Review of 23 Actinides from JENDL–3.3

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This study includes 23 evaluations from the JENDL–3.3 file that are not included in ENDF/B–VI or any of the other evaluated files. A brief review has been completed and will be summarized here.

There is very little experimental data for any of these nuclides in the CSISRS/EXFOR database. Generally, the only data available is the values for the thermal fission and capture cross sections and resonance integrals. In most cases, these values are given on the Chart of the Nuclides (2002).

A brief review for each of the 23 nuclides has been completed. Some of the information is shown in Table 1. Only 6 evaluations include resolved resonance data and 3 evaluations have unresolved resonance data. The values for the thermal cross sections and resonance integrals are given in Table 2. CHECKR, FIZCON, and PSYCHE were executed. Some minor problems (less than 1%) were noted for the sum-up results for the total cross section and the total nubar. Revisions were made to eliminate these problems.

A minor change was made for the Th–228 evaluation. The original file contained resolved resonance parameters as well as a large background capture cross section in MF = 3. Three new levels were added, a bound level and two positive levels above the upper limit of the RRR. The contribution from the new levels replace the MF = 3 background which was eliminated. Details are given in the MF = 1 comments section. A plot of the capture background (Th228.tif) is attached. Note that this is not the capture cross section, just the part that corresponds to the original MF = 3 background.

The evaluation for Th–229 was changed from SLBW to MLBW. The upper limit of the RRR is 9.50 eV which is unchanged. Th–229 has I = 5/2; for L = 0, J = 3 or 2 are allowed. The original evaluation used J = 5/2 which is incorrect and not allowed for MLBW. Values of J = 3 or 2 were assigned by RQW. In addition, small changes were made in the neutron width of the 0.609 eV resonance and the fission width of the 1.260 eV resonance. These

changes result in the 2200–m/s cross-sections and resonance integrals given in Table 2, which are very close to the values in the original SLBW evaluation. Details are given in the MF = 1 comments section.

The evaluation for Cm–249 also had illegal J values. Cm–249 has I = ½; for L = 0, J = 1 or 0 are allowed. The original evaluation used J = ½ which is incorrect. Values of J = 1 or 0 were assigned by RQW. The energy of the bound level was changed from –3.0 eV to –3.3 eV. In addition, the capture widths of the bound level and the 15.0 eV level were increased. These changes result in the 2200–m/s cross-sections and resonance integrals given in Table 2, which are very close to the values in the original evaluation. Details are given in the MF = 1 comments section.

The evaluations have been combined into one file (stanef_rqw.txt) that is attached. STANEF, CHECKR, FIZCON, and PSYCHE were then executed for the combined file. These 23 actinides are recommended for inclusion into ENDF/B-VII.

Table 1. Review of JENDL–3.3 Nuclides

No.	Nuclide	Date	RRR	Cutoff	FW	Fission
1	Ra–223	AUG88	NO			YES
2	Ra–224	AUG88	NO			NO
3	Ra–225	AUG88	NO			NO
4	Ra–226	AUG88	MLBW	1 keV	NO	YES
5	Ac–225	AUG88	NO			NO
6	Ac–226	AUG88	NO			NO
7	Ac–227	AUG88	NO			YES
8	Th–227	AUG88	NO			YES
9	†Th–228	JUN87	MLBW	7.8 eV	NO	YES
10	#Th–229	AUG88	MLBW	9.5 eV	YES	YES
11	Th–233	JUL87	NO			YES
12	Th–234	JUL87	NO			YES
13	Np–235	MAR95	NO			YES
14	Pu–246	MAR95	NO			YES
15	Am–244	MAR88	NO			YES
16	Am–244m	MAR88	NO			YES
17	*Cm–249	OCT95	MLBW	150 eV	YES	YES
18	*Cm–250	OCT95	MLBW	150 eV	YES	YES
19	*Bk–250	MAR87	MLBW	100 eV	YES	YES
20	Cf–254	AUG87	NO			YES
21	Es–254	AUG87	NO			YES
22	Es–255	AUG87	NO			YES
23	Fm–255	AUG87	NO			YES

RRR = resolved resonance region:
SLBW– single level Breit-Wigner
MLBW– multi-level Breit-Wigner
Cutoff = upper limit off RRR
FW = fission widths given for RRR
Fission = fission cross section given in MF = 3
†Th–228 RRR evaluation was revised, see text.
#Th–229 was SLBW, changed to MLBW; RRR evaluation was revised, see text.
*** Unresolved resonance parameters given.**

Table 2. Thermal Cross Sections and Resonance Integrals

No.	Nuclide	Total (barns)	Elastic (barns)	Fission (barns)	Capture (barns)	RIF (barns)	RIC (barns)
1	Ra–223	143.1	12.4	0.70	130.0	1.06	435
2	Ra–224	24.5	12.5		12.0		29.0
3	Ra–225	112.4	12.4		100.0		593
4	Ra–226	22.58	9.80	7 μb	12.78	0.0119	285.6
5	Ac–225	1012.4	12.4		1000.0		1590
6	Ac–226	112.4	12.4		100.0		1680
7	Ac–227	902.4	12.4	0.00029	890.0	0.138	1650
8	Th–227	1794.9	12.4	202.0	1535.0	210	1420
9	†Th–228	156.7	36.5	0.3	119.9	1.02	1160
10	#Th–229	104.98	10.01	31.63	63.34	446	1236
11	Th–233	1478.0	13.0	15.0	1450.0	11.1	643
12	Th–234	14.75	13.0	0.0	1.75	0.26	93.7
13	Np–235	181.4	11.4	20.0	150.0	46.6	851
14	Pu–246	810.8	10.8	0.0	800.0	3.94	696
15	Am–244	2912	11.6	2300	600.0	1260	316
16	Am–244m	2012	11.6	1600	400.0	1260	316
17	*Cm–249	21.28	9.28	10.25	1.75	134	59.1
18	Cm–250	124.9	39.5	0.002	85.3	6.91	304
19	Bk–250	1325	12.22	959.3	353.4	517	199
20	Cf–254	17.10	10.60	2.00	4.50	24.3	6.5
21	Es–254	2004.9	10.60	1966	28.3	1220	18.0
22	Es–255	79.03	10.60	13.43	55.0	93.3	278
23	Fm–255	3396.6	10.60	3360	26.0	1170	101

RIF = fission resonance integral
RIC = capture resonance integral
†Th–228 evaluation was revised, see text for details.
#Th–229 was SLBW, changed to MLBW;
RRR evaluation was revised, see text.
***Cm–249 evaluation was revised, see text for details.**