

**CROSS SECTIONS AND SOURCE  
SPECTRUM FOR NAGASAKI  
DOSE RECONSTRUCTION FOR  
RISK ESTIMATION**

**D. B. Simpson  
R. T. Santoro  
Y. Y. Azmy  
J. V. Pace III**



**CROSS SECTIONS AND SOURCE SPECTRUM FOR NAGASAKI DOSE  
RECONSTRUCTION FOR RISK ESTIMATION**

D. B. Simpson  
R. T. Santoro  
Y. Y. Azmy  
J. V. Pace III

Computational Physics and Engineering

Date Published: May 2001

Prepared by the  
OAK RIDGE NATIONAL LABORATORY  
Oak Ridge, TN 37831-6363  
Managed by  
UT-BATTELLE, LLC  
for the  
U.S. DEPARTMENT OF ENERGY  
under contract DE-AC05-00OR22725



## CONTENTS

<b>ABSTRACT .....</b>	<b>ix</b>
<b>1. INTRODUCTION .....</b>	<b>1</b>
<b>2. SUMMARY DESCRIPTION OF RELATED CROSS-SECTION LIBRARIES` .....</b>	<b>3</b>
<b>DABL69 .....</b>	<b>3</b>
<b>VITAMIN-E .....</b>	<b>3</b>
<b>VITAMIN-B6 .....</b>	<b>4</b>
<b>NEW LIBRARIES .....</b>	<b>4</b>
<b>3. DESCRIPTION OF NEUTRON AND PHOTON SOURCE SPECTRA .....</b>	<b>7</b>
<b>4. REFERENCES .....</b>	<b>9</b>
<b>APPENDIX A: DABL69 ABSTRACT .....</b>	<b>39</b>
<b>APPENDIX B: KAOS-LIB-V ABSTRACT .....</b>	<b>43</b>
<b>APPENDIX C: RESPONSE FUNCTIONS IN THE KAOS/LIB-V LIBRARY .....</b>	<b>47</b>
<b>APPENDIX D: VITAMIN-E ABSTRACT .....</b>	<b>53</b>
<b>APPENDIX E: VITAMIN-B6 ABSTRACT .....</b>	<b>57</b>



## LIST OF TABLES

Table 1. Energy Boundaries for Neutron Groups .....	11
Table 2. Energy Boundaries for Photon Groups .....	16
Table 3. Materials in the DABL69 Library with Standard Weighting .....	17
Table 4. Nuclides Available in VITAMIN-B6 .....	18
Table 5. List of Materials in New Libraries.....	20
Table 6. List of Materials in KAOS/LIB-V .....	32
Table 7. Neutron Source Interpolation .....	34
Table 8. Photon Source Interpolation .....	35





## LIST OF FIGURES

Figure 1. Neutron Source Spectra .....	36
Figure 2. Photon Source Spectra .....	37



## **ABSTRACT**

A new broad-group cross-section library with the DABL69 energy group structure and based on ENDF/B-VI Release 3 data has been created. This new library was prepared using the standard weighting function in the VITAMIN-B6 fine-group cross-section library. The new broad-group library was prepared as a requisite for a project in which various factors in estimated doses to surviving Nagasaki factory workers are being investigated. This report documents the procedure used in creating the new library and provides specifications and limitations of the data which determine the usefulness of the library for problem-specific applications. The published neutron and photon source terms for the Nagasaki calculations have been interpolated to the energy group structure of the new library and are also presented within this report.



# 1. INTRODUCTION

A project at ORNL to investigate the impact of various factors on estimated doses to Nagasaki factory workers is ongoing. The newer dose estimates generated in this project will be verified by comparisons between calculated and measured chromosome aberration yields for the Nagasaki factory workers. Calculations for this project are to use cross sections from the latest ENDF/B-VI<sup>1</sup> evaluation. The purpose of this report is to document the procedure that was used in creating a new broad-group cross-section library based on ENDF/B-VI, and to define the specifications needed to successfully use the library.

VITAMIN-B6<sup>2</sup> is a fine-group (199-neutron, 42-photon) library based on ENDF/B-VI Release 3. Because VITAMIN-B6 is distributed in AMPX<sup>3</sup> master library format, an infinite dilution ANISN<sup>4</sup> -format library was created as part of the task to prepare a new cross-section library. A broad-group library is also needed because of the large storage requirement for discrete ordinates calculations in two and three dimensions. Since the DABL69<sup>5</sup> broad-group (46-neutron, 23-photon) library was used in previous calculations to estimate the doses to Nagasaki factory workers, its group structure was chosen for the new broad-group library.

The VITAMIN-B6 library, rather than the ENDF/B-VI data files, was used to create the new broad-group library having the DABL69 group structure. Creation of a multigroup library may involve considerable effort to process pointwise data into multigroup form. Fine-group libraries may generally be considered general purpose because the concern for application-dependent energy weighting has been lessened as a result of the fine-group structure. The dominant uncertainty with broad-group libraries is generally with regard to the energy weighting functions used in collapsing the fine-group data into broad-group data. For a selected set of problems, judicious selection of the energy group structure can reduce the sensitivity of the computed responses to the weighting functions. Since many of the VITAMIN-B6 materials have been used and tested in other applications, greater reliability is gained by using this approach.

Like DABL69, the new broad-group library uses the KAOS/LIB-V<sup>6</sup> response functions instead of the response functions available in the AMPX master data library. At the time DABL69 was created, the KAOS<sup>7</sup> data was known to be more accurate.

Section two of this report provides summary descriptions of the DABL69, VITAMIN-E<sup>8</sup>, and VITAMIN-B6 cross-section libraries, and a description of the new broad-group library. Section three discusses the prompt neutron and photon sources produced in the DABL69 group structure for the current Nagasaki dose calculations.



## **2. SUMMARY DESCRIPTION OF RELATED CROSS-SECTION LIBRARIES**

The DABL69, VITAMIN-E, and VITAMIN-B6 cross-section libraries are distributed by the Radiation Shielding Information Computational Center (RSICC) at ORNL. Each library is packaged together with a complete set of documentation as part of the RSICC Data Library Collection (DLC). The abstract from the documentation for each DLC package is replicated in the appendices to this report.

### **DABL69**

The DABL69 energy group structure is a subset of the VITAMIN-E group structure and is tailored to air-over-ground environments. DABL69 contains 46 neutron and 23 photon energy groups. Angular distributions are approximated using a P5 Legendre expansion. As in DLC-31<sup>9</sup>, the neutron groups are tailored to allow for the major peaks and valleys in the total neutron cross sections of nitrogen, oxygen, silicon, and iron. The photon groups are tailored to allow accurate calculation of pair production, annihilation photon transport, hydrogen capture, and backscatter photon transport. In the neutron energy range between 0.2 and 1.8 MeV, additional boundaries were added to the parent DLC-31/FEWG1 group structure to give better resolution in the region where the largest fraction of the total kerma frequently occurs. Eighty materials from the DLC-113C/VITAMIN-E library that were available in October 1987 are included as a first part of the DABL69 library. The cross-section for these materials were collapsed using the AMPX code system with the VITAMIN-E weighting functions. The second part of the DABL69 library contains eight additional materials including N-14, O-16, and steel using problem-dependent weighting functions generated by an ANISN analysis of a typical problem. Source spectra and response functions useful in radiation transport applications are included in the library. Elemental kerma factors are provided for nuclides ranging from H-1 to Am-243. DABL69 is available as ASCII data for ANISN input. The kerma factor data are derived from DLC-160/KAOS-LIB-V. The DLC-130/DABL69 abstract is replicated in Appendix A. The DLC-160 abstract is replicated in Appendix B, and the DLC-160 description of the nuclear responses in KAOS-LIB-V is replicated in Appendix C.

### **VITAMIN-E**

The energy structure of VITAMIN-E contains 174 neutron and 38 photon groups and includes the 171 neutron and 36 photon groups of VITAMIN-C<sup>10</sup> as a subset. The group structure has fine detail in the energy region where cross-section minima occur for important shielding materials. The 174 neutron group data were processed with MINXI5<sup>11</sup>; the 174 neutron group interaction data and the 38 group photon production data were processed with LAPHNGAS (AMPX III); and the 38 photon group data were processed with SMUG (AMPXIII) from DLC-99/HUGO<sup>12</sup>. The ENDF/B-V special purpose dosimetry, activation, and gas production files have also been processed into the VITAMIN-E group structure using XLACS2, NITAWL, and WORM. The DLC-113/VITAMIN-E abstract is replicated in Appendix D.

## VITAMIN-B6

VITAMIN-B6 is derived from ENDF/B-VI, Release 3, nuclear data, except for the Sn data that is obtained from LENDL<sup>13</sup> and the Zirc2 data that is obtained from ENDF/B-IV. The responses and kerma factors were derived primarily from ENDF/B-VI. The ENDF data were processed with the PSR-355/NJOY94<sup>14</sup> code system and converted to the AMPX master library format with the SMILER module of PSR-315/AMPX77. The actual 199 neutron group boundaries in VITAMIN-B6 were selected from the 175 groups in VITAMIN-J<sup>15</sup> (a European library based on the VITAMIN-C and VITAMIN-E structures) and the 27 groups used in the SCALE<sup>16</sup> shielding library, with deference given to the VITAMIN-J boundaries at higher energies when the energy values are slightly different. The thermal energy range, which contains 36 neutron groups, is defined with 5.043 eV as the uppermost boundary. The photon energy group structure is based on a combination of the 42 photon groups in VITAMIN-J and the 18 groups in the SCALE shielding library. The top energy group extends to 30 MeV, which allows proper representation of high energy photons from neutron capture at high energies. Although the cross section for capture at neutron energies between 20 and 30 MeV is small, such a reaction in some materials could produce photons with energies between 20 and 30 MeV (VITAMIN-E photon groups have a maximum top energy boundary of 20 MeV). The DLC-184/VITAMIN-B6 abstract is replicated in Appendix E.

## NEW LIBRARIES

The new broad-group cross-section library created to estimate doses received by surviving Nagasaki factory workers has the DABL69 energy group structure and is based on ENDF/B-VI data. Most of the materials in DABL69 created with standard weighting were included in the new broad-group library. Ar, Sn, I-127, Cs-133, Cs-137, Gd, and Pd were not available in VITAMIN-B6 and are not in the new broad-group library. Also, data for multiple isotopes rather than the natural element are included for Cr, Fe, Nr, Cu, and Pb. The neutron and photon energy group boundaries for VITAMIN-B6, VITAMIN-E, and DABL69 are provided in Table 1 and Table 2. The list of materials in DABL69 is provided in Table 3, and the list of materials in VITAMIN-B6 is provided in Table 4. The materials in the new broad-group library are listed in Table 5. Table 6 lists the materials having response functions in KAOS/LIB-V.

The order of scattering used for both neutrons and photons is  $P_7$  for nuclides having  $Z$  less than or equal to 29 and  $P_5$  for the remainder of nuclides for both the new fine-group library in the VITAMIN-B6 group structure and the new broad-group library in the DABL69 group structure. The standard weighting spectrum in VITAMIN-B6 was used to create the new broad-group library, and consists of a Maxwellian thermal spectrum for neutron energies less than 0.125 eV, a “1/E” slowing-down spectrum for neutron energies between 0.125 eV and 820.8 keV, and a fission spectrum for neutron energies between 820.8 keV and 20 MeV. The VITAMIN-B6 standard weighting spectrum corresponds to IWT=3 in the NJOY<sup>14</sup> module GAMINR (1/E plus roll offs).

