<td>Pa-233 (1233)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-232</td>
<td>232</td>
<td>3.1879E-10</td>
<td>-</td>
<td>U-233 (9233)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-233</td>
<td>9233</td>
<td>Stable</td>
<td>-</td>
<td>U-234 (234)</td>
<td>1.0</td>
</tr>
<tr>
<td>91-Pa-231</td>
<td>1231</td>
<td>6.7047E-13</td>
<td>-</td>
<td>U-232 (232)</td>
<td>1.0</td>
</tr>
<tr>
<td>91-Pa-233</td>
<td>1233</td>
<td>2.9741E-07</td>
<td>U-233 (9233)</td>
<td>U-234 (234)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-234</td>
<td>234</td>
<td>Stable</td>
<td>-</td>
<td>U-235 (2235)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-235</td>
<td>2235</td>
<td>Stable</td>
<td>-</td>
<td>U-236 (236)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-236</td>
<td>236</td>
<td>Stable</td>
<td>-</td>
<td>U-237 (927)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-237</td>
<td>927</td>
<td>1.1885E-06</td>
<td>Np-237 (937)</td>
<td>U-238 (8238)</td>
<td>1.0</td>
</tr>
<tr>
<td>92-U-238</td>
<td>8238</td>
<td>Stable</td>
<td>-</td>
<td>Np-239 (1939)</td>
<td>1.0</td>
</tr>
<tr>
<td>93-Np-237</td>
<td>937</td>
<td>Stable</td>
<td>-</td>
<td>Pu-238 (948)</td>
<td>1.0</td>
</tr>
<tr>
<td>93-Np-239</td>
<td>1939</td>
<td>3.4052E-06</td>
<td>Pu-239 (6239)</td>
<td>Pu-240 (1240)</td>
<td>1.0</td>
</tr>
<tr>
<td>94-Pu-238</td>
<td>948</td>
<td>2.5045E-10</td>
<td>U-234 (234)</td>
<td>Pu-239 (6239)</td>
<td>1.0</td>
</tr>
<tr>
<td>94-Pu-239</td>
<td>6239</td>
<td>9.1101E-13</td>
<td>U-235 (2235)</td>
<td>Pu-240 (1240)</td>
<td>1.0</td>
</tr>
<tr>
<td>94-Pu-240</td>
<td>1240</td>
<td>3.3477E-12</td>
<td>U-236 (236)</td>
<td>Pu-241 (1241)</td>
<td>1.0</td>
</tr>
<tr>
<td>94-Pu-241</td>
<td>1241</td>
<td>1.5371E-09</td>
<td>Am-241 (951)</td>
<td>Pu-242 (1242)</td>
<td>1.0</td>
</tr>
<tr>
<td>94-Pu-242</td>
<td>242</td>
<td>Stable</td>
<td>-</td>
<td>Am-243 (953)</td>
<td>1.0</td>
</tr>
<tr>
<td>95-Am-241</td>
<td>951</td>
<td>5.0773E-11</td>
<td>Np-237 (937)</td>
<td>Am-242m (952)</td>
<td>0.12</td>
</tr>
<tr>
<td>95-Am-242</td>
<td>1952</td>
<td>1.2019E-05</td>
<td>Cm-242 (962)</td>
<td>Am-242 (953)</td>
<td>0.80</td>
</tr>
<tr>
<td>95-Am-242m</td>
<td>952</td>
<td>1.5578E-10</td>
<td>Am-242 (1952)</td>
<td>Am-243 (953)</td>
<td>1.0</td>
</tr>
<tr>
<td>95-Am-243</td>
<td>953</td>
<td>2.9803E-12</td>
<td>Np-239 (1939)</td>
<td>Cm-244 (964)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-242</td>
<td>962</td>
<td>4.9236E-08</td>
<td>Pu-238 (948)</td>
<td>Cm-243 (963)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-243</td>
<td>963</td>
<td>7.5479E-10</td>
<td>Pu-239 (6239)</td>
<td>Cm-244 (964)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-244</td>
<td>964</td>
<td>1.2128E-09</td>
<td>Pu-240 (1240)</td>
<td>Cm-245 (965)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-245</td>
<td>965</td>
<td>2.5841E-12</td>
<td>Pu-241 (1241)</td>
