

NJOY/JACQMIN-01

JEF/DOC-647

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ECCO/ERANOS VALIDATION STUDIES

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1. Introduction

The ECCO/ERANOS calculation scheme uses collision probability methods for cell calculations and has the option to use different deterministic methods at the whole reactor stage, such as nodal Pn.

The scheme is being validated using Monte Carlo methods based on the same JEF-2.2 nuclear data library as the ECCO fine group (plus sub-group).

Calculations have been made for two fast reactor models in RZ geometry, a MASURCA core and a model of the Super-Phenix reactor. Both of these are fuelled with Pu-UO₂ and contain sodium and steel. The blanket regions consist of UO₂, sodium and steel.

Surprisingly large differences have been found between the different methods, with the two Monte Carlo methods differing in reactivity by about 1% in reactivity and the ERANOS result being between the two.

In order to investigate the differences calculations have been made for a series of three zero leakage, uniform compositions: a plutonium oxide region, the core centre composition of the MASURCA core, the core centre composition of the SPX core and a blanket region composition. The reaction rates have been calculated in the standard broad group structure and hence group cross-section have been derived. Using the differences in the cross-sections from the values derived using ECCO the reactivity differences have been calculated. The differences calculated in this way agree with the differences found in the direct calculations.

2. Sources of differences in the cross-sections.

The differences between the cross-sections calculated using the different methods are found to be in the unresolved region and for all cross-sections excepting the Pu-239 cross-sections the two Monte Carlo codes are in

agreement. The differences for the Pu-239 cross-sections explain the differences between the two Monte Carlo codes.

It is clear that:

1 Resonance shielding in the unresolved region is very important in fast reactor calculations. It is important that the Monte Carlo codes be developed to treat this effect.

2 There is a serious inconsistency between different methods of interpreting the Pu-239 unresolved resonance region data. A standard way to interpret the data should be defined.