The fine-group library has 199 neutron groups and 42 photon groups. The cross-section table length



of 279 positions provides for 240 downscatters and 35 upscatters, with group 164 being the first thermal neutron group. Upscatter has not been included in the new broad-group library.



### 3. DESCRIPTION OF NEUTRON AND PHOTON SOURCE SPECTRA

The Nagasaki source term is presented in open literature<sup>17</sup>, and is repeated in Tables 7 and 8 as the “literature” values. The literature presents the source term as yield per kiloton, with an energy value corresponding to each yield/kiloton value. It is assumed that the energy value is an upper bound on an energy interval, with the next lowest given energy as the lower bound of the energy interval. It is also assumed that the yield per kiloton value, per unit energy, is constant over the energy interval.

When radiation transport analyses are performed, a source term is prepared and input to the calculation in the same group structure as the cross sections. The space- and energy- dependent source is then integrated over all energy and volume and normalized, in 1D (ANISN) and 2D (DORT)<sup>18</sup> analyses, to an input parameter. The 3D (TORT)<sup>19</sup> code employs a multiplier, so the user must choose the multiplier with care for proper normalization. Consequently, the source term prepared for the DABL69 group structure should have the same integral over energy as the source provided in the literature.

The “calculated” source terms in Tables 7 and 8 are the source terms for the DABL69 energy group structure. They were calculated by the INTERP program written by, and obtained from, Dr. Richard A. Lillie at ORNL. This program was undocumented, but work has recently been performed to expand the capabilities of this program. The option to interpolate a flux was specified, along with energy values and the reference source term values, as input. The output of this program is listed in Tables 3 and 4 as the “calculated” values.

The neutron and photon source terms are depicted in Figures 1 and 2, respectively. To compare the “literature” and “calculated” values meaningfully, the source term values were divided by the width of the energy interval prior to being plotted.



## 4. REFERENCES

1. P. F. Rose and C. L. Dunford, "Data Formats and Procedures for the Evaluated Nuclear Data File ENDF-6," BNL-NCS-44945 (ENDF 102), (July 1990).
2. J. E. White et. al., "VITAMIN-B6: A Fine-Group Cross Section Library Based on ENDF/B-VI for Radiation Transport Applications," *International Conference on Nuclear Data for Science and Technology*, Gatlinburg, TN, p. 733, American Nuclear Society, LaGrange Park, IL, (1994).
3. N. M. Greene, "AMPX-77: A Modular Code System for Generating Coupled Multigroup Neutron-Gamma Cross Section Libraries from ENDF/B-IV and/or ENDF/B-V," ORNL/CSD/TM-283.
4. W. W. Engle, Jr. et. al., "A User's Manual for ANISN - A One-Dimensional Discrete Ordinates Transport Code with Anisotropic Scattering," Oak Ridge Gaseous Diffusion Plant Report, K-1693 (1967).
5. D. T. Ingersoll et. al., "DABL69: A Broad-Group Neutron/Photon Cross-Section Library for Defense Nuclear Applications," ORNL/TM-10568, Oak Ridge National Laboratory, (1989).
6. Y. Farawila et. al., "A Library of Nuclear Response Functions Generated by KAOS-V Code from ENDF/B-V and Other Data Files," ANL/FPP/TM-241, Argonne National Laboratory, (April 1989). [Also available from RSICC as DLC-160 (KAOS/LIB-V)]
7. Y. Farawila et. al., "KAOS-V Code: An Evaluation Tool for Neutron Kerma Factors and Other Nuclear Responses," ANL/FPP/TM-240, Argonne National Laboratory, (September 1989). [Also available from RSICC as PSR-306.]
8. C. R. Weisbin, et. al., "VITAMIN-E: An ENDF/B-V Multigroup Cross Section Library for LMFBR Core and Shield, LWR Shield, Dosimetry, and Fusion Blanket Technology," ORNL-5505, (February 1979).
9. D. E. Bartine et. al., "Production and Testing of the DNA Few-Group Coupled Neutron-Gamma Cross-Section Library," ORNL/TM-4840, Oak Ridge National Laboratory, (1977).
10. R. W. Roussin et. al., "VITAMIN-C: The CTR Processed Multigroup Cross Section Library for Neutronics Studies," ORNL/RSIC-37, Oak Ridge National Laboratory, (1980). [Also available from RSICC as DLC-41/VITAMIN-C]
11. J. E. White, et al, "MINX I.5: User's Manual for the ENDF/B-V IBM Version of the

- MINX Cross Section Processing Program,” unpublished.
12. R. W. Roussin et. al., “Description of the DLC-99/HUGO Package of Photon Interaction Data in ENDF/B-V Format,” ORNL/RSIC-46 (ENDF-335), (December 1983).
  13. R. J. Howerton, D. C. Cullen, M. H. MacGregor, S. T. Perkins, and E. F. Plechaty, "The LLL Evaluated-Nuclear-Data-Library (ENDL): Graphs of Cross Sections from the Library," UCRL-50400, Vol. 15 (October 1978). [Also available from RSICC as DLC-034 (LENDL)]
  14. R. E. MacFarlane et. al., “NJOY94.10: Code System for Producing Pointwise and Multigroup Neutron and Photon Cross Sections from ENDF/B Data,” RSIC Computer Code Collection, PSR-355, (August 1995).
  15. E. Sartori, “VITAMIN-J, A 175 Group Neutron Cross Section Library based on JEF-1 for Shielding Benchmark Calculations,” JEF/DOC-100, (1985).
  16. Oak Ridge National Laboratory, “SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation,” NUREG/CR-200, Revision 4 (ORNL/NUREG/CSD-2/R4), Vols. I, II, and III, (April 1995).
  17. William C. Roesch, Ed., “Reassessment of Atomic Bomb Radiation Dosimetry in Hiroshima and Nagasaki,” The Radiation Effects Research Foundation, Japan (1987).
  18. W. A. Rhoades and R. L. Childs, “DORT: A Two-Dimensional Discrete Ordinates Transport Code,” in *A User’s Manual for MASH v2.0 - A Monte Carlo Adjoint Shielding Code System*, J. O. Johnson, Ed., ORNL/TM-11788/R2, Oak Ridge National Laboratory, (May 1999).
  19. W. A. Rhoades et. al., “The TORT Three-Dimensional Discrete Ordinates Neutron/Photon Transport Code (TORT Version 3),” ORNL/TM-13221, (October 1977).

**Table 1. Energy Boundaries for Neutron Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL69
1.9640e+7	1	1	1
1.7332e+7	2	2	
1.6905e+7	3	3	2
1.6487e+7	4	4	
1.5683e+7	5	5	
1.4918e+7	6	6	3
1.4550e+7	7	7	
1.4191e+7	8	8	4
1.3840e+7	9	9	5
1.3499e+7	10	10	
1.2840e+7	11		
1.2523e+7	12	11	6
1.2214e+7	13	12	7
1.1618e+7	14	13	
1.1052e+7	15	14	8
1.0513e+7	16	15	
1.0000e+7	17	16	9
9.5123e+6	18	17	
9.0484e+6	19	18	10
8.6071e+6	20	19	
8.1873e+6	21	20	11
7.7880e+6	22	21	
7.4082e+6	23	22	12
7.0469e+6	24	23	
6.7032e+6	25	24	
6.5924e+6	26	25	
6.3763e+6	27	26	13
6.0653e+6	28	27	
5.7695e+6	29	28	
5.4881e+6	30	29	
5.2295e+6	31	30	
4.9659e+6	32	31	14
4.7237e+6	33	32	15
4.4933e+6	34	33	
4.0657e+6	35	34	16
3.6788e+6	36	35	
3.3287e+6	37	36	
3.1664e+6	38	37	
3.0119e+6	39	38	17
2.8651e+6	40	39	
2.7253e+6	41	40	

**Table 1. Energy Boundaries for Neutron Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL69
2.5924e+6	42	41	
2.4660e+6	43	42	
2.3852e+6	44	43	18
2.3653e+6	45	44	
2.3457e+6	46	45	
2.3069e+6	47	46	19
2.2313e+6	48	47	
2.1225e+6	49	48	
2.0190e+6	50	49	
1.9205e+6	51	50	
1.8268e+6	52	51	20
1.7377e+6	53	52	
1.6530e+6	54	53	
1.5724e+6	55	54	
1.4957e+6	56	55	
1.4227e+6	57	56	21
1.3534e+6	58	57	
1.2874e+6	59	58	
1.2246e+6	60	59	
1.1648e+6	61	60	
1.1080e+6	62	61	22
1.0026e+6	63	62	
9.6164e+5	64	63	23
9.0718e+5	65	64	
8.6294e+5	66	65	
8.2085e+5	67	66	24
7.8082e+5	68	67	
7.4274e+5	69	68	25
7.0651e+5	70	69	
6.7206e+5	71	70	
6.3928e+5	72	71	26
6.0810e+5	73	72	
5.7844e+5	74	73	
5.5023e+5	75	74	27
5.2340e+5	76	75	
4.9787e+5	77	76	
4.5049e+5	78	77	
4.0762e+5	79	78	
3.8774e+5	80	79	
3.6883e+5	81	80	28
3.3373e+5	82	81	
3.0197e+5	83	82	
2.9849e+5	84	83	



**Table 1. Energy Boundaries for Neutron Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL69
2.9721e+5	85	84	
2.9452e+5	86	85	
2.8725e+5	87	86	
2.7324e+5	88	87	
2.4724e+5	89	88	29
2.3518e+5	90	89	
2.2371e+5	91	90	
2.1280e+5	92	91	
2.0242e+5	93	92	
1.9255e+5	94	93	
1.8316e+5	95	94	
1.7422e+5	96	95	
1.6573e+5	97	96	
1.5764e+5	98	97	30
1.4996e+5	99	98	
1.4264e+5	100	99	
1.3569e+5	101	100	
1.2907e+5	102	101	
1.2277e+5	103	102	
1.1679e+5	104	103	
1.1109e+5	105	104	31
9.8037e+4	106	105	
8.6517e+4	107	106	
8.2503e+4	108	107	
7.9499e+4	109	108	
7.1998e+4	110	109	
6.7379e+4	111	110	
5.6562e+4	112	111	
5.2475e+4	113	112	32
4.6309e+4	114	113	
4.0868e+4	115	114	
3.4307e+4	116	115	33
3.1828e+4	117	116	
2.8501e+4	118	117	
2.7000e+4	119	118	
2.6058e+4	120	119	
2.4788e+4	121	120	34
2.4176e+4	122	121	
2.3579e+4	123	122	
2.1875e+4	124	123	35
1.9305e+4	125	124	
1.5034e+4	126	125	
1.1709e+4	127	126	

