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CSRL-V: AN ENDF/B-V 227-GROUP CROSS-SECTION LIBRARY FOR CRITICALITY SAFETY STUDIES*

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DISCLAIMER

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The AMPX system[1,a] was used to generate a P_3 227-neutron-group master cross section library[b] containing data for all materials in the ENDF/B-V general purpose file.[2] (See Table I for a list of the master data sets, the ENDF/B-V materials processed, and the data sets which contain resonance parameters.) The library, designated CSRL-V, is a data base for the subsequent generation of problem-dependent fine- and/or broad-group cross sections for shipping cask calculations and other criticality safety analyses. The problem-dependent data can be used with codes such as KENO IV, ANISN, XSDRNPM, VENTURE, DOT, MORSE, etc. CSRL-V data can be coupled with photon-production and photon-interaction multigroup data produced with the AMPX system to produce coupled neutron-gamma cross-section libraries.

Experiences gained with the ENDF/B-IV 218-group master cross-section library for criticality safety studies[3,4,c] influenced the selection of the group structure and the point-to-multigroup weighting functions used to generate the subject library. When selecting the energy structure for the

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[a] The AMPX system is distributed by the Radiation Shielding Information Center (RSIC) in a code package identified as PSR-63/AMPX-II.

[b] An AMPX master cross-section library is the most comprehensive processed library in the AMPX system. The library contains multigroup cross sections, transfer matrices, resonance parameters, weighting functions, etc., has provisions for neutron, photon-production, and photon-interaction data, has provisions for temperature dependence on thermal scattering kernels, etc.

[c] The ENDF/B-IV 218-group library (CSRL) is distributed by RSIC in a code package identified as DLC-43.

3-eV to 20-MeV energy range, consideration was given to the resonance structure of prominent nuclei, the thresholds of important reactions, and various fission spectra. Additional groups were added in the 6-20 MeV range to facilitate the calculation of deep penetration in concrete. For $10^{-5} \leq En \leq 3eV$, 79 closely spaced thermal groups were chosen to examine the effects of low-energy resonance and thermal-neutron upscatter. Two groups were added in the 10^{-5}-10^{-2}eV range to "better treat" capture by gadolinium. The 218-group CSRL, the 27-group SCALE, and the 16-group Hansen-Roach energy structures are subsets of the 227-group structure. As identified in Table I, various weighting spectra were used to prepare the multigroup cross sections for the actinides, the resonance structural materials, and the nonresonance materials.

Data in the CSRL-V library were checked for first-order consistencies with the RADE module of the AMPX system. The validity of the selected data sets from the library was tested in performance parameter calculations for a series of benchmark critical experiments. Where available, results using CSRL-V data were compared with results using ENDF/B-IV processed data.

The CSRL-V library is available on magnetic tape from RSIC. An AMPX-generated pointwise cross-section library was produced as an intermedite step in the preparation of the CSRL-V library. The pointwise library, containing energy-cross-section pairs for the fission, capture, elastic scattering, and total reactions, is also available from RSIC.

References

1. N. M. Greene et al., *"AMPX: A Modular Code System for Generating Coupled Multigroup Neutron-Gamma Libraries from ENDF/B,"* ORNL-TM-3706 (March 1976).

2. R. Kinsey, Ed., *ENDF/B Summary Documentation,"* BNL-NCS-17541 (ENDF-201), 3rd ed., Brookhaven National Laboratory, Upton, N.Y., 1979.

3. W. E. Ford, III, R. M. Westfall, and C. C. Webster, "A 218-Neutron-Group Master Cross-Section Library for Criticality Safety Studies," *Trans. Am. Nucl. Soc., 22,* 290-291 (1975).

4. W. E. Ford, III, C. C. Webster, and R. M. Westfall, *A 218-Group Neutron Cross-Section Library in the AMPX Master Interface Format for Criticality Safety Studies,"* ORNL/CSD/TM-4 (July 1976).