<td>Cm-246 (966)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-246</td>
<td>966</td>
<td>4.6144E-12</td>
<td>Pu-242(1242)</td>
<td>Cm-247 (967)</td>
<td>1.0</td>
</tr>
<tr>
<td>Nuclide</td>
<td>WIMSD ID</td>
<td>Decay constant [1/s]</td>
<td>Decay product (DP)</td>
<td>Capture product (CP)</td>
<td>Capture branching ratio (BR)</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>96-Cm-247</td>
<td>967</td>
<td>Stable</td>
<td>-</td>
<td>Cm-248 (968)</td>
<td>1.0</td>
</tr>
<tr>
<td>96-Cm-248</td>
<td>968</td>
<td>Stable</td>
<td>-</td>
<td>Bk-249 (9749)</td>
<td>1.0</td>
</tr>
<tr>
<td>97-Bk-249</td>
<td>9749</td>
<td>2.5070E-08</td>
<td>Cf-249 (5849)</td>
<td>Cf-250 (9850)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-249</td>
<td>9849</td>
<td>6.2577E-11</td>
<td>Cm-245 (965)</td>
<td>Cf-250 (9850)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-250</td>
<td>9850</td>
<td>1.6792E-09</td>
<td>Cm-246 (966)</td>
<td>Cf-251 (9851)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-251</td>
<td>9851</td>
<td>2.4459E-11</td>
<td>Cm-247(967)</td>
<td>Cf-252 (9852)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-252</td>
<td>9852</td>
<td>8.3043E-11</td>
<td>Cm-248(968)</td>
<td>Cf-253 (9853)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-253</td>
<td>9853</td>
<td>4.5045E-07</td>
<td>(4)</td>
<td>Cf-254 (9854)</td>
<td>1.0</td>
</tr>
<tr>
<td>98-Cf-254</td>
<td>9854</td>
<td>1.3260E-07</td>
<td>(5)</td>
<td>-</td>
<td>(5)</td>
</tr>
</tbody>
</table>

(1) Pm-147 + n → Pm-148m Mat 4147
→ Pm-148 Mat 5147
(2) Sm-152 + n → [Sm-153] → Eu-153
(3) Eu-152 decays into void (ignore 72.08% Sm-152 and 27.92 % Gd-152)
(4) Cf-253 decays into void
(5) Cf-254 decay and capture products are void
Table 8. Fission spectrum of the 69-group library

<table>
<thead>
<tr>
<th>Group</th>
<th>Fission Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.7155E-02</td>
</tr>
<tr>
<td>2</td>
<td>1.1348E-01</td>
</tr>
<tr>
<td>3</td>
<td>2.1581E-01</td>
</tr>
<tr>
<td>4</td>
<td>2.3289E-01</td>
</tr>
<tr>
<td>5</td>
<td>1.7578E-01</td>
</tr>
<tr>
<td>6</td>
<td>1.1040E-01</td>
</tr>
<tr>
<td>7</td>
<td>6.2441E-02</td>
</tr>
<tr>
<td>8</td>
<td>3.1854E-02</td>
</tr>
<tr>
<td>9</td>
<td>1.5632E-02</td>
</tr>
<tr>
<td>10</td>
<td>7.5740E-03</td>
</tr>
<tr>
<td>11</td>
<td>3.6242E-03</td>
</tr>
<tr>
<td>12</td>
<td>1.7394E-03</td>
</tr>
<tr>
<td>13</td>
<td>8.4624E-04</td>
</tr>
<tr>
<td>14</td>
<td>4.0858E-04</td>
</tr>
<tr>
<td>15</td>
<td>1.8690E-04</td>
</tr>
<tr>
<td>16</td>
<td>8.3818E-05</td>
</tr>
<tr>
<td>17</td>
<td>4.3405E-05</td>
</tr>
<tr>
<td>18</td>
<td>2.2574E-05</td>
</tr>
<tr>
<td>19</td>
<td>1.1801E-05</td>
</tr>
<tr>
<td>20</td>
<td>9.4982E-06</td>
</tr>
<tr>
<td>21</td>
<td>2.7058E-06</td>
</tr>
<tr>
<td>22</td>
<td>6.8004E-07</td>
</tr>
<tr>
<td>23</td>
<td>2.1249E-07</td>
</tr>
<tr>
<td>24</td>
<td>1.3763E-07</td>
</tr>
<tr>
<td>25</td>
<td>6.9403E-08</td>
</tr>
<tr>
<td>26</td>
<td>3.2289E-08</td>
