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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[1] 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[2] is a fine-group (199-neutron, 42-photon) library based on ENDF/B-VI Release 3. Because VITAMIN-B6 is distributed in AMPX[3] master library format, an infinite dilution ANISN[4] -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[5] 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[6] response functions instead of the response functions available in the AMPX master data library. At the time DABL69 was created, the KAOS[7] data was known to be more accurate.

Section two of this report provides summary descriptions of the DABL69, VITAMIN-E[8], 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[9], 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-l 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[10] 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[11]; 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[12]. 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[13] 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[14] 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[15] (a European library based on the VITAMIN-C and VITAMIN-E structures) and the 27 groups used in the SCALE[16] 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 weigting 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[14] 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[17], 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)[18] analyses, to an input parameter. The 3D (TORT)[19] 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.

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Table 1. Energy Boundaries for Neutron Groups

	Group Number		
Upper Energy (eV)	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

	Group Number		
Upper Energy (eV)	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

	Group Number		
Upper Energy (eV)	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

	Group Number		
Upper Energy (eV)	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

	Group Number		
Upper Energy (eV)	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

	Group Number		
Upper Energy (eV)	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

Material	ID (AMPX)	ID (ANISN)	Material	ID (AMPX)	ID (ANISN)
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

Entry	Identifier	Nuclide	Entry	Identifier	Nuclide
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	eul53	97	16032	s32
38	63154	eu154	98	14000	si

Table 4. Continued

Entry	Identifier	Nuclide	Entry	Identifier	Nuclide
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

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 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
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Table 5. Continued

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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
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Table 5. Continued

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

Table 5. Continued

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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
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Table 5. Continued

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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
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Table 5. Continued

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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
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Table 5. Continued

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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 l007850vb60003030195  ampx id   50000
514 p1 data for   sn(nat) v91.94 standard wgt l007850vb60003030195  ampx id   50000
515 p2 data for   sn(nat) v91.94 standard wgt l007850vb60003030195  ampx id   50000
516 p3 data for   sn(nat) v91.94 standard wgt l007850vb60003030195  ampx id   50000
517 p4 data for   sn(nat) v91.94 standard wgt l007850vb60003030195  ampx id   50000
518 p5 data for   sn(nat) v91.94 standard wgt l007850vb60003030195  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

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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

No.	Material Name	ENDF/B-V MAT number	KAOS/LIB-V Symbol
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	0-16
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.)

No.	Material Name	ENDF/B-V MAT number	KAOS/LIB-V Symbol
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