Table I. CSRL-V 227-Neutron-Group Master Cross-Section Library

Nuclide	ENDF/B-V MAT No.	Master Library ID No.	Resolved Resonance Data	Weight Function[a]	Nuclide	ENDF/B-V MAT No.	Master Library ID No.	Resolved Resonance Data	Weight Function[a]
H-1	1301	1001	No	A	Xe-132	1352	54132	Yes	B
H-2	1302	1002	No	A	Xe-134	1354	54134	Yes	B
H-3	1169	1003	No	A	Xe-135	1294	54135	No	B
He-3	1146	2003	No	A	Xe-136	1356	54136	No	B
He-4	1270	2004	No	A	Cs-133	1355	55133	Yes	B
Li-6	1303	3006	No	A	Ba-138	1353	56138	No	B
Li-7	1272	3007	No	A	Sm-149	1319	62149	Yes	B
Be-9	1304	4009	No	A	Eu-151	1357	63151	Yes	B
B-10	1305	5010	No	A	Eu-152	1292	63151	Yes	B
B-11	1160	5011	No	A	Eu-153	1359	63151	Yes	B
C-12	1306	6012	No	A	Eu-154	1293	63151	Yes	B
N-14	1275	7014	No	A	Gd-152	1362	64152	Yes	B
N-15	1307	7015	No	A	Gd-154	1364	64154	Yes	B
O-16	1276	8016	No	A	Gd-155	1365	64155	Yes	B
O-17	1317	8017	No	A	Gd-156	1366	64156	Yes	B
F-19	1309	9019	No	A	Gd-157	1367	64157	Yes	B
Na-23	1311	11023	Yes	B	Gd-158	1368	64158	Yes	B
Mg	1312	12000	No	A	Gd-160	1370	64160	Yes	B
Al-27	1313	13027	No	A	Dy-164	1031	66164	Yes	B
Si	1314	14000	No	A	Lu-175	1032	71175	Yes	B
P-31	1315	15031	No	A	Lu-176	1033	71176	Yes	B
S-32	1316	16032	No	A	Hf	1372	72000	Yes	B
Cl	1149	17000	No	A	Hf-174	1374	72174	Yes	B
Ca	1320	20000	No	A	Hf-176	1376	72176	Yes	B
Ti	1322	22000	No	A	Hf-177	1377	72177	Yes	B
V	1323	23000	No	B	Hf-178	1378	72178	Yes	B
Cr	1324	24000	Yes	B	Hf-179	1383	72179	Yes	B
Mn-55	1325	25055	Yes	B	Hf-180	1384	72180	Yes	B
Fe	1326	26000	Yes	B	Ta-181	1285	73181	Yes	B
Co-59	1327	27059	Yes	B	Ta-182	1127	73182	Yes	B
Ni	1328	28000	Yes	B	W-182	1128	74182	Yes	B
Cu	1329	29000	Yes	B	W-183	1129	74183	Yes	B
Kr-78	1330	36078	Yes	B	W-184	1130	74184	Yes	B
Kr-80	1331	36080	Yes	B	W-186	1131	74186	Yes	B
Kr-82	1332	36082	Yes	B	Re-185	1083	75185	Yes	B
Kr-83	1333	36083	Yes	B	Re-187	1084	75187	Yes	B
Kr-84	1334	36084	Yes	B	Au-197	1379	79197	No	B
Kr-86	1336	36086	Yes	B	Pb	1382	82000	No	A
Zr	1340	40000	Yes	B	Th-232	1390	90232	Yes	C
Zr-90	1385	40090	Yes	B	Pa-233	1391	91233	Yes	C
Zr-91	1386	40091	Yes	B	U-233	1393	91233	No	C
Zr-92	1387	40092	Yes	B	U-234	1394	92234	Yes	C
Zr-94	1388	40094	Yes	B	U-235	1395	92235	Yes	C
Zr-96	1389	40096	Yes	B	U-236	1396	92236	Yes	C
Nb-99	1189	41099	Yes	B	U-238	1398	92238	Yes	C
Mo	1321	42000	Yes	B	Np-237	1337	93237	Yes	C
Tc-99	1308	43099	Yes	B	Pu-238	1338	94238	Yes	C
Rh-103	1310	45103	Yes	B	Pu-239	1399	94239	Yes	C
Ag-107	1371	47107	Yes	B	Pu-240	1380	94240	Yes	C
Ag-109	1373	47109	Yes	B	Pu-241	1381	94241	Yes	C
Cd	1281	48000	No	A	Pu-242	1342	94242	Yes	C
Cd-113	1318	48113	Yes	B	Am-241	1361	95241	Yes	C
Xe-124	1335	54124	Yes	B	Am-242	1369	95242	Yes	C
Xe-126	1339	54126	Yes	B	Am-243	1363	95243	Yes	C
Xe-128	1348	54128	Yes	B	Cm-243	1343	96243	Yes	C
Xe-129	1349	54129	Yes	B	Cm-244	1344	96244	Yes	C
Xe-130	1350	54130	Yes	B	Cm-245	1345	96245	Yes	C
Xe-131	1351	54131	Yes	B	Cm-246	1346	96246	Yes	C

[a]The following code is used to identify the weight functions:

Code	Weight Function
A	10^{-5}-0.1265 eV Maxwellian; 0.1265 eV-1.4 MeV 1/E; 1.4-20 MeV fission.
B	10^{-5}-0.1265 eV Maxwellian; 0.1265 eV-0.75 MeV 1/E; 0.75-20 MeV fission.
C	10^{-5}-0.1265 eV Maxwellian; 0.1265 eV-0.1 MeV 1/E; 0.1-20 MeV fission.