</tr>
<tr>
<td>27</td>
<td>2.6470E-08</td>
</tr>
<tr>
<td>sum</td>
<td>1.0000E+00</td>
</tr>
</tbody>
</table>
Table 9: Fission spectrum of the 172-group library

<table>
<thead>
<tr>
<th>Group</th>
<th>Fission Spectrum</th>
<th>Group</th>
<th>Fission Spectrum</th>
<th>Group</th>
<th>Fission Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.4366E-06</td>
<td>32</td>
<td>1.3352E-02</td>
<td>63</td>
<td>1.2407E-06</td>
</tr>
<tr>
<td>2</td>
<td>3.0151E-05</td>
<td>33</td>
<td>2.2999E-03</td>
<td>64</td>
<td>6.0053E-07</td>
</tr>
<tr>
<td>3</td>
<td>4.6129E-05</td>
<td>34</td>
<td>5.1939E-03</td>
<td>65</td>
<td>1.1988E-07</td>
</tr>
<tr>
<td>4</td>
<td>3.6377E-04</td>
<td>35</td>
<td>2.3912E-03</td>
<td>66</td>
<td>4.2185E-07</td>
</tr>
<tr>
<td>5</td>
<td>1.0609E-03</td>
<td>36</td>
<td>1.7753E-03</td>
<td>67</td>
<td>1.3563E-07</td>
</tr>
<tr>
<td>6</td>
<td>4.2858E-03</td>
<td>37</td>
<td>1.8526E-03</td>
<td>68</td>
<td>6.2924E-08</td>
</tr>
<tr>
<td>7</td>
<td>1.1374E-02</td>
<td>38</td>
<td>4.5624E-04</td>
<td>69</td>
<td>9.5335E-08</td>
</tr>
<tr>
<td>8</td>
<td>9.9939E-03</td>
<td>39</td>
<td>8.3687E-04</td>
<td>70</td>
<td>2.9881E-08</td>
</tr>
<tr>
<td>9</td>
<td>1.3719E-02</td>
<td>40</td>
<td>1.9225E-04</td>
<td>71</td>
<td>2.4257E-08</td>
</tr>
<tr>
<td>10</td>
<td>4.0475E-02</td>
<td>41</td>
<td>2.5538E-04</td>
<td>72</td>
<td>1.9597E-08</td>
</tr>
<tr>
<td>11</td>
<td>5.9306E-02</td>
<td>42</td>
<td>7.2186E-04</td>
<td>73</td>
<td>3.7407E-08</td>
</tr>
<tr>
<td>12</td>
<td>7.7123E-02</td>
<td>43</td>
<td>1.2468E-04</td>
<td>74</td>
<td>1.9764E-08</td>
</tr>
<tr>
<td>13</td>
<td>9.0501E-02</td>
<td>44</td>
<td>2.8184E-04</td>
<td>75</td>
<td>2.3610E-08</td>
</tr>
<tr>
<td>14</td>
<td>4.8103E-02</td>
<td>45</td>
<td>1.2699E-04</td>
<td>76</td>
<td>2.0828E-08</td>
</tr>
<tr>
<td>15</td>
<td>4.8690E-02</td>
<td>46</td>
<td>9.1430E-05</td>
<td>77</td>
<td>1.8387E-08</td>
</tr>
<tr>
<td>16</td>
<td>9.5545E-02</td>
<td>47</td>
<td>9.5464E-05</td>
<td>78</td>
<td>1.6241E-08</td>
</tr>
<tr>
<td>17</td>
<td>8.8608E-02</td>
<td>48</td>
<td>2.3573E-05</td>
<td>79</td>
<td>1.4355E-08</td>
</tr>
<tr>
<td>18</td>
<td>4.0651E-02</td>
<td>49</td>
<td>5.9994E-05</td>
<td>80</td>
<td>1.8485E-08</td>
</tr>
<tr>
<td>19</td>
<td>3.7989E-02</td>
<td>50</td>
<td>6.3356E-06</td>
<td>81</td>
<td>1.9935E-08</td>
</tr>
<tr>
<td>20</td>
<td>3.5199E-02</td>
<td>51</td>
<td>3.7064E-05</td>
<td>82</td>
<td>1.2090E-08</td>
</tr>
<tr>
<td>21</td>
<td>3.2434E-02</td>
<td>52</td>
<td>6.3669E-06</td>
<td>83</td>
<td>1.3087E-08</td>
</tr>
<tr>
<td>22</td>
<td>2.9670E-02</td>
<td>53</td>
<td>1.4414E-05</td>
<td>84</td>
<td>6.7340E-09</td>
</tr>
<tr>
<td>23</td>
<td>7.3557E-02</td>
<td>54</td>
<td>1.8536E-06</td>
<td>85</td>
<td>3.5601E-09</td>
</tr>
<tr>
<td>24</td>
<td>1.9817E-02</td>
<td>55</td>
<td>4.8264E-06</td>
<td>86</td>
<td>4.2240E-09</td>
</tr>
<tr>
<td>25</td>
<td>1.7688E-02</td>
<td>56</td>