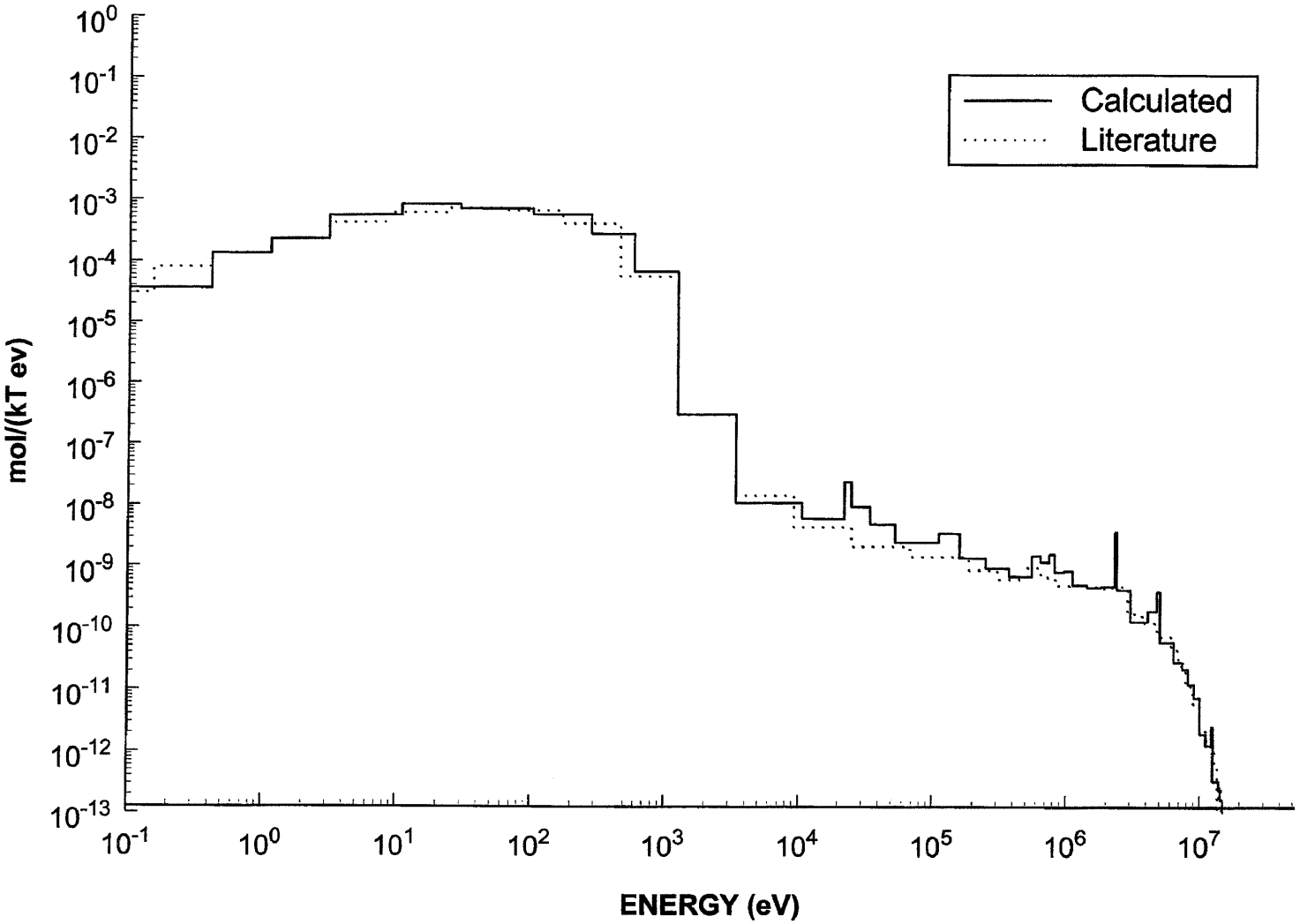

Figure 1. Neutron Source Spectra

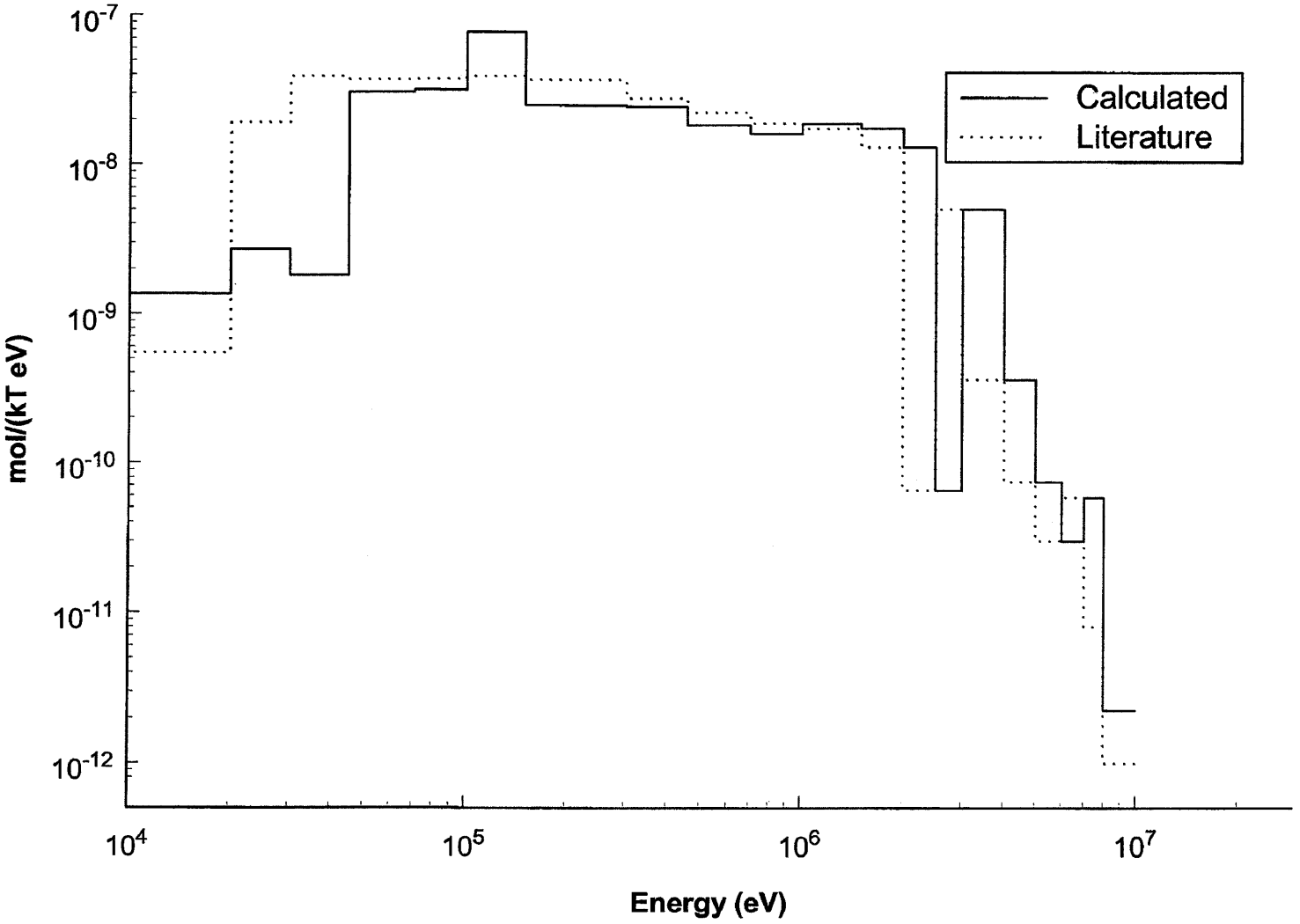

Figure 2. Photon Source Spectra

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 wich 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,2nα) reaction (MT=24), and (n,2n2α) 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,3nα) 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 MINXI5; 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).

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