**Table 1. Energy Boundaries for Neutron Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL69
1.0595e+4	128	127	36
9.1188e+3	129	128	
7.1017e+3	130	129	
5.5308e+3	131	130	
4.3074e+3	132	131	
3.7074e+3	133	132	
3.3546e+3	134	133	37
3.0354e+3	135	134	
2.7465e+3	136	135	
2.6126e+3	137	136	
2.4852e+3	138	137	
2.2487e+3	139	138	
2.0347e+3	140	139	
1.5846e+3	141	140	
1.2341e+3	142	141	38
9.6112e+2	143	142	
7.4852e+2	144	143	
5.8295e+2	145	144	39
4.5400e+2	146	145	
3.5357e+2	147	146	
2.7536e+2	148	147	40
2.1445e+2	149	148	
1.6702e+2	150	149	
1.3007e+2	151	150	
1.0130e+2	152	151	41
7.8893e+1	153	152	
6.1442e+1	154	153	
4.7851e+1	155	154	
3.7266e+1	156	155	
2.9023e+1	157	156	42
2.2603e+1	158	157	
1.7604e+1	159	158	
1.3710e+1	160	159	
1.0677e+1	161	160	43
8.3153e+0	162	161	
6.4760e+0	163	162	
5.0435e+0	164	163	
3.9279e+0	165	164	
3.0590e+0	166	165	44
2.3824e+0	167	166	
1.8554e+0	168	167	
1.4450e+0	169	168	
1.3000e+0	170		

**Table 1. Energy Boundaries for Neutron Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL69
1.1253e+0	171	169	45
1.0800e+0	172		
1.0400e+0	173		
1.0000e+0	174		
8.7643e-1	175	170	
8.0000e-1	176		
6.8256e-1	177	171	
6.2506e-1	178		
5.3158e-1	179	172	
5.0000e-1	180		
4.1399e-1	181	173	46
3.6680e-1	182		
3.2500e-1	183		
2.7500e-1	184		
2.2500e-1	185		
1.8400e-1	186		
1.5000e-1	187		
1.2500e-1	188		
1.0000e-1	189	174	
7.0000e-2	190		
5.0000e-2	191		
4.0000e-2	192		
3.0000e-2	193		
2.1000e-2	194		
1.4500e-2	195		
1.0000e-2	196		
5.0000e-3	197		
2.0000e-3	198		
5.0000e-4	199		
1.0000e-5			

**Table 2. Energy Boundaries for Photon Groups**

Upper Energy (eV)	Group Number		
	VITAMIN-B6	VITAMIN-E	DABL-69
3.00+7	1		
2.00+7	2	1	1
1.40+7	3	2	2
1.20+7	4	3	3
1.00+7	5	4	4
8.00+6	6	5	5
7.50+6	7	6	
7.00+6	8	7	6
6.50+6	9	8	
6.00+6	10	9	7
5.50+6	11	10	
5.00+6	12	11	8
4.50+6	13	12	
4.00+6	14	13	9
3.50+6	15	14	
3.00+6	16	15	10
2.50+6	17	16	11
2.00+6	18	17	12
1.66+6	19	18	
1.50+6	20	19	13
1.34+6	21		
1.33+6	22	20	
1.00+6	23	21	14
8.00+5	24	22	
7.00+5	25	23	15
6.00+5	26	24	
5.12+5	27	25	
5.10+5	28	26	
4.50+5	29	27	16
4.00+5	30	28	
3.00+5	31	29	17
2.00+5	32	30	
1.50+5	33	31	18
1.00+5	34	32	19
7.50+4	35	33	
7.00+4	36	34	20
6.00+4	37	35	
4.50+4	38	36	21
4.00+4	39		
3.00+4	40	37	22
2.00+4	41	38	23
1.00+4	42		
1.00+3			

**TABLE 3. Materials in the DABL69 Library with Standard Weighting**

<b>Material</b>	<b>ID (AMPX)</b>	<b>ID (ANISN)</b>	<b>Material</b>	<b>ID (AMPX)</b>	<b>ID (ANISN)</b>
H-1	930101	1-6	Cs-137	966901	241-246
H-2	930202	7-12	Ba-138	135301	247-252
H-3	116901	13-18	Gd	8853	253-258
He-4	127000	19-24	Hf-174	137401	259-264
Li-6	130301	25-30	Hf-176	137601	265-270
Li-7	139701	31-36	Hf-177	137701	271-276
Be-9	104	37-42	Hf-178	137801	277-282
B-10	130501	43-48	Hf-179	138301	283-288
B-11	8811	49-54	Hf-180	138401	289-294
C	130601	55-60	Ta-181	128502	295-300
N-14	127501	61-66	W-182	182	301-306
O-16	127601	67-72	W-183	183	307-312
F-19	130902	73-78	W-184	184	313-318
Na-23	131101	79-84	W-186	186	319-324
Mg	131201	85-90	Re-185	108301	325-330
Al-27	131301	91-96	Re-187	108401	331-336
Si	131401	97-102	Pt	8860	337-342
P-31	131501	103-108	Au-197	8861	343-348
S	134701	109-114	Pb	138202	349-354
Cl	114901	115-120	Bi-209	137501	355-360
Ar	8824	121-126	Th-232	139001	361-366
K	115001	127-132	Pa-233	139101	367-372
Ca	132003	133-138	U-233	139301	373-378
Ti	132201	139-144	U-234	9394	379-384
V	132301	145-150	U-235	139501	385-390
Cr	132401	151-156	U-236	139601	391-396
Mn-55	132502	157-162	U-238	139801	397-402
Fe	923604	163-168	Np-237	133701	403-408
Co-59	132703	169-174	Pu-238	133801	409-414
Ni	132802	175-180	Pu-239	139901	415-420
Cu	132901	181-186	Pu-240	138001	421-426
Ga	135801	187-192	Pu-241	138101	427-432
Y-89	920201	193-198	Pu-242	134201	433-438
Zr	8841	199-204	Am-241	136101	439-444
Nb-93	118901	205-210	Am-242	854201	445-450
Mo	132101	211-216	Am-242m	136901	451-456
Cd	8847	217-222	Am-243	136301	457-462
Sn	8850	223-228	Cm-242	864201	463-468
I-127	960601	229-234	Cm-243	134301	469-474
Cs-133	135501	235-240	Cm-244	134401	475-480

**Table 4. Nuclides Available in VITAMIN-B6**

<b>Entry</b>	<b>Identifier</b>	<b>Nuclide</b>	<b>Entry</b>	<b>Identifier</b>	<b>Nuclide</b>
1	47107	ag107	61	3007	li7
2	47109	ag109	62	12000	mg
3	13027	al27	63	25055	mn55
4	95241	am241	64	42000	mo
5	95242	am242	65	7014	n14
6	95601	am242m	66	7015	n15
7	95243	am243	67	11023	na23
8	79197	au197	68	41093	nb93
9	5010	b10	69	28058	ni58
10	5011	b11	70	28060	ni60
11	56138	ba138	71	28061	ni61
12	4009	be9	72	28062	ni62
13	4309	be9(th)	73	28064	ni64
14	83209	bi209	74	93237	np237
15	6012	c	75	93238	np238
16	6312	c (gph)	76	93239	np239
17	20000	ca	77	8016	o16
18	48000	cd(nat)	78	8017	o17
19	17000	cl(nat)	79	15031	p31
20	96241	cm241	80	91231	pa231
21	96242	cm242	81	91233	pa233
22	96243	cm243	82	82206	pb206
23	96244	cm244	83	82207	pb207
24	96245	cm245	84	82208	pb208
25	96246	cm246	85	94236	pu236
26	96247	cm247	86	94237	pu237
27	96248	cm248	87	94238	pu238
28	27059	co59	88	94239	pu239
29	24050	cr50	89	94240	pu240
30	24052	cr52	90	94241	pu241
31	24053	cr53	91	94242	pu242
32	24054	cr54	92	94243	pu243
33	29063	cu63	93	94244	pu244
34	29065	cu65	94	75185	re185
36	63152	eu152	96	16000	s
37	63153	eu153	97	16032	s32
38	63154	eu154	98	14000	si

**Table 4. Continued**

<b>Entry</b>	<b>Identifier</b>	<b>Nuclide</b>	<b>Entry</b>	<b>Identifier</b>	<b>Nuclide</b>
39	63155	eu155	99	50000	sn(nat)
40	9019	fl9	100	73181	ta181
41	26054	fe54	101	73182	ta182
42	26056	fe56	102	90230	th230
43	26057	fe57	103	90232	th232
44	26058	fe58	104	22000	ti
45	31000	ga	105	92232	u232
46	1001	hl(h2o)	106	92233	u233
47	1901	h1(ch2)	107	92234	u234
48	1002	h2(d2o)	108	92235	u235
49	1003	h3	109	92236	u236
50	2003	he3	110	92237	u237
51	2004	he4	111	92238	u238
52	72174	hfl74	112	23000	v
53	72176	hfl76	113	74000	w(nat)
54	72177	hfl77	114	74182	w182
55	72178	hfl78	115	74183	w183
56	72179	hfl79	116	74184	w184
57	72180	hfl80	117	74186	w186
58	49000	in(nat)	118	39089	y89
59	19000	k	119	40000	zr
60	3006	li6	120	40302	zirc2

**Table 5. List of Materials in New Libraries**

ANISN ID	NUCLIDE	DESCRIPTION						
1	p0 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
2	p1 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
3	p2 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
4	p3 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
5	p4 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
6	p5 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
7	p6 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
8	p7 data for	al27	v94.10	standard	wgt	e611325vb60003092095	ampx id	13027
9	p0 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
10	p1 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
11	p2 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
12	p3 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
13	p4 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
14	p5 data for	am241	v94.10	standard	wgt	e639543vb60003011896	ampx id	95241
15	p0 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
16	p1 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
17	p2 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
18	p3 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
19	p4 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
20	p5 data for	am242	v91.94	standard	wgt	e629546vb60003030195	ampx id	95242
21	p0 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
22	p1 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
23	p2 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
24	p3 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
25	p4 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
26	p5 data for	am242m	v91.94	standard	wgt	e629547vb60003030195	ampx id	95601
27	p0 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
28	p1 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
29	p2 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
30	p3 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
31	p4 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
32	p5 data for	am243	v91.94	standard	wgt	e619549vb60003030195	ampx id	95243
33	p0 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
34	p1 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
35	p2 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
36	p3 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
37	p4 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
38	p5 data for	au197	v91.94	standard	wgt	e627925vb60003030195	ampx id	79197
39	p0 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
40	p1 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
41	p2 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
42	p3 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
43	p4 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
44	p5 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
45	p6 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
46	p7 data for	b10	v91.94	standard	wgt	e620525vb60003030195	ampx id	5010
47	p0 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011
48	p1 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011
49	p2 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011
50	p3 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011
51	p4 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011
52	p5 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx id	5011



Table 5. Continued

53	p6 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx	id	5011
54	p7 data for	b11	v91.94	standard	wgt	e610528vb60003030195	ampx	id	5011
55	p0 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
56	p1 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
57	p2 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
58	p3 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
59	p4 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
60	p5 data for	ba138	v94.10	standard	wgt	e625649vb60003092095	ampx	id	56138
61	p0 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
62	p1 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
63	p2 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
64	p3 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
65	p4 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
66	p5 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
67	p6 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
68	p7 data for	be9	v91.94	standard	wgt	e610425vb60003030195	ampx	id	4009
69	p0 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
70	p1 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
71	p2 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
72	p3 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
73	p4 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
74	p5 data for	bi209	v91.94	standard	wgt	e618325vb60003030195	ampx	id	83209
75	p0 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
76	p1 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
77	p2 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
78	p3 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
79	p4 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
80	p5 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
81	p6 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
82	p7 data for	c	v91.94	standard	wgt	e620600vb60003030195	ampx	id	6012
83	p0 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
84	p1 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
85	p2 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
86	p3 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
87	p4 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
88	p5 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
89	p6 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
90	p7 data for	c (gph)	v91.94	standard	wgt	e620631vb60003030195	ampx	id	6312
91	p0 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
92	p1 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
93	p2 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
94	p3 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
95	p4 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
96	p5 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
97	p6 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
98	p7 data for	ca	v91.94	standard	wgt	e602000vb60003030195	ampx	id	20000
99	p0 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
100	p1 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
101	p2 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
102	p3 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
103	p4 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
104	p5 data for	cd(nat)	v91.94	standard	wgt	e604800vb60003030195	ampx	id	48000
105	p0 data for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
106	p1 data for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000