<td>5.0179E-06</td>
<td>87</td>
<td>3.7027E-09</td>
</tr>
<tr>
<td>26</td>
<td>1.5710E-02</td>
<td>57</td>
<td>2.0210E-06</td>
<td>88</td>
<td>6.1156E-09</td>
</tr>
<tr>
<td>27</td>
<td>1.3851E-02</td>
<td>58</td>
<td>3.2750E-06</td>
<td>89</td>
<td>3.4881E-09</td>
</tr>
<tr>
<td>28</td>
<td>3.2319E-02</td>
<td>59</td>
<td>1.3210E-06</td>
<td>90</td>
<td>1.2680E-09</td>
</tr>
<tr>
<td>29</td>
<td>8.1900E-03</td>
<td>60</td>
<td>3.7631E-06</td>
<td>91</td>
<td>3.7259E-09</td>
</tr>
<tr>
<td>30</td>
<td>7.1535E-03</td>
<td>61</td>
<td>1.2250E-06</td>
<td>92</td>
<td>5.1452E-10</td>
</tr>
<tr>
<td>31</td>
<td>1.6320E-02</td>
<td>62</td>
<td>9.2828E-07</td>
<td>sum</td>
<td>1.0000E+00</td>
</tr>
</tbody>
</table>
Table 10: Fission product yields for Th-232, U-233, U-235 and U-238

<table>
<thead>
<tr>
<th>Fission product</th>
<th>WIMS ID</th>
<th>Th-232</th>
<th>U-233</th>
<th>U-235</th>
<th>U-238</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kr-83</td>
<td>4083</td>
<td>2.1836E-02</td>
<td>1.0155E-02</td>
<td>5.4016E-03</td>
<td>3.9992E-03</td>
</tr>
<tr>
<td>Mo-95</td>
<td>4095</td>
<td>5.6503E-02</td>
<td>6.3490E-02</td>
<td>6.5007E-02</td>
<td>5.1362E-02</td>
</tr>
<tr>
<td>Tc-99</td>
<td>4099</td>
<td>2.9503E-02</td>
<td>4.9131E-02</td>
<td>6.1233E-02</td>
<td>6.1844E-02</td>
</tr>
<tr>
<td>Ru-101</td>
<td>4101</td>
<td>7.1204E-03</td>
<td>3.1711E-02</td>
<td>5.1789E-02</td>
<td>6.2049E-02</td>
</tr>
<tr>
<td>Ru-103</td>
<td>5103</td>
<td>1.5511E-03</td>
<td>1.5733E-02</td>
<td>3.0353E-02</td>
<td>6.2652E-02</td>
</tr>
<tr>
<td>Ru-106</td>
<td>4106</td>
<td>4.8494E-04</td>
<td>2.4620E-03</td>
<td>4.0380E-03</td>
<td>2.4773E-02</td>
</tr>
<tr>
<td>Rh-103</td>
<td>4103</td>
<td>1.0164E-20</td>
<td>1.7922E-10</td>
<td>4.8418E-12</td>
<td>8.9286E-14</td>
</tr>
<tr>
<td>Rh-105</td>
<td>4105</td>
<td>5.3416E-04</td>
<td>4.9663E-03</td>
<td>9.7199E-03</td>
<td>4.0850E-02</td>
</tr>
<tr>
<td>Pd-105</td>
<td>5105</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>3.7500E-09</td>
</tr>
<tr>
<td>Pd-107</td>
<td>4107</td>
<td>5.0256E-04</td>
<td>1.1451E-03</td>
<td>1.4926E-03</td>
<td>1.4383E-02</td>
</tr>
<tr>
<td>Ag-109</td>
<td>4109</td>
<td>6.4521E-04</td>
<td>3.3341E-04</td>
<td>3.1149E-04</td>
<td>2.5104E-03</td>
</tr>
<tr>
<td>Cd-113</td>
<td>4113</td>
<td>7.7159E-04</td>
<td>1.3452E-04</td>
<td>1.4415E-04</td>
<td>4.5601E-04</td>
</tr>
<tr>
<td>In-115</td>
<td>4115</td>
<td>7.3378E-04</td>
<td>1.4309E-04</td>
<td>1.2405E-04</td>
<td>3.5773E-04</td>
</tr>
<tr>
<td>Sb-125</td>
<td>4125</td>
<td>3.2952E-04</td>
<td>1.1699E-03</td>
<td>3.4717E-04</td>
<td>4.8519E-04</td>
</tr>
<tr>
<td>Te-127</td>
<td>5127</td>
<td>1.6701E-04</td>
<td>9.1565E-04</td>
<td>2.6420E-04</td>
<td>2.2457E-04</td>
</tr>
<tr>
<td>I-127</td>
<td>4127</td>
<td>8.4638E-04</td>
<td>4.6404E-03</td>
<td>1.3390E-03</td>
<td>1.1381E-03</td>
</tr>
<tr>
<td>I-135</td>
<td>6135</td>
<td>5.5061E-02</td>
<td>5.0326E-02</td>