CELLULE PIT INFINIE

Pu239 FISSON		Section mic	Section mic		Section mic						
Groupe	Energie (MeV)	ECCO	MCNP	Sigma MCNP	T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	2.23E+00	2.26E+00	0.0156	2.31E+00	0.0127	0.01528	0.03819	0.00021	0.00000	0.00001
2	1.00E+01	2.00E+00	1.99E+00	0.0038	2.00E+00	0.0031	-0.00669	0.00070	0.00203	-0.00001	0.00000
3	6.07E+00	1.72E+00	1.72E+00	0.0017	1.72E+00	0.0014	0.00068	-0.00161	0.00704	0.00000	-0.00001
4	3.68E+00	1.90E+00	1.90E+00	0.0011	1.89E+00	0.0010	0.00160	-0.00352	0.01612	0.00003	-0.00006
5	2.23E+00	1.99E+00	1.99E+00	0.0009	1.98E+00	0.0008	-0.00012	-0.00310	0.02200	0.00000	-0.00007
6	1.35E+00	1.78E+00	1.77E+00	0.0008	1.77E+00	0.0008	-0.00121	-0.00090	0.02173	-0.00003	-0.00002
7	8.21E-01	1.64E+00	1.64E+00	0.0007	1.64E+00	0.0006	-0.00015	0.00046	0.03588	-0.00001	0.00002
8	4.98E-01	1.53E+00	1.52E+00	0.0006	1.53E+00	0.0006	-0.00065	0.00009	0.03288	-0.00002	0.00000
9	3.02E-01	1.48E+00	1.48E+00	0.0005	1.48E+00	0.0005	-0.00062	-0.00075	0.04093	-0.00003	-0.00003
10	1.83E-01	1.49E+00	1.49E+00	0.0005	1.49E+00	0.0005	-0.00065	-0.00015	0.04638	-0.00003	-0.00001
11	1.11E-01	1.55E+00	1.55E+00	0.0006	1.54E+00	0.0005	0.00057	-0.00043	0.04405	0.00003	-0.00002
12	6.74E-02	1.57E+00	1.58E+00	0.0006	1.57E+00	0.0006	0.00093	0.00067	0.03866	0.00004	0.00003
13	4.09E-02	1.59E+00	1.66E+00	0.0007	1.59E+00	0.0006	0.04735	-0.00191	0.03334	0.00158	-0.00006
14	2.48E-02	1.67E+00	1.86E+00	0.0008	1.66E+00	0.0007	0.11299	-0.00544	0.03043	0.00344	-0.00017
15	1.50E-02	1.85E+00	1.97E+00	0.0009	1.82E+00	0.0009	0.06619	-0.01702	0.02475	0.00164	-0.00042
16	9.12E-03	2.10E+00	2.25E+00	0.0011	2.13E+00	0.0010	0.07067	0.01099	0.01643	0.00116	0.00018
17	5.53E-03	2.47E+00	2.53E+00	0.0013	2.42E+00	0.0011	0.02581	-0.01659	0.01070	0.00028	-0.00018
18	3.35E-03	3.42E+00	3.15E+00	0.0015	3.09E+00	0.0013	-0.07866	-0.09705	0.00510	-0.00040	-0.00050
19	2.03E-03	4.17E+00	4.21E+00	0.0017	4.18E+00	0.0014	0.00937	0.00239	0.01733	0.00016	0.00004
20	1.23E-03	5.59E+00	5.78E+00	0.0023	5.81E+00	0.0021	0.03322	0.03838	0.01366	0.00045	0.00052
21	7.49E-04	7.06E+00	7.08E+00	0.0039	7.06E+00	0.0035	0.00319	0.00036	0.00739	0.00002	0.00000
22	4.54E-04	6.90E+00	6.87E+00	0.0064	6.80E+00	0.0057	-0.00370	-0.01431	0.00196	-0.00001	-0.00003
23	3.04E-04	1.37E+01	1.39E+01	0.0094	1.39E+01	0.0084	0.01495	0.00976	0.00185	0.00003	0.00002
24	1.49E-04	1.60E+01	1.60E+01	0.0287	1.66E+01	0.0242	0.00116	0.03914	0.00020	0.00000	0.00001
25	9.17E-05	3.62E+01	3.30E+01	0.0692	3.85E+01	0.0612	-0.08697	0.06423	0.00004	0.00000	0.00000
26	6.79E-05	3.93E+01	4.07E+01	0.1432	3.29E+01	0.1347	0.03366	-0.16293	0.00001	0.00000	0.00000
27	4.02E-05	5.05E+00	2.22E+00	0.6687	2.03E+00	0.4281	-0.56042	-0.59777	0.00000	0.00000	0.00000
28	2.26E-05	3.80E+01							0.00000	0.00000	0.00000
29	1.37E-05	2.95E+01							0.00000	0.00000	0.00000
30	8.32E-06	2.06E+01							0.00000	0.00000	0.00000
31	4.00E-06	6.80E+01							0.00000	0.00000	0.00000
32	5.40E-07	5.20E+02							0.00000	0.00000	0.00000
33	1.00E-07	6.17E+02							0.00000	0.00000	0.00000
SOMME		1.76E+00	1.77E+00	0.0004	1.75E+00	0.0004	0.01032	-0.00381	0.47112	0.00832	-0.00073