**Table 5. Continued**

107	p2	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
108	p3	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
109	p4	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
110	p5	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
111	p6	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
112	p7	data	for	cl(nat)	v91.94	standard	wgt	e601700vb60003030195	ampx	id	17000
113	p0	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
114	p1	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
115	p2	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
116	p3	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
117	p4	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
118	p5	data	for	cm242	v91.94	standard	wgt	e619631vb60003030195	ampx	id	96242
119	p0	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
120	p1	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
121	p2	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
122	p3	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
123	p4	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
124	p5	data	for	cm243	v91.94	standard	wgt	e609634vb60003030195	ampx	id	96243
125	p0	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
126	p1	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
127	p2	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
128	p3	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
129	p4	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
130	p5	data	for	cm244	v91.94	standard	wgt	e609637vb60003030195	ampx	id	96244
131	p0	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
132	p1	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
133	p2	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
134	p3	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
135	p4	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
136	p5	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
137	p6	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
138	p7	data	for	cr50	v91.94	standard	wgt	e622425vb60003030195	ampx	id	24050
139	p0	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
140	p1	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
141	p2	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
142	p3	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
143	p4	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
144	p5	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
145	p6	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
146	p7	data	for	cr52	v91.94	standard	wgt	e622431vb60003030195	ampx	id	24052
147	p0	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
148	p1	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
149	p2	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
150	p3	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
151	p4	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
152	p5	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
153	p6	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
154	p7	data	for	cr53	v91.94	standard	wgt	e622434vb60003030195	ampx	id	24053
155	p0	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
156	p1	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
157	p2	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
158	p3	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
159	p4	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
160	p5	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054

Table 5. Continued

161	p6	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
162	p7	data	for	cr54	v91.94	standard	wgt	e622437vb60003030195	ampx	id	24054
163	p0	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
164	p1	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
165	p2	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
166	p3	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
167	p4	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
168	p5	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
169	p6	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
170	p7	data	for	cu63	v91.94	standard	wgt	e632925vb60003030195	ampx	id	29063
171	p0	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
172	p1	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
173	p2	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
174	p3	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
175	p4	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
176	p5	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
177	p6	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
178	p7	data	for	cu65	v91.94	standard	wgt	e632931vb60003030195	ampx	id	29065
179	p0	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
180	p1	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
181	p2	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
182	p3	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
183	p4	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
184	p5	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
185	p6	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
186	p7	data	for	f19	v91.94	standard	wgt	e610925vb60003030195	ampx	id	9019
187	p0	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
188	p1	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
189	p2	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
190	p3	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
191	p4	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
192	p5	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
193	p6	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
194	p7	data	for	fe54	v91.94	standard	wgt	e622625vb60003030195	ampx	id	26054
195	p0	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
196	p1	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
197	p2	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
198	p3	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
199	p4	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
200	p5	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
201	p6	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
202	p7	data	for	fe56	v91.94	standard	wgt	e622631vb60003030195	ampx	id	26056
203	p0	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
204	p1	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
205	p2	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
206	p3	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
207	p4	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
208	p5	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
209	p6	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
210	p7	data	for	fe57	v91.94	standard	wgt	e622634vb60003030195	ampx	id	26057
211	p0	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
212	p1	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
213	p2	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
214	p3	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058

Table 5. Continued

215	p4	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
216	p5	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
217	p6	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
218	p7	data	for	fe58	v91.94	standard	wgt	e622637vb60003030195	ampx	id	26058
219	p0	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
220	p1	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
221	p2	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
222	p3	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
223	p4	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
224	p5	data	for	ga	v91.94	standard	wgt	e603100vb60003030195	ampx	id	31000
225	p0	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
226	p1	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
227	p2	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
228	p3	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
229	p4	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
230	p5	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
231	p6	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
232	p7	data	for	h1(h2o)	v91.94	standard	wgt	e620125vb60003030195	ampx	id	1001
233	p0	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
234	p1	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
235	p2	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
236	p3	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
237	p4	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
238	p5	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
239	p6	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
240	p7	data	for	h1(ch2)	v91.94	standard	wgt	e620137vb60003030195	ampx	id	1901
241	p0	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
242	p1	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
243	p2	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
244	p3	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
245	p4	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
246	p5	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
247	p6	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
248	p7	data	for	h2(d2o)	v94.10	standard	wgt	e620128vb60003092095	ampx	id	1002
249	p0	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
250	p1	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
251	p2	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
252	p3	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
253	p4	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
254	p5	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
255	p6	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
256	p7	data	for	h3	v91.94	standard	wgt	e600131vb60003030195	ampx	id	1003
257	p0	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
258	p1	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
259	p2	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
260	p3	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
261	p4	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
262	p5	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
263	p6	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
264	p7	data	for	he4	v91.94	standard	wgt	e600228vb60003030195	ampx	id	2004
265	p0	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174
266	p1	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174
267	p2	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174
268	p3	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174

Table 5. Continued

269	p4	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174
270	p5	data	for	hf174	v91.94	standard	wgt	e627225vb60003030195	ampx	id	72174
271	p0	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
272	p1	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
273	p2	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
274	p3	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
275	p4	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
276	p5	data	for	hf176	v91.94	standard	wgt	e627231vb60003030195	ampx	id	72176
277	p0	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
278	p1	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
279	p2	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
280	p3	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
281	p4	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
282	p5	data	for	hf177	v91.94	standard	wgt	e627234vb60003030195	ampx	id	72177
283	p0	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
284	p1	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
285	p2	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
286	p3	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
287	p4	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
288	p5	data	for	hf178	v91.94	standard	wgt	e627237vb60003030195	ampx	id	72178
289	p0	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
290	p1	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
291	p2	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
292	p3	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
293	p4	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
294	p5	data	for	hf179	v91.94	standard	wgt	e627240vb60003030195	ampx	id	72179
295	p0	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
296	p1	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
297	p2	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
298	p3	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
299	p4	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
300	p5	data	for	hf180	v91.94	standard	wgt	e627243vb60003030195	ampx	id	72180
301	p0	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
302	p1	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
303	p2	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
304	p3	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
305	p4	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
306	p5	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
307	p6	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
308	p7	data	for	k	v91.94	standard	wgt	e601900vb60003030195	ampx	id	19000
309	p0	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
310	p1	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
311	p2	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
312	p3	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
313	p4	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
314	p5	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
315	p6	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
316	p7	data	for	li6	v91.94	standard	wgt	e620325vb60003030195	ampx	id	3006
317	p0	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
318	p1	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
319	p2	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
320	p3	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
321	p4	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
322	p5	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007

Table 5. Continued

323	p6	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
324	p7	data	for	li7	v91.94	standard	wgt	e610328vb60003030195	ampx	id	3007
325	p0	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
326	p1	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
327	p2	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
328	p3	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
329	p4	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
330	p5	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
331	p6	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
332	p7	data	for	mg	v91.94	standard	wgt	e601200vb60003030195	ampx	id	12000
333	p0	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
334	p1	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
335	p2	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
336	p3	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
337	p4	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
338	p5	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
339	p6	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
340	p7	data	for	mn55	v91.94	standard	wgt	e612525vb60003030195	ampx	id	25055
341	p0	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
342	p1	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
343	p2	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
344	p3	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
345	p4	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
346	p5	data	for	mo	v91.94	standard	wgt	e604200vb60003030195	ampx	id	42000
347	p0	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
348	p1	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
349	p2	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
350	p3	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
351	p4	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
352	p5	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
353	p6	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
354	p7	data	for	n14	v94.10	standard	wgt	e630725vb60003092095	ampx	id	7014
355	p0	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
356	p1	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
357	p2	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
358	p3	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
359	p4	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
360	p5	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
361	p6	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
362	p7	data	for	na23	v91.94	standard	wgt	e621125vb60003030195	ampx	id	11023
363	p0	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
364	p1	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
365	p2	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
366	p3	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
367	p4	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
368	p5	data	for	nb93	v91.94	standard	wgt	e624125vb60003030195	ampx	id	41093
369	p0	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
370	p1	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
371	p2	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
372	p3	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
373	p4	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
374	p5	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
375	p6	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058
376	p7	data	for	ni58	v91.94	standard	wgt	e622825vb60003030195	ampx	id	28058

Table 5. Continued

377	p0	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
378	p1	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
379	p2	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
380	p3	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
381	p4	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
382	p5	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
383	p6	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
384	p7	data	for	ni60	v91.94	standard	wgt	e622831vb60003030195	ampx	id	28060
385	p0	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
386	p1	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
387	p2	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
388	p3	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
389	p4	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
390	p5	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
391	p6	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
392	p7	data	for	ni61	v91.94	standard	wgt	e622834vb60003030195	ampx	id	28061
393	p0	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
394	p1	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
395	p2	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
396	p3	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
397	p4	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
398	p5	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
399	p6	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
400	p7	data	for	ni62	v91.94	standard	wgt	e622837vb60003030195	ampx	id	28062
401	p0	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
402	p1	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
403	p2	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
404	p3	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
405	p4	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
406	p5	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
407	p6	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
408	p7	data	for	ni64	v91.94	standard	wgt	e622843vb60003030195	ampx	id	28064
409	p0	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
410	p1	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
411	p2	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
412	p3	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
413	p4	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
414	p5	data	for	np237	v91.94	standard	wgt	e629346vb60003030195	ampx	id	93237
415	p0	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
416	p1	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
417	p2	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
418	p3	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
419	p4	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
420	p5	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
421	p6	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
422	p7	data	for	o16	v91.94	standard	wgt	e610825vb60003030195	ampx	id	8016
423	p0	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
424	p1	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
425	p2	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
426	p3	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
427	p4	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
428	p5	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
429	p6	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031
430	p7	data	for	p31	v91.94	standard	wgt	e601525vb60003030195	ampx	id	15031

Table 5. Continued

431	p0	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
432	p1	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
433	p2	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
434	p3	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
435	p4	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
436	p5	data	for	pa233	v91.94	standard	wgt	e609137vb60003030195	ampx	id	91233
437	p0	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
438	p1	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
439	p2	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
440	p3	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
441	p4	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
442	p5	data	for	pb206	v91.94	standard	wgt	e618231vb60003030195	ampx	id	82206
443	p0	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
444	p1	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
445	p2	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
446	p3	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
447	p4	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
448	p5	data	for	pb207	v91.94	standard	wgt	e628234vb60003030195	ampx	id	82207
449	p0	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
450	p1	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
451	p2	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
452	p3	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
453	p4	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
454	p5	data	for	pb208	v91.94	standard	wgt	e618237vb60003030195	ampx	id	82208
455	p0	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
456	p1	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
457	p2	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
458	p3	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
459	p4	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
460	p5	data	for	pu238	v91.94	standard	wgt	e619434vb60003030195	ampx	id	94238
461	p0	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
462	p1	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
463	p2	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
464	p3	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
465	p4	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
466	p5	data	for	pu239	v91.94	standard	wgt	e629437vb60003030195	ampx	id	94239
467	p0	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
468	p1	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
469	p2	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
470	p3	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
471	p4	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
472	p5	data	for	pu240	v91.94	standard	wgt	e639440vb60003030195	ampx	id	94240
473	p0	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
474	p1	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
475	p2	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
476	p3	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
477	p4	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
478	p5	data	for	pu241	v94.10	standard	wgt	e639443vb60003092095	ampx	id	94241
479	p0	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242
480	p1	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242
481	p2	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242
482	p3	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242
483	p4	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242
484	p5	data	for	pu242	v91.94	standard	wgt	e619446vb60003030195	ampx	id	94242