<td>6.2807E-02</td>
<td>6.9321E-02</td>
</tr>
<tr>
<td>Xe-131</td>
<td>4131</td>
<td>1.6205E-02</td>
<td>3.6046E-02</td>
<td>2.8886E-02</td>
<td>3.2911E-02</td>
</tr>
<tr>
<td>Xe-134</td>
<td>5134</td>
<td>5.3767E-02</td>
<td>6.3050E-02</td>
<td>7.8636E-02</td>
<td>7.6277E-02</td>
</tr>
<tr>
<td>Xe-135</td>
<td>4135</td>
<td>1.0181E-04</td>
<td>1.2244E-02</td>
<td>2.5710E-03</td>
<td>2.6817E-04</td>
</tr>
<tr>
<td>Xe-136</td>
<td>4136</td>
<td>5.5950E-02</td>
<td>6.7764E-02</td>
<td>6.3657E-02</td>
<td>6.9684E-02</td>
</tr>
<tr>
<td>Cs-133</td>
<td>4133</td>
<td>4.0713E-02</td>
<td>5.9533E-02</td>
<td>6.7104E-02</td>
<td>6.7968E-02</td>
</tr>
<tr>
<td>Cs-134</td>
<td>4134</td>
<td>3.0400E-10</td>
<td>2.6826E-06</td>
<td>7.6546E-08</td>
<td>6.4600E-09</td>
</tr>
<tr>
<td>Cs-135</td>
<td>5135</td>
<td>2.5812E-07</td>
<td>8.3154E-05</td>
<td>1.0200E-05</td>
<td>8.4230E-07</td>
</tr>
<tr>
<td>Cs-137</td>
<td>4137</td>
<td>5.8274E-02</td>
<td>6.7514E-02</td>
<td>6.1312E-02</td>
<td>6.0156E-02</td>
</tr>
<tr>
<td>Nd-143</td>
<td>4143</td>
<td>6.3040E-02</td>
<td>5.9630E-02</td>
<td>5.9252E-02</td>
<td>4.4078E-02</td>
</tr>
<tr>
<td>Nd-145</td>
<td>4145</td>
<td>5.3287E-02</td>
<td>3.4435E-02</td>
<td>3.9294E-02</td>
<td>3.8034E-02</td>
</tr>
<tr>
<td>Pm-147</td>
<td>4147</td>
<td>1.2290E-02</td>
<td>6.6862E-03</td>
<td>8.5794E-03</td>
<td>8.4290E-03</td>
</tr>
<tr>
<td>Pm-147*</td>
<td>5147</td>
<td>1.3858E-02</td>
<td>7.5398E-03</td>
<td>9.6746E-03</td>
<td>9.5050E-03</td>
</tr>
<tr>
<td>Pm-148</td>
<td>5148</td>
<td>1.9600E-13</td>
<td>3.1256E-09</td>
<td>4.6171E-11</td>
<td>6.1300E-12</td>
</tr>
<tr>
<td>Pm-148m</td>
<td>4148</td>
<td>5.2999E-13</td>
<td>9.8878E-09</td>
<td>8.6334E-11</td>
<td>1.6600E-11</td>
</tr>
<tr>
<td>Pm-149</td>
<td>5149</td>
<td>1.0838E-02</td>
<td>7.7800E-03</td>
<td>1.0807E-02</td>
<td>1.6272E-02</td>
</tr>
<tr>
<td>Sm-147</td>
<td>6147</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Sm-148</td>
<td>6148</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Sm-149</td>
<td>4149</td>
<td>0.0000E+00</td>
<td>1.2541E-10</td>
<td>1.6865E-12</td>
<td>1.5703E-14</td>
</tr>
<tr>
<td>Sm-150</td>
<td>4150</td>
<td>1.4500E-09</td>
<td>4.3812E-06</td>
<td>2.9909E-07</td>
<td>3.2902E-08</td>
</tr>
<tr>
<td>Sm-151</td>
<td>4151</td>
<td>3.6252E-03</td>
<td>3.1570E-03</td>
<td>4.1857E-03</td>
<td>7.9736E-03</td>
</tr>
<tr>
<td>Sm-152</td>
<td>4152</td>
<td>7.5505E-04</td>
<td>2.1361E-03</td>
<td>2.6700E-03</td>
<td>5.3013E-03</td>
</tr>
<tr>
<td>Eu-151</td>
<td>5151</td>
<td>0.0000E+00</td>
<td>3.8358E-12</td>
<td>2.6348E-12</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Eu-152</td>
<td>5152</td>
<td>0.0000E+00</td>
<td>7.6428E-11</td>
<td>1.7888E-12</td>
<td>2.9200E-14</td>
</tr>
<tr>
<td>Fission product</td>
<td>WIMS ID</td>
<td>Th-232</td>
<td>U-233</td>
<td>U-235</td>
<td>U-238</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Eu-153</td>