CELLULE PIT INFINIE

Pu239		CAPTURE									
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	9.79E-07	7.34E-08	0.0201	-8.18E-02	0.0297	-0.92503	#####	0.00000	0.00000	0.00001
2	1.00E+01	1.06E-04	1.07E-04	0.0051	-1.06E-03	0.0074	0.01046	-10.98162	0.00000	0.00000	0.00000
3	6.07E+00	2.82E-03	2.83E-03	0.0019	6.11E-03	0.0036	0.00131	1.16291	-0.00001	0.00000	-0.00001
4	3.68E+00	1.81E-02	1.81E-02	0.0012	2.48E-02	0.0024	0.00357	0.37341	-0.00018	0.00000	-0.00007
5	2.23E+00	4.39E-02	4.40E-02	0.0009	4.95E-02	0.0019	0.00088	0.12698	-0.00057	0.00000	-0.00007
6	1.35E+00	6.82E-02	6.82E-02	0.0008	6.97E-02	0.0019	-0.00027	0.02179	-0.00090	0.00000	-0.00002
7	8.21E-01	1.01E-01	1.01E-01	0.0007	1.01E-01	0.0016	0.00031	-0.00705	-0.00233	0.00000	0.00002
8	4.98E-01	1.53E-01	1.53E-01	0.0006	1.53E-01	0.0014	-0.00084	-0.00059	-0.00310	0.00000	0.00000
9	3.02E-01	1.98E-01	1.98E-01	0.0005	1.99E-01	0.0013	-0.00062	0.00565	-0.00477	0.00000	-0.00003
10	1.83E-01	2.42E-01	2.42E-01	0.0005	2.43E-01	0.0013	-0.00058	0.00113	-0.00596	0.00000	-0.00001
11	1.11E-01	3.06E-01	3.06E-01	0.0006	3.07E-01	0.0013	0.00076	0.00242	-0.00612	0.00000	-0.00001
12	6.74E-02	3.85E-01	3.85E-01	0.0006	3.84E-01	0.0014	0.00096	-0.00259	-0.00592	-0.00001	0.00002
13	4.09E-02	5.03E-01	5.11E-01	0.0007	5.06E-01	0.0015	0.01654	0.00606	-0.00600	-0.00010	-0.00004
14	2.48E-02	7.01E-01	7.26E-01	0.0008	7.11E-01	0.0017	0.03434	0.01322	-0.00699	-0.00024	-0.00009
15	1.50E-02	9.95E-01	1.03E+00	0.0009	1.01E+00	0.0021	0.03407	0.01356	-0.00716	-0.00024	-0.00010
16	9.12E-03	1.46E+00	1.50E+00	0.0011	1.49E+00	0.0023	0.02881	0.02091	-0.00614	-0.00018	-0.00013
17	5.53E-03	2.01E+00	2.08E+00	0.0013	2.06E+00	0.0026	0.03054	0.02457	-0.00482	-0.00015	-0.00012
18	3.35E-03	2.82E+00	2.91E+00	0.0015	2.89E+00	0.0032	0.03049	0.02406	-0.00241	-0.00007	-0.00006
19	2.03E-03	3.07E+00	3.55E+00	0.0016	3.52E+00	0.0034	0.15680	0.14814	-0.00752	-0.00118	-0.00111
20	1.23E-03	3.70E+00	3.73E+00	0.0025	3.66E+00	0.0053	0.00971	-0.00943	-0.00531	-0.00005	0.00005
21	7.49E-04	5.76E+00	5.78E+00	0.0041	5.67E+00	0.0085	0.00331	-0.01487	-0.00382	-0.00001	0.00006
22	4.54E-04	5.60E+00	5.61E+00	0.0075	5.45E+00	0.0150	0.00141	-0.02743	-0.00103	0.00000	0.00003
23	3.04E-04	1.02E+01	1.03E+01	0.0105	1.06E+01	0.0217	0.01371	0.03970	-0.00103	-0.00001	-0.00004
24	1.49E-04	1.06E+01	1.04E+01	0.0340	1.01E+01	0.0604	-0.01645	-0.05111	-0.00011	0.00000	0.00001
25	9.17E-05	1.42E+01	1.20E+01	0.1013	1.18E+01	0.1713	-0.15311	-0.16755	-0.00002	0.00000	0.00000
26	6.79E-05	1.60E+01	1.81E+01	0.1984	1.67E+01	0.3291	0.12707	0.04144	0.00000	0.00000	0.00000
27	4.02E-05	5.09E+00	2.03E+00	0.6894	2.34E+00	0.9778	-0.60032	-0.53975	0.00000	0.00000	0.00000
28	2.26E-05	2.48E+01							0.00000		0.00000
29	1.37E-05	1.89E+01							0.00000		0.00000
30	8.32E-06	1.36E+01							0.00000		0.00000
31	4.00E-06	2.45E+01							0.00000		0.00000
32	5.40E-07	3.10E+02							0.00000		0.00000
33	1.00E-07	2.51E+02							0.00000		0.00000
SOMME		4.54E-01	4.55E-01	0.0008	4.59E-01	0.0011	0.00307	0.01148	-0.08224	-0.00224	-0.00172