Table 5. Continued

485	p0	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
486	p1	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
487	p2	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
488	p3	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
489	p4	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
490	p5	data for	re185	v91.94	standard	wgt	e617525vb60003030195	ampx	id	75185
491	p0	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
492	p1	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
493	p2	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
494	p3	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
495	p4	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
496	p5	data for	re187	v91.94	standard	wgt	e617531vb60003030195	ampx	id	75187
497	p0	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
498	p1	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
499	p2	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
500	p3	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
501	p4	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
502	p5	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
503	p6	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
504	p7	data for	s	v91.94	standard	wgt	e601600vb60003030195	ampx	id	16000
505	p0	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
506	p1	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
507	p2	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
508	p3	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
509	p4	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
510	p5	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
511	p6	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
512	p7	data for	si	v91.94	standard	wgt	e601400vb60003030195	ampx	id	14000
513	p0	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
514	p1	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
515	p2	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
516	p3	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
517	p4	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
518	p5	data for	sn(nat)	v91.94	standard	wgt	1007850vb60003030195	ampx	id	50000
519	p0	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
520	p1	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
521	p2	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
522	p3	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
523	p4	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
524	p5	data for	ta181	v91.94	standard	wgt	e607328vb60003030195	ampx	id	73181
525	p0	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
526	p1	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
527	p2	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
528	p3	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
529	p4	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
530	p5	data for	th232	v91.94	standard	wgt	e619040vb60003030195	ampx	id	90232
531	p0	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
532	p1	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
533	p2	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
534	p3	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
535	p4	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
536	p5	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
537	p6	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000
538	p7	data for	ti	v91.94	standard	wgt	e602200vb60003030195	ampx	id	22000

Table 5. Continued

539	p0	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
540	p1	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
541	p2	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
542	p3	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
543	p4	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
544	p5	data	for	u233	v91.94	standard	wgt	e619222vb60003030195	ampx	id	92233
545	p0	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
546	p1	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
547	p2	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
548	p3	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
549	p4	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
550	p5	data	for	u234	v91.94	standard	wgt	e619225vb60003030195	ampx	id	92234
551	p0	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
552	p1	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
553	p2	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
554	p3	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
555	p4	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
556	p5	data	for	u235	v94.10	standard	wgt	e649228vb60003092095	ampx	id	92235
557	p0	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
558	p1	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
559	p2	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
560	p3	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
561	p4	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
562	p5	data	for	u236	v91.94	standard	wgt	e619231vb60003030195	ampx	id	92236
563	p0	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
564	p1	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
565	p2	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
566	p3	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
567	p4	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
568	p5	data	for	u238	v91.94	standard	wgt	e639237vb60003030195	ampx	id	92238
569	p0	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
570	p1	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
571	p2	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
572	p3	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
573	p4	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
574	p5	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
575	p6	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
576	p7	data	for	v	v91.94	standard	wgt	e612300vb60003030195	ampx	id	23000
577	p0	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
578	p1	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
579	p2	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
580	p3	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
581	p4	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
582	p5	data	for	w182	v91.94	standard	wgt	e607431vb60003030195	ampx	id	74182
583	p0	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
584	p1	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
585	p2	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
586	p3	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
587	p4	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
588	p5	data	for	w183	v91.94	standard	wgt	e607434vb60003030195	ampx	id	74183
589	p0	data	for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184
590	p1	data	for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184
591	p2	data	for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184
592	p3	data	for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184

**Table 5. Continued**

593	p4 data for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184
594	p5 data for	w184	v91.94	standard	wgt	e607437vb60003030195	ampx	id	74184
595	p0 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
596	p1 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
597	p2 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
598	p3 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
599	p4 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
600	p5 data for	w186	v91.94	standard	wgt	e607443vb60003030195	ampx	id	74186
601	p0 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
602	p1 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
603	p2 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
604	p3 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
605	p4 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
606	p5 data for	y89	v91.94	standard	wgt	e613925vb60003030195	ampx	id	39089
607	p0 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000
608	p1 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000
609	p2 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000
610	p3 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000
611	p4 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000
612	p5 data for	zr	v91.94	standard	wgt	e624000vb60003030195	ampx	id	40000

**Table 6. List of Materials in KAOS/LIB-V**

<b>No.</b>	<b>Material Name</b>	<b>ENDF/B-V MAT number</b>	<b>KAOS/LIB-V Symbol</b>
1	Hydrogen	1301	h-1
2	Deuterium	1302	h-2
3	Helium	1270	he-4
4	Lithium-6	1303	li-6
5	Lithium-7	1397	li-7
6	Beryllium	1304	be-9
7	Boron-10	1305	b-10
8	Boron-11	1160	b-11
9	Carbon	1306	c-12
10	Nitrogen	1275	n-14
11	Oxygen	1276	o-16
12	Fluorine	1309	f-19
13	Sodium	1311	na-23
14	Magnesium	1312	mg-nat
15	Aluminum	1313	al-27
16	Silicon	1314	si-nat
17	Phosphorus	1315	p-31
18	Sulfur	1347	s-nat
19	Chlorine	1149	cl-nat
20	Potassium	1150	k-nat
21	Calcium	1320	ca-nat
22	Titanium	1322	ti-nat
23	Vanadium	1323	v-nat
24	Chromium	1324	cr-nat
25	Manganese	1325	mn-55
26	Iron	1326	fe-nat
27	Cobalt	1327	co-59
28	Nickel	1328	ni-nat
29	Copper	1329	cu-nat
30	Zirconium-90	1385	zr-90
31	Zirconium-91	1386	zr-91
32	Zirconium-92	1387	zr-92
33	Zirconium-94	1388	zr-94
34	Zirconium-96	1389	zr-96

**Table 6. List of Materials in KAOS/LIB-V (cont.)**

<b>No.</b>	<b>Material Name</b>	<b>ENDF/B-V MAT number</b>	<b>KAOS/LIB-V Symbol</b>
35	Niobium	1189	nb-93
36	Molybdenum	1321	mo-nat
37	Hafnium-174	1374	hf-174
38	Hafnium-176	1376	hf-176
39	Hafnium-177	1377	hf-177
40	Hafnium-178	1378	hf-178
41	Hafnium-179	1383	hf-179
42	Hafnium-180	1384	hf-180
43	Tantalum	1285	ta-181
44	Tungsten-182	1475	w-182
45	Tungsten-183	1476	w-183
46	Tungsten-184	1477	w-184
47	Tungsten-186	1478	w-186
48	Lead	1382	pb-nat
49	Bismuth	1375	bi-209
50	Thorium-232	1390	th-232
51	Protactinium-233	1391	pa-233
52	Uranium-233	1393	u-233
53	Uranium-234	1394	u-234
54	Uranium-235	1395	u-235
55	Uranium-236	1396	u-236
56	Uranium-238	1398	u-238
57	Neptunium-237	1337	np-237
58	Plutonium-238	1338	pu-238
59	Plutonium-239	1399	pu-239
60	Plutonium-240	1380	pu-240
61	Plutonium-241	1381	pu-241
62	Plutonium-242	1342	pu-242
63	Americium-241	1361	am-241
64	Americium-243	1363	am-243

**Table 7. Neutron Source Interpolation**

Calculated			Literature	
Group	Energy(eV)	Yield per kiloton	Energy(eV)	Yield per kiloton
1	1.96e+07			
2	1.69e+07	6.97e-08	1.60e+07	9.66e-08
3	1.49e+07	1.16e-07	1.45e+07	1.44e-07
4	1.42e+07	6.67e-08	1.40e+07	3.65e-08
5	1.38e+07	7.54e-07	1.35e+07	4.97e-07
6	1.25e+07	3.16e-07	1.28e+07	7.67e-07
7	1.22e+07	1.67e-06	1.20e+07	1.53e-06
8	1.11e+07	2.25e-06	1.10e+07	2.17e-06
9	1.00e+07	5.75e-06	1.00e+07	7.07e-06
10	9.05e+06	8.66e-06	8.83e+06	1.19e-05
11	8.19e+06	1.40e-05	7.79e+06	2.25e-05
12	7.41e+06	3.54e-05	6.88e+06	3.60e-05
13	6.38e+06	9.37e-05	6.07e+06	9.72e-05
14	4.97e+06	1.79e-05	4.73e+06	1.26e-04
15	4.72e+06	7.90e-05	3.68e+06	1.42e-04
16	4.07e+06	1.62e-04	2.86e+06	3.02e-04
17	3.01e+06	2.55e-04	2.23e+06	2.20e-04
18	2.39e+06	3.74e-05	1.74e+06	1.84e-04
19	2.31e+06	2.16e-04	1.35e+06	1.50e-04
20	1.83e+06	1.91e-04	1.06e+06	1.16e-04
21	1.42e+06	1.58e-04	8.23e+05	1.23e-04
22	1.11e+06	7.27e-05	6.40e+05	1.35e-04
23	9.62e+05	6.94e-05	5.00e+05	1.23e-04
24	8.21e+05	5.25e-05	3.03e+05	1.06e-04
25	7.43e+05	6.98e-05	1.84e+05	1.67e-04
26	6.39e+05	8.57e-05	6.76e+04	9.10e-05
27	5.50e+05	1.30e-04	2.48e+04	6.91e-05
28	3.69e+05	9.06e-05	9.12e+03	8.21e-05
29	2.47e+05	9.39e-05	3.35e+03	6.43e-04
30	1.58e+05	6.69e-05	1.24e+03	4.37e-02
31	1.11e+05	9.46e-05	4.54e+02	1.18e-01
32	5.25e+04	3.86e-05	1.67e+02	6.95e-02
33	3.43e+04	2.03e-05	6.14e+01	2.79e-02
34	2.48e+04	1.28e-05	2.26e+01	8.68e-03
35	2.19e+04	4.97e-05	8.32e+00	2.20e-03
36	1.06e+04	8.86e-05	3.06e+00	4.41e-04
37	3.35e+03	6.94e-04	1.13e+00	9.64e-05
38	1.23e+03	3.64e-02	4.14e-01	2.07e-05
39	5.83e+02	8.06e-02	1.52e-01	4.55e-06
40	2.75e+02	8.77e-02	1.39e-04	
41	1.01e+02	4.96e-02	sum =	2.73e-01
42	2.90e+01	1.19e-02		
43	1.07e+01	3.63e-03		
44	3.06e+00	4.42e-04		
45	1.12e+00	9.57e-05		
46	4.14e-01	2.53e-05		
	1.00e-05			
	sum =	2.73e-01		