<td>4153</td>
<td>3.0993E-04</td>
<td>1.0368E-03</td>
<td>1.5847E-03</td>
<td>4.1458E-03</td>
</tr>
<tr>
<td>Eu-154</td>
<td>4154</td>
<td>2.2000E-13</td>
<td>2.0854E-08</td>
<td>1.9128E-09</td>
<td>8.2500E-11</td>
</tr>
<tr>
<td>Eu-155</td>
<td>4155</td>
<td>3.6169E-05</td>
<td>2.1430E-04</td>
<td>3.2285E-04</td>
<td>1.4150E-03</td>
</tr>
<tr>
<td>Gd-154</td>
<td>2154</td>
<td>0.0000E+00</td>
<td>6.1092E-12</td>
<td>1.1022E-13</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Gd-155</td>
<td>2155</td>
<td>0.0000E+00</td>
<td>1.3556E-10</td>
<td>4.0232E-12</td>
<td>8.0401E-14</td>
</tr>
<tr>
<td>Gd-156</td>
<td>2156</td>
<td>2.6901E-05</td>
<td>1.2799E-04</td>
<td>1.4964E-04</td>
<td>7.6021E-04</td>
</tr>
<tr>
<td>Gd-158</td>
<td>2158</td>
<td>4.6406E-06</td>
<td>2.0561E-05</td>
<td>3.3511E-05</td>
<td>1.8481E-04</td>
</tr>
<tr>
<td>Dy-160</td>
<td>160</td>
<td>4.8699E-14</td>
<td>1.3734E-09</td>
<td>2.8047E-10</td>
<td>1.8900E-11</td>
</tr>
<tr>
<td>Dy-161</td>
<td>161</td>
<td>1.4485E-07</td>
<td>1.2155E-06</td>
<td>9.0384E-07</td>
<td>1.2150E-05</td>
</tr>
<tr>
<td>Dy-162</td>
<td>162</td>
<td>7.9749E-08</td>
<td>1.2592E-07</td>
<td>1.6722E-07</td>
<td>3.4046E-06</td>
</tr>
<tr>
<td>Dy-163</td>
<td>163</td>
<td>4.6512E-08</td>
<td>5.9312E-08</td>
<td>6.1743E-08</td>
<td>2.0420E-06</td>
</tr>
<tr>
<td>Dy-164</td>
<td>164</td>
<td>2.0314E-08</td>
<td>1.9531E-08</td>
<td>1.9617E-08</td>
<td>1.2476E-06</td>
</tr>
<tr>
<td>Ho-165</td>
<td>165</td>
<td>3.5330E-09</td>
<td>6.3259E-09</td>
<td>9.7921E-09</td>
<td>7.6592E-07</td>
</tr>
<tr>
<td>Er-166</td>
<td>2166</td>
<td>1.3835E-09</td>
<td>3.6772E-09</td>
<td>3.7473E-09</td>
<td>5.6491E-07</td>
</tr>
<tr>
<td>Er-167</td>
<td>2167</td>
<td>9.7640E-10</td>
<td>5.0880E-10</td>
<td>2.4995E-09</td>
<td>4.3504E-07</td>
</tr>
<tr>
<td>pseudo</td>
<td>4902</td>
<td>1.2809E+00</td>
<td>1.1533E+00</td>
<td>1.0682E+00</td>
<td>9.5381E-01</td>
</tr>
<tr>
<td>Fission product</td>
<td>WIMS ID</td>
<td>Pu-239</td>
<td>Pu-240</td>
<td>Pu-241</td>
<td>Pu-242</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>Kr-83</td>
<td>4083</td>
<td>2.9851E-03</td>
<td>2.3241E-03</td>
<td>2.3241E-03</td>
<td>1.7810E-03</td>
</tr>
<tr>
<td>Mo-95</td>
<td>4095</td>
<td>4.8184E-02</td>
<td>4.5032E-02</td>
<td>4.5032E-02</td>
<td>3.6289E-02</td>
</tr>
<tr>
<td>Tc-99</td>
<td>4099</td>
<td>6.2143E-02</td>
<td>5.9470E-02</td>
<td>5.9470E-02</td>
<td>5.4689E-02</td>
</tr>
<tr>
<td>Ru-101</td>
<td>4101</td>
<td>6.0294E-02</td>
<td>6.3326E-02</td>
<td>6.3326E-02</td>
<td>5.9902E-02</td>
</tr>
<tr>
<td>Ru-103</td>
<td>5103</td>
<td>6.9859E-02</td>
<td>6.4442E-02</td>
<td>6.4442E-02</td>
<td>6.5307E-02</td>
</tr>
<tr>
<td>Ru-106</td>
<td>4106</td>
<td>4.3476E-02</td>
<td>5.1332E-02</td>
<td>5.1332E-02</td>
<td>5.7524E-02</td>
</tr>
<tr>
<td>Rh-103</td>
<td>4103</td>
<td>2.5625E-09</td>
<td>2.1682E-10</td>
<td>2.1682E-10</td>
<td>8.8132E-12</td>
</tr>
<tr>
<td>Rh-105</td>
<td>4105</td>
<td>5.6375E-02</td>
<td>5.6146E-02</td>
<td>5.6146E-02</td>
<td>6.9646E-02</td>
</tr>
<tr>
<td>Pd-105</td>
<td>5105</td>
<td>2.4422E-10</td>
<td>1.8380E-11</td>
<td>1.8380E-11</td>
<td>7.6369E-13</td>
</tr>
<tr>
<td>Pd-107</td>
<td>4107</td>
<td>3.3265E-02</td>
<td>3.9964E-02</td>
<td>3.9964E-02</td>
<td>5.0364E-02</td>
</tr>
<tr>
<td>Pd-108</td>
<td>4108</td>
<td>2.1603E-02</td>
<td>2.9187E-02</td>
<td>2.9187E-02</td>
<td>4.3980E-02</td>
</tr>
<tr>
<td>Ag-109</td>
<td>4109</td>
<td>9.3569E-03</td>
<td>1.1922E-02</td>
<td>1.1922E-02</td>
<td>2.5650E-02</td>
</tr>
<tr>
<td>Cd-113</td>
<td>4113</td>
<td>8.2317E-04</td>
<td>1.3774E-03</td>
<td>1.3774E-03</td>
<td>3.1216E-03</td>
</tr>
<tr>
<td>In-115</td>
<td>4115</td>
<td>4.1878E-04</td>
<td>6.0516E-04</td>
<td>6.0516E-04</td>
<td>1.0434E-03</td>
</tr>
<tr>
<td>Sb-125</td>
<td>4125</td>
<td>1.1377E-03</td>
<td>8.1814E-04</td>
<td>8.1814E-04</td>
<td>1.2607E-03</td>
</tr>
<tr>
<td>I-127</td>
<td>4127</td>
<td>4.2327E-03</td>
<td>3.3577E-03</td>
<td>3.3577E-03</td>
<td>2.2934E-03</td>
</tr>
<tr>
<td>I-135</td>
<td>6135</td>
<td>6.5190E-02</td>
<td>6.8499E-02</td>
<td>6.8499E-02</td>
<td>6.8627E-02</td>
</tr>
<tr>
<td>Xe-131</td>
<td>4131</td>
<td>3.8556E-02</td>
<td>3.4731E-02</td>
<td>3.4731E-02</td>
<td>3.0874E-02</td>
</tr>
<tr>
<td>Xe-134</td>
<td>5134</td>
<td>7.6601E-02</td>
<td>7.5207E-02</td>
<td>7.5207E-02</td>
<td>7.3430E-02</td>
</tr>
<tr>
<td>Xe-135</td>
<td>4135</td>
<td>1.0784E-02</td>
<td>5.3232E-03</td>
<td>5.3232E-03</td>
<td>1.4784E-03</td>
</tr>
<tr>
<td>Xe-136</td>
<td>4136</td>
<td>7.0417E-02</td>
<td>6.7260E-02</td>
<td>6.7260E-02</td>
<td>6.8852E-02</td>
</tr>
<tr>
<td>Cs-133</td>
<td>4133</td>
<td>7.0160E-02</td>
<td>6.8747E-02</td>
<td>6.8747E-02</td>
<td>6.6400E-02</td>
</tr>
<tr>
<td>Cs-134</td>
<td>4134</td>
<td>6.6982E-06</td>
<td>1.1138E-06</td>
<td>1.1138E-06</td>
<td>1.0145E-07</td>
</tr>
<tr>
<td>Cs-135</td>
<td>5135</td>
<td>1.4880E-04</td>
<td>4.2887E-05</td>
<td>4.2887E-05</td>
<td>7.1050E-06</td>
</tr>
<tr>
<td>Cs-137</td>
<td>4137</td>
<td>6.6007E-02</td>
<td>6.5528E-02</td>
<td>6.5528E-02</td>
<td>6.3220E-02</td>
</tr>
<tr>
<td>Nd-143</td>
<td>4143</td>
<td>4.4029E-02</td>
<td>4.4352E-02</td>
<td>4.4352E-02</td>
<td>4.4726E-02</td>
</tr>
<tr>
<td>Nd-145</td>
<td>4145</td>
<td>2.9866E-02</td>
<td>3.0734E-02</td>
<td>3.0734E-02</td>
<td>3.3701E-02</td>
</tr>
<tr>
<td>Pm-147</td>
<td>4147</td>
<td>5.9427E-03</td>
<td>6.2524E-03</td>
<td>6.2524E-03</td>
<td>6.4935E-03</td>
</tr>
<tr>
<td>Pm-147*</td>
<td>5147</td>
<td>6.7013E-03</td>
<td>7.0506E-03</td>
<td>7.0506E-03</td>
<td>7.3225E-03</td>
</tr>
<tr>
<td>Pm-148</td>
<td>5148</td>
<td>1.3309E-08</td>
<td>4.2982E-09</td>
<td>4.2982E-09</td>
<td>3.7195E-10</td>
</tr>
<tr>
<td>Pm-148m</td>
<td>4148</td>
<td>4.6655E-08</td>
<td>1.1256E-08</td>
<td>1.1256E-08</td>
<td>1.0086E-09</td>
</tr>
<tr>
<td>Pm-149</td>
<td>5149</td>
<td>1.2197E-02</td>