**Table 8. Photon Source Interpolation**

Calculated			Literature	
Group	Energy (eV)	Yield per kiloton	Energy (eV)	Yield per kiloton
1	2.00e+07			
2	1.40e+07			
3	1.20e+07			
4	1.00e+07	8.93e-06	1.00e+07	9.94e-07
5	8.00e+06	5.83e-05	9.00e+06	7.94e-06
6	7.00e+06	2.99e-05	8.00e+06	5.83e-05
7	6.00e+06	7.41e-05	7.00e+06	2.99e-05
8	5.00e+06	3.61e-04	6.00e+06	7.41e-05
9	4.00e+06	4.98e-03	5.00e+06	3.61e-04
10	3.00e+06	3.25e-05	4.00e+06	4.98e-03
11	2.50e+06	6.49e-03	3.00e+06	3.25e-05
12	2.00e+06	8.62e-03	2.50e+06	6.49e-03
13	1.50e+06	9.35e-03	2.00e+06	8.62e-03
14	1.00e+06	7.20e-03	1.50e+06	9.35e-03
15	7.00e+05	8.17e-03	1.00e+06	4.44e-03
16	4.55e+05	5.86e-03	8.00e+05	5.52e-03
17	3.00e+05	5.61e-03	6.00e+05	3.66e-03
18	1.50e+05	1.93e-03	5.00e+05	3.88e-03
19	1.00e+05	5.70e-04	4.00e+05	3.72e-03
20	7.00e+04	3.83e-04	3.00e+05	3.68e-03
21	4.50e+04	8.17e-06	2.00e+05	3.86e-03
22	3.00e+04	5.45e-06	1.00e+05	9.49e-04
23	2.00e+04	1.09e-05	5.00e+04	2.72e-05
	1.00e+01		1.00e+01	
	sum =	5.97e-02	sum =	5.97e-02

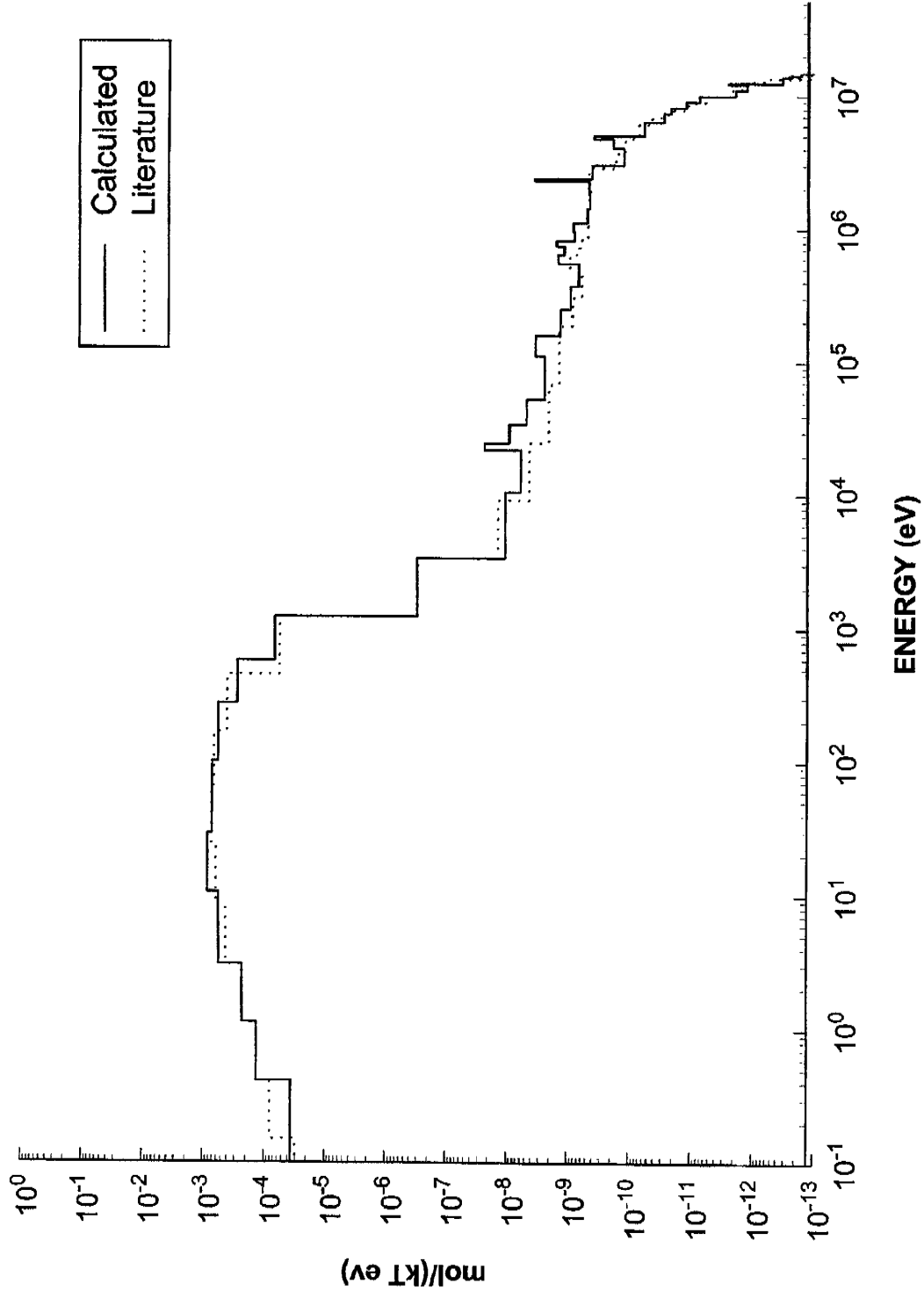


Figure 1. Neutron Source Spectra



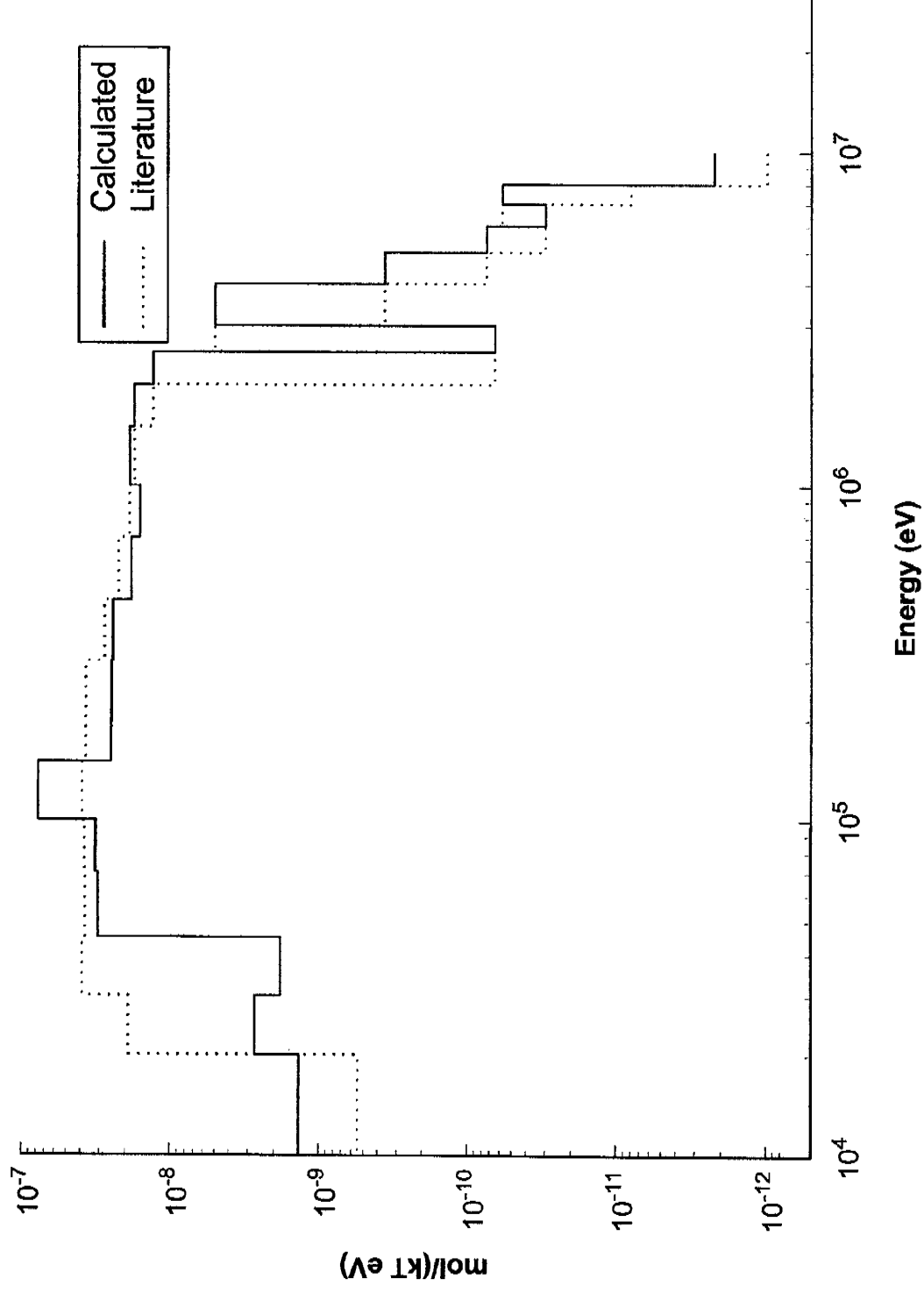


Figure 2. Photon Source Spectra



**APPENDIX A**  
**DABL69 ABSTRACT**



## RSIC DATA LIBRARY DLC-130

### 1. NAME AND TITLE OF DATA LIBRARY

DABL69: Defense Nuclear Applications Broad-Group Library based on ENDF/B-V in ANISN Format.

### 2. NAME AND TITLE OF DATA RETRIEVAL PROGRAM

BCBN: Convert ANISN card-image data to binary format.

### 3. CONTRIBUTOR

Oak Ridge National Laboratory, Oak Ridge, Tennessee.

### 4. HISTORICAL BACKGROUND AND INFORMATION

This data package was developed to supersede the DLC-31/FEWG1 cross section library which has been used for Defense Nuclear Agency radiation transport calculations. The availability of ENDF/B-V data coupled with some evidence that the original group structure needed some refinement, provided the driving force in the development of a replacement for FEWG1 which is based on ENDF/B-IV.

The energy group structure (46n,23g) is a subset of the VITAMIN-E group structure and is tailored to air-over-ground environments.

### 5. APPLICATION OF THE DATA

Based on ENDF/B-V data and a reevaluation of Fe (MOD 3) which contains significant improvements, this library consists of 80 nuclides that can be used to solve typical calculations of interest to the DNA radiation transport community. Any computer code requiring multigroup cross sections can use the data.

### 6. SOURCE AND SCOPE OF DATA

Eighty materials from the DLC-113C/VITAMIN-E library which were available on October 30, 1987 are included as a first part of the DABL69 library. These materials were collapsed using the AMPX code system with the VITAMIN-E weighting functions. The second part of the DABL69 library contains 8 additional materials including N-14, O-16, and steel using problem-dependent weighting functions generated by ANISN analysis of a typical problem. DABL69 contains 46 neutron and 23 gamma-ray energy groups. The Legendre order of expansion for angular distribution is 5.