<td>1.3506E-02</td>
<td>1.3506E-02</td>
<td>1.5749E-02</td>
</tr>
<tr>
<td>Sm-147</td>
<td>6147</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Sm-148</td>
<td>6148</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
<td>0.0000E+00</td>
</tr>
<tr>
<td>Sm-149</td>
<td>4149</td>
<td>8.2205E-10</td>
<td>4.4663E-11</td>
<td>4.4663E-11</td>
<td>2.4188E-12</td>
</tr>
<tr>
<td>Sm-150</td>
<td>4150</td>
<td>1.1793E-05</td>
<td>4.1831E-06</td>
<td>4.1831E-06</td>
<td>7.5841E-07</td>
</tr>
<tr>
<td>Sm-151</td>
<td>4151</td>
<td>7.4165E-03</td>
<td>8.5148E-03</td>
<td>8.5148E-03</td>
<td>9.8875E-03</td>
</tr>
<tr>
<td>Sm-152</td>
<td>4152</td>
<td>5.7944E-03</td>
<td>6.5236E-03</td>
<td>6.5236E-03</td>
<td>7.9079E-03</td>
</tr>
<tr>
<td>Eu-151</td>
<td>5151</td>
<td>4.6053E-11</td>
<td>2.3742E-12</td>
<td>2.3742E-12</td>
<td>1.2373E-13</td>
</tr>
</tbody>
</table>

Table 11: Fission product yields for Pu-239, Pu-240, Pu-241 and Pu-242
<table>
<thead>
<tr>
<th>Fission product</th>
<th>WIMS ID</th>
<th>Pu-239</th>
<th>Pu-240</th>
<th>Pu-241</th>
<th>Pu-242</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eu-153</td>
<td>4153</td>
<td>3.6428E-03</td>
<td>4.9960E-03</td>
<td>4.9960E-03</td>
<td>6.2340E-03</td>
</tr>
<tr>
<td>Eu-154</td>
<td>4154</td>
<td>2.8474E-07</td>
<td>5.0316E-08</td>
<td>5.0316E-08</td>
<td>9.1112E-09</td>
</tr>
<tr>
<td>Eu-155</td>
<td>4155</td>
<td>1.6762E-03</td>
<td>2.4149E-03</td>
<td>2.4149E-03</td>
<td>3.2771E-03</td>
</tr>
<tr>
<td>Gd-155</td>
<td>2155</td>
<td>1.7484E-09</td>
<td>3.1147E-10</td>
<td>3.1147E-10</td>
<td>2.8369E-11</td>
</tr>
<tr>
<td>Gd-156</td>
<td>2156</td>
<td>1.2545E-03</td>
<td>1.6483E-03</td>
<td>1.6483E-03</td>
<td>2.3702E-03</td>
</tr>
<tr>
<td>Gd-157</td>
<td>2157</td>
<td>7.5439E-04</td>
<td>1.2219E-03</td>
<td>1.2219E-03</td>
<td>1.6423E-03</td>
</tr>
<tr>
<td>Gd-158</td>
<td>2158</td>
<td>4.2369E-04</td>
<td>7.6414E-04</td>
<td>7.6414E-04</td>
<td>1.0975E-03</td>
</tr>
<tr>
<td>Dy-160</td>
<td>160</td>
<td>6.5772E-08</td>
<td>3.9359E-08</td>
<td>3.9359E-08</td>
<td>8.2707E-09</td>
</tr>
<tr>
<td>Dy-161</td>
<td>161</td>
<td>4.9889E-05</td>
<td>1.1102E-04</td>
<td>1.1102E-04</td>
<td>2.3740E-04</td>
</tr>
<tr>
<td>Dy-162</td>
<td>162</td>
<td>2.3352E-05</td>
<td>5.3408E-05</td>
<td>5.3408E-05</td>
<td>1.2594E-04</td>
</tr>
<tr>
<td>Dy-163</td>
<td>163</td>
<td>9.9398E-06</td>
<td>1.8389E-05</td>
<td>1.8389E-05</td>
<td>5.4107E-05</td>
</tr>
<tr>
<td>Dy-164</td>
<td>164</td>
<td>3.7916E-06</td>
<td>9.4215E-06</td>
<td>9.4215E-06</td>
<td>1.3716E-05</td>
</tr>
<tr>
<td>Ho-165</td>
<td>165</td>
<td>1.6025E-06</td>
<td>4.4949E-06</td>
<td>4.4949E-06</td>
<td>9.1246E-06</td>
</tr>
<tr>
<td>Er-166</td>
<td>2166</td>
<td>8.5972E-07</td>
<td>2.4083E-06</td>
<td>2.4083E-06</td>
<td>4.4353E-06</td>
</tr>
<tr>
<td>Er-167</td>
<td>2167</td>
<td>2.3783E-07</td>
<td>1.4052E-06</td>
<td>1.4052E-06</td>
<td>1.7658E-06</td>
</tr>
</tbody>
</table>