As in DLC-31, the neutron groups are tailored to allow for the major peaks and valleys in the total neutron cross sections of nitrogen, oxygen, silicon, and iron. On the other hand, the gamma-ray groups are tailored to allow accurate calculation of pair production, annihilation photon transport, hydrogen capture, and backscatter photon transport. In the neutron energy range 0.2 to 1.8 MeV, additional boundaries were added to the parent DLC-31 group structure to give better resolution in the region where the largest fraction of the total kerma frequently occurs.

Source spectra and response functions useful in radiation transport applications are included in the library. Elemental kerma factors are provided for nuclides ranging from H-1 to Am-243.

Version A (D00130/I0360/00) includes card-image data files in both ANISN format and AMPX master format with kerma factor data derived from DLC-060/MACKLIB-IV.

Version B (D00130/I0360/01) is available in ANISN card images in which the kerma factor data has been replaced with data derived from DLC-160/KAOS-LIB-V.

## **7. DISCUSSION OF THE DATA RETRIEVAL PROGRAM**

BCBN will convert the data in ANISN format from card image to binary form. No input is required.

## **8. DATA FORMAT AND COMPUTER**

Both ANISN and AMPX Card images; IBM 360/370. (D00130/I0360/00)

ANISN card images; All Computers. (D00130/I0360/01)

## **9. TYPICAL RUNNING TIME**

Not applicable.

## **10. REFERENCES**

### **a. Included in documentation:**

"Notes on Contents of DLC-130/DABL-69" (November 22, 1993).

D.T. Ingersoll, R.W. Roussin, C.Y. Fu, and J.E. White, "DABL69: A Broad-Group Neutron/Photon Cross-Section Library for Defense Nuclear Applications," ORNL/TM-10568 (June 1989).

### **b. Background information:**

C.R. Weisbin, R.W. Roussin, J.J. Wagschal, J.E. White, and R.Q. Wright, "Vitamin-E: An ENDF/B-V Multigroup Cross Section Library for LMFBR Core and Shield, LWR Shield, Dosimetry and Fusion Blanket Technology," ORNL-5505 (ENDF-274) (1979).

Radiation Shielding Information Center Data Package DLC-113C/VITAMIN-E, "A Coupled 174-Neutron, 38-Gamma-ray Multigroup Cross-Section Library for Deriving Application-Dependent Working Libraries for Radiation Transport Calculations," contributed by Oak Ridge National Laboratory.

Radiation Shielding Information Center Data Package DLC-160/KAOS-LIB-V, "A Library of Nuclear Response Functions Generated by KAOS-V Code from ENDF/B-V and Other Data Files" (March 1991).

## **11. CONTENTS OF LIBRARY**

Included is the referenced document and the cross sections and retrieval program transmitted on 1 cartridge tape in tar format or 10 DS/HD diskettes in self-extracting compressed DOS files (D00130/I0360/00) or (D00130/I0360/01) on two DS/HD diskettes in self-extracting compressed DOS files.

## **12. DATE OF ABSTRACT**

August 1988, revised November 1988, September 1989, November 1993.

**KEYWORDS:** COUPLED NEUTRON-GAMMA-RAY CROSS SECTIONS; ANISN FORMAT; NEUTRON CROSS SECTIONS; DETECTOR RESPONSE; MULTIGROUP CROSS SECTIONS; KERMA FACTORS

**APPENDIX B**  
**KAOS-LIB-V ABSTRACT**





## **RSIC DATA LIBRARY DLC-160**

### **1. NAME AND TITLE OF DATA LIBRARY**

KAOS/LIB-V: A Library of Nuclear Response Functions Generated by KAOS-V Code From ENDF/B-V and Other Data Files

### **2. NAME AND TITLE OF DATA RETRIEVAL PROGRAMS**

RETRIEVE: An interactive program to retrieve selected responses and perform group collapsing from the VITAMIN-E 174-group values.

### **3. CONTRIBUTOR**

Argonne National Laboratory, Argonne, Illinois.

### **4. HISTORICAL BACKGROUND AND INFORMATION**

The microscopic cross section data bases provide the means of computing kerma factors for many materials and for incident neutron energies up to 20 MeV. The computed kerma factors from microscopic cross sections suffer from large uncertainties that cruelly manifest themselves as negative values. It is believed that improving the nuclear data files would solve the problem. However, the effort involved in doing so is massive. There is a need for improved methods in calculating nuclear heating parameters from existing data. The creation of KAOS/LIB-V is a response to this need.

### **5. APPLICATION OF THE DATA**

The library is designed for fusion and fission applications.

### **6. SOURCE AND SCOPE OF DATA**

The library includes neutron kerma factors, gas production, tritium breeding cross sections, and all important reaction cross sections for a large number of materials of interest in fission and fusion systems. The library was generated with the KAOS-V code (PSR-306) employing basic nuclear data from ENDF/B-V. Auxiliary nuclear data bases, such as the Japanese library JENDL-2, were used as a source of isotopic cross sections when these data are not provided in ENDF/B-V files for a natural element. KAOS/LIB-V employs the VITAMIN-E weighting function and energy group structure of 174 neutron groups.

### **7. DISCUSSION OF THE DATA RETRIEVAL PROGRAMS**

RETRIEVE is an interactive program written in Fortran 77 to retrieve selected responses and perform group collapsing from the VITAMIN-E 174-group values.

### **8. DATA FORMAT AND COMPUTER**

Card images; Cray computers.

### **9. TYPICAL RUNNING TIME**

None noted.

### **10. REFERENCES**

- a. Included in the package:

Y. Farawila, Y. Gohar, and C. Maynard, "KAOS/LIB-V: A Library of Nuclear Response Functions Generated by KAOS-V Code From ENDF/B-V and Other Data Files," ANL/FPP/TM-241 (April 1989).

**b. Background Material:**

Y. Gohar, "Kerma Factors and Activation Analyses," Paper presented at Specialists Meeting on Shielding Experiments and Analyses, Garching, Federal Republic of Germany, Feb. 12-14, 1990.

**11. CONTENTS OF PACKAGE**

The package contains the reference listed in (10.a), and the data library. The data library is transmitted on one DS/HD 5.25-inch diskette (1.2 MB).

**12. DATE OF ABSTRACT**

March 1991.

**KEYWORDS:**    BASED ON ENDF/B-V; DAMAGE CROSS SECTIONS; KERMA FACTORS;  
                     REACTION CROSS SECTIONS

**APPENDIX C**  
**RESPONSE FUNCTIONS IN THE KAOS/LIB-V LIBRARY**



There are 22 nuclear response function tables for each material in the library. These responses are outlined below:

1- Recommended Prompt Kerma Factor: The recommended prompt kerma factor can be either calculated by direct energy balance, kinematics, or a combination of these methods in different energy ranges according to the description in the summary provided in section III. This response is provided for all the materials included in this library. The response is given in units of (eV.barn).

2- Recommended Kerma Factor with Charged Particle Decay Heat: In this response, the decay heat deposited locally via the emitted charged particles are added to the recommended set of prompt kerma factors. This response is provided for all materials. In case there is no charged particle decay heat (within the half-life cutoff of 1 day), this response will be identical to the recommended prompt kerma.

3- Recommended Kerma Factor Plus Total Decay Heat: In this response, the total decay heat including energy carried by charged particles and gamma rays are added to the recommended prompt kerma factor response.

4- Direct Energy Balance Prompt Kerma Factor: The prompt kerma factors produced by the direct energy balance method in units of (eV.barn) are listed. Notice that in the case gamma files are not provided in ENDF/B-V, the Direct Energy Balance Prompt kerma factor includes the gamma energy as deposited locally. It is possible to find negative kerma factors in this list. These can be used for comparison purposes and in special cases to account for a global energy balance in large systems. This response is presented for most but not all materials, where zeros are entered instead.

- 5- Direct Energy Balance Kerma Factor with Charged Particle Decay Heat: Charged Particle decay heat is added to the direct energy balance prompt kerma in the same way described for the recommended set. If the prompt direct energy balance was zeroed out, this response will be also zeroed out.
- 6- Direct energy Balance Kerma Factor Plus Total Decay Heat: The total decay heat is added to the direct energy balance kerma in the same way described for the recommended set.
- 7- Kinematics Prompt Kerma Factor: The prompt kerma factor produced by the kinematics method is listed. This response is provided for most, but not all materials.
- 8- Kinematics Kerma Factor with Charged Particle Decay Heat: The charged particle decay heat is added to the prompt kinematic kerma factor in the same way described for the recommended set. This response will be zeroed out in the case the prompt kinematic kerma factor is not provided.
- 9- Kinematics Kerma Plus Total Decay Heat: The total decay heat is added to the kinematics prompt kerma in the same way described for the third response. Again, this response will be zeroed out if the prompt kinematic set is not provided, and it will be identical to the prompt set if decay heat (within the 1 day half-life cutoff) is zero.
- 10- Prompt Gamma Energy Production: The total prompt gamma energy production is given in the units of (eV.barn). With the exception of Zirconium isotopes, where gamma files are not provided in the ENDF/B- V, this response is not calculated from kinematics, but rather by direct processing of ENDF/B-V files. In a few cases, interpolation and other minor corrections were made.

- 11- Hydrogen-1 Production Cross Section: In this response the H-1 gas production cross section is given in barns. The response is computed by summing up all proton-producing reaction cross sections multiplied by the respective number of emitted protons. For gas production responses, the delayed component of gas production due to radioactive decay is also added.
- 12- Deuterium Production Cross Section: The production of H-2 gas is presented in the same way as in response 11.
- 13- Tritium Production Cross Section: The production of H-3 is presented in this response in the same way as response 11.
- 14- Helium-3 Production Cross Section: See response 11.
- 15- Helium-4 Production Cross Section: See response 11.
- 16- Total Cross Section: The total cross section is computed from the ENDF/B-V file 2 resonance parameters (if any) and MT=1 file 3 data.
- 17- Elastic Scattering Cross Section: Computed from ENDF/B-V resonance file 2 (if any) and MT=2 file 3 data.
- 18- Total Inelastic Cross Section: This response is equivalent to the data presented in ENDF/B-V file 3 MT=4. The  $(n,nx)$  and  $(n,xn)$  reactions, where  $x$  represents a charged particle e.g. proton or alpha particle, are not included if they are not contained in MT=4 ( and equivalently MT=51-91 series ).
- 19- Radiative Capture Cross Section: Computed from ENDF/B-V file 2 resonance parameters (if any) and file 3 MT=102 data.
- 20- Total  $(n,2n)$  Cross Section: All non-redundant reactions producing two neutrons are added to form this response. These include sequential representation (MT=6-9), direct reaction (MT=16),  $(n,2n\alpha)$  reaction (MT=24), and  $(n,2n2\alpha)$  reaction (MT=30).

21- Total (n,3n) Cross Section: Reactions producing 3 neutrons are added to form this response. These include (n,3n) and (n,3n $\alpha$ ) reactions (MT=17, MT=25).

22- Number of Fission Neutrons \* Cross Section: In this response, the total number of fission neutrons (prompt plus delayed) is given. It is computed by multiplying the total number of neutrons produced per fission obtained from ENDF/B-V file 1 by the fission cross section. The fission cross section is computed from file 2 resonance parameters and file 3 MT=18 data.



**APPENDIX D**  
**VITAMIN-E ABSTRACT**



## RSIC DATA LIBRARY DLC-113

### 1. NAME AND TITLE OF DATA LIBRARY

VITAMIN-E: 174n, 38g Cross-Section Library in AMPX Format.

### 2. NAME AND TITLE OF DATA RETRIEVAL PROGRAM

No retrieval program is provided. The PSR-117/MARS or PSR-63/AMPX code packages are suggested for full implementation of the capabilities of VITAMIN-E. JCL and sample input are provided to execute sample problems using MARS.

### 3. CONTRIBUTOR

Oak Ridge National Laboratory, Oak Ridge, Tennessee.

### 4. HISTORICAL BACKGROUND AND INFORMATION

The successful application of DLC-41/VITAMIN-C, based on ENDF/B-IV, to a variety of radiation transport problems led to the development of specifications for an ENDF/B-V based cross-section library, denoted VITAMIN-E.

### 5. APPLICATION OF THE DATA

The early phases of this new cross-section library were focused on materials for fast reactor applications and were applied to benchmark testing of ENDF/B-V. More recently, requests have been made for additional materials to be added to the basic library for fusion and weapons radiation transport applications. The library is expected to perform well for radiation transport problems where thermal upscatter is not important.

### 6. SOURCE AND SCOPE OF DATA

The energy structure of VITAMIN-E contains 174 neutron and 38 gamma-ray groups and includes the 171 neutron and 36 photon groups of VITAMIN-C as a subset. The group structure has fine detail in the energy region where cross section minima occur for important shielding materials. The 174 neutron group data were processed with MINX15; the 174 neutron, 38 photon group data were processed with LAPHNGAS (AMPX III); and the 38 gamma-ray group data with SMUG (AMPX III) from DLC-99/HUGO. The ENDF/B-V special purpose dosimetry, activation, and gas production files have also been processed into the VITAMIN-E group structure using XLACS2, NITAWL, and WORM.

### 7. DISCUSSION OF THE DATA RETRIEVAL PROGRAM

PSR-117/MARS can be used to translate the data into binary form and to perform a variety of useful manipulations including checking, editing, self shielding, and group collapsing.

### 8. DATA FORMAT AND COMPUTER

Card images; IBM 3033 D00113I303301).

### 9. TYPICAL RUNNING TIME

The first part of the ZPR 6/7 infinite medium problem required approximately 55,000 I/O's and 10.5 cpu minutes on the IBM 3033. This includes the 20,000 I/O's and 9 cpu minutes required to convert the formatted library to binary. The XSDRNPM run required only 37 cpu seconds and 6065 I/O's, and the GIP/ANISN run took 10,060 I/O's and 38 cpu seconds. The first part of the CTR standard blanket run

required 58,066 I/O's and 10.15 cpu minutes. The XSDRNPM problem ran for 1.3 cpu minutes using 5147 I/O's while the GIP/ANISN run required 1.16 cpu minutes and 9160 I/O's.

#### **10. REFERENCE**

R. W. Roussin et al., "VITAMIN-E: A Coupled 174 Neutron, 38 Gamma-Ray Multigroup Cross-Section Library for Deriving Application Dependent Working Libraries for Radiation Transport Calculations," Draft ORNL-RSIC Report (November 1987).

#### **11. CONTENTS OF LIBRARY**

The 174n group transport cross section data are separated into six files; the 174n, 38g group photon production data and the 38g group photon transport data are each included in separate files. Special purpose neutron dosimetry, activation, and gas production data files are also provided. JCL is included to execute sample problems using MARS. One DC6150 cartridge tape in TAR format is required to obtain the entire package.

#### **12. DATE OF ABSTRACT**

July 1984; December 1984, August 1985, November 1987.

**KEYWORDS:** AMPX INTERFACE FORMAT; COUPLED NEUTRON-GAMMA-RAY CROSS SECTIONS; CTR NEUTRONICS CROSS SECTIONS; CTR PROCESSED CROSS-SECTION LIBRARY; GAMMA-RAY CROSS SECTIONS; GAMMA-RAY PRODUCTION DATA; MULTIGROUP CROSS SECTIONS; MULTIGROUP CROSS SECTIONS BASED ON ENDF/B; NEUTRON CROSS SECTIONS; REACTION CROSS SECTIONS

**APPENDIX E**  
**VITAMIN-B6 ABSTRACT**



## RSIC DATA LIBRARY DLC-184

### 1. NAME AND TITLE OF DATA LIBRARY

VITAMIN-B6: A Fine-Group Cross Section Library Based on ENDF/B-VI Release 3 for Radiation Transport Applications.

### 2. NAME AND TITLE OF DATA RETRIEVAL PROGRAMS

AIM: Convert AMPX master card-image data to binary format (not included).

### 3. CONTRIBUTOR

Oak Ridge National Laboratory, Oak Ridge, Tennessee.

### 4. HISTORICAL BACKGROUND AND INFORMATION

The successful use of DLC-41/VITAMIN-C, which was based on ENDF/B-IV, and DLC-113/VITAMIN-E, which was based on ENDF/B-V, to a variety of radiation transport problems led to the development of specifications for VITAMIN-B6.

This new multigroup cross-section library based on ENDF/B-VI Release 3 data was produced and tested for light water reactor shielding and reactor pressure vessel dosimetry applications. Significant benchmark data testing of VITAMIN-B6 was an integral part of this development work to accelerate the qualification. Over 50 benchmarks were calculated using the VITAMIN-B6 library. In general, results using the new data show significant improvements relative to earlier ENDF data.

### 5. APPLICATION OF THE DATA

The successful application of VITAMIN-B6 to LWR pressure vessel fluence calculations has been demonstrated. It is expected that the range of applications will be similar to previous multigroup cross section development efforts using the VITAMIN concept (generation of fine-group, pseudo problem-independent data). In the past, the VITAMIN concept has proven to be a very effective approach for fusion reactor neutronics, LMFBR core physics analysis, radiation effects of nuclear weapons, and light water reactor shielding and dosimetry. This new fine-group, pseudo problem-independent, cross-section library contains 120 nuclides. Several dosimetry response functions and kerma factors for all 120 nuclides are also included with the library. Unlike previous VITAMIN series data libraries, VITAMIN-B6 contains multigroup cross sections with thermal upscattering.

### 6. SOURCE AND SCOPE OF DATA

VITAMIN-B6 is derived from ENDF/B-VI nuclear data, except for two nuclides (Sn obtained from LENDL and Zirc2 obtained from ENDF/B-IV). The responses and kerma factors were also derived primarily from ENDF/B-VI. The ENDF data were processed with the PSR-355/NJOY94 code system and converted to AMPX master library format with the SMILER module of PSR-315/AMPX77.

The actual 199 neutron group boundaries in VITAMIN-B6 were selected from 175

groups in VITAMIN-J (a European library based on the VITAMIN-C and VITAMIN-E structures) and the 27 groups used in the SCALE shielding library, with deference given to the VITAMIN-J boundaries at higher energies when the energy values are slightly different. The thermal energy range, which contains 36 neutron groups, is defined with 5.043 eV as the uppermost boundary.

The photon energy group structure is based on a combination of the 42 gamma-ray groups in VITAMIN-J and the 18 groups in the SCALE shielding library. The top energy group extends to 30 MeV, which allows proper representation of high energy gamma rays from neutron capture at high energies. Although the cross-section for capture at neutron energies between 20 and 30 MeV is small, such a reaction in some materials could produce gamma rays with energies between 20 and 30 MeV (VITAMIN-E gamma-ray groups only went up to 20 MeV).

Attached tables provide information on file contents.

## **7. DISCUSSION OF THE DATA RETRIEVAL PROGRAM**

Modules from PSR-352/SCAMPI, which is a subset of PSR-315/AMPX77 with some improvements from CCC-545/SCALE/4.3, were used to read the ASCII files, convert them to binary, and run test cases. The AIM program, which is included in each of these three packages, reads the formatted data and writes them as unformatted records.

## **8. DATA FORMAT AND COMPUTER**

Card images in AMPX master library format; all computers (D00184/ALLCP/00).

## **9. TYPICAL RUNNING TIME**

Run times are problem dependent. The test cases were run at RSICC on an IBM RS/6000 using modules from the SCAMPI package. The ctrb6 case ran in about 4 minutes. The zpr1 case ran in about 5 minutes, and the zpr2 case ran in about 10 minutes.

## **10. REFERENCES**

The following is interim documentation for DLC-184. Formal documentation is in process and will be announced in the RSICC Newsletter upon completion.

a. included in document:

RSICC, "READ.ME," (December 1996).

J. E. White, R. Q. Wright, D. T. Ingersoll, R. W. Roussin, N. M. Greene, and R. E. MacFarlane, "VITAMIN-B6: A Fine-Group Cross Section Library Based on ENDF/B-VI for Radiation Transport Applications," from Proceedings of the International Conference on Nuclear Data for Science and Technology, Gatlinburg, Tennessee, pp. 733-736 (May 1994).

J. E. White, D.T. Ingersoll, C. O. Slater, R. W. Roussin, "BUGLE-96: A Revised Multigroup Cross Section Library for LWR Applications Based on ENDF/B-VI Release 3," (presented at the American Nuclear Society Radiation Protection & Shielding Topical Meeting, April 21-25, 1996, Falmouth, MA) (April 1996).



# **INTERNAL DISTRIBUTION**

- |      |                 |        |                          |
|------|-----------------|--------|--------------------------|
| 1-2. | Y. Y. Azmy      | 9-10.  | R. T. Santoro            |
| 3.   | J. M. Barnes    | 11-12. | D. B. Simpson            |
| 4.   | D. T. Ingersoll | 13.    | Central Research Library |
| 5.   | R. A. Lillie    | 14.    | Laboratory Records - RC  |
| 6.   | M. A. Kuliasha  | 15.    | Laboratory Records (for  |
| 7-8. | J. V. Pace, III |        | submission to OSTI)      |

# **EXTERNAL DISTRIBUTION**

16. Dr. Robert F Christy, 1230 Arden Road, Pasadena, CA 91106
17. Dr. Harry M. Cullings, Dept. of Statistics, Radiation Effects Research Foundation, 5-2 Hijiyama Park, Minami-ku, Hiroshima-shi, 732-0815 JAPAN
18. Dr. Stephen D. Egbert, SAIC, 10260 Campus Pointe Drive, MSX2, San Diego, CA 92121-1578
19. Dr. Alexandra R. Heath, Diagnostics Applications Group Leader, Los Alamos National Laboratory, MS F663, Los Alamos, NM 87545
20. Mr. Dean C. Kaul, SAIC, 10260 Campus Pointe Drive, MSX2, San Diego, CA 92121-1578
21. Dr. George D. Kerr, Kerr Consulting, P.O. Box 12052, Knoxville, TN 37912-0052
22. Dr. Tore Straume, University of Utah, Radiobiology Division, 729 Arapen Drive, Suite 2334, Salt Lake City, UT 84108
23. Dr. David G. Thomassen, Office of Biological and Environmental Research, U.S. Department of Energy, ER-72, 19901 Germantown Road, Germantown, MD 20874-1290
24. Dr. Joseph Weiss, Office of Health Studies, U. S. Department of Energy, EH-6/270CC, 19901 Germantown Road, Germantown, MD 20874-1290
25. Dr. Paul P. Whalen, Los Alamos National Laboratory, MS D413, Los Alamos, NM 87545
26. Dr. Robert W. Young, 946 Torrey Pine Drive, Winter Springs, FL 32708-4346