CELLULE PIT INFINIE

Pu240 FISSON		Section mic	Section mic		Section mic						
Groupe	Energie (MeV)	ECCO	MCNP	Sigma MCNP	T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	2.14E+00	2.16E+00	0.0155	2.21E+00	0.0126	0.00946	0.03234	0.00005	0.00000	0.00000
2	1.00E+01	1.95E+00	1.93E+00	0.0038	1.95E+00	0.0031	-0.00734	0.00024	0.00046	0.00000	0.00000
3	6.07E+00	1.56E+00	1.56E+00	0.0017	1.56E+00	0.0014	0.00091	-0.00161	0.00149	0.00000	0.00000
4	3.68E+00	1.71E+00	1.71E+00	0.0011	1.70E+00	0.0010	0.00150	-0.00359	0.00339	0.00001	-0.00001
5	2.23E+00	1.66E+00	1.66E+00	0.0009	1.66E+00	0.0008	-0.00022	-0.00327	0.00422	0.00000	-0.00001
6	1.35E+00	1.50E+00	1.50E+00	0.0008	1.50E+00	0.0008	-0.00112	-0.00079	0.00423	0.00000	0.00000
7	8.21E-01	7.92E-01	7.91E-01	0.0007	7.92E-01	0.0007	-0.00103	0.00045	0.00400	0.00000	0.00000
8	4.98E-01	2.22E-01	2.23E-01	0.0006	2.23E-01	0.0006	0.00180	0.00251	0.00110	0.00000	0.00000
9	3.02E-01	1.07E-01	1.07E-01	0.0005	1.07E-01	0.0005	0.00024	-0.00011	0.00068	0.00000	0.00000
10	1.83E-01	7.53E-02	7.51E-02	0.0005	7.52E-02	0.0005	-0.00157	-0.00112	0.00054	0.00000	0.00000
11	1.11E-01	7.52E-02	7.54E-02	0.0006	7.53E-02	0.0006	0.00302	0.00198	0.00049	0.00000	0.00000
12	6.74E-02	7.17E-02	7.17E-02	0.0006	7.17E-02	0.0006	0.00010	-0.00013	0.00040	0.00000	0.00000
13	4.09E-02	9.48E-02	9.24E-02	0.0007	9.23E-02	0.0006	-0.02496	-0.02609	0.00045	-0.00001	-0.00001
14	2.48E-02	7.52E-02	7.78E-02	0.0008	7.78E-02	0.0007	0.03507	0.03434	0.00031	0.00001	0.00001
15	1.50E-02	8.73E-02	8.87E-02	0.0009	8.91E-02	0.0009	0.01680	0.02092	0.00027	0.00000	0.00001
16	9.12E-03	3.84E-02	3.73E-02	0.0011	3.74E-02	0.0010	-0.02852	-0.02586	0.00007	0.00000	0.00000
17	5.53E-03	9.28E-02	9.55E-02	0.0013	9.56E-02	0.0011	0.02946	0.03075	0.00009	0.00000	0.00000
18	3.35E-03	1.79E-01	1.78E-01	0.0040	1.78E-01	0.0034	-0.00487	-0.00585	0.00006	0.00000	0.00000
19	2.03E-03	3.65E-01	3.67E-01	0.0028	3.69E-01	0.0024	0.00525	0.01075	0.00035	0.00000	0.00000
20	1.23E-03	3.66E-01	3.59E-01	0.0054	3.62E-01	0.0047	-0.01975	-0.01063	0.00021	0.00000	0.00000
21	7.49E-04	2.17E-01	1.72E-01	0.0037	1.71E-01	0.0032	-0.20686	-0.20953	0.00005	-0.00001	-0.00001
22	4.54E-04	2.03E-01	2.05E-01	0.0060	2.03E-01	0.0054	0.00817	-0.00181	0.00001	0.00000	0.00000
23	3.04E-04	2.16E-01	2.17E-01	0.0097	2.16E-01	0.0089	0.00269	-0.00007	0.00001	0.00000	0.00000
24	1.49E-04	2.50E-01	2.52E-01	0.0319	2.60E-01	0.0281	0.00563	0.03707	0.00000	0.00000	0.00000
25	9.17E-05	1.58E-01	9.39E-02	0.1604	1.49E-01	0.1029	-0.40620	-0.05627	0.00000	0.00000	0.00000
26	6.79E-05	1.87E-01	2.06E-01	0.2291	2.51E-01	0.2168	0.10156	0.34304	0.00000	0.00000	0.00000
27	4.02E-05	2.04E-01	1.16E-01	0.6419	3.40E-01	0.6718	-0.43341	0.66466	0.00000	0.00000	0.00000
28	2.26E-05	1.71E-01							0.00000		0.00000
29	1.37E-05	9.57E-04							0.00000		0.00000
30	8.32E-06	1.16E-03							0.00000		0.00000
31	4.00E-06	1.43E-01							0.00000		0.00000
32	5.40E-07	3.95E-02							0.00000		0.00000
33	1.00E-07	5.47E-02							0.00000		0.00000
SOMME		4.03E-01	4.05E-01	0.0004	4.03E-01	0.0004	0.00475	-0.00062	0.02292	-0.00001	-0.00003

CELLULE PIT INFINIE

Pu240 CAPTURE		Section mic	Section mic		Section mic						
Groupe	Energie (MeV)	ECCO	MCNP	Sigma MCNP	T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	1.01E-03	1.22E-03	0.0157	-7.97E-02	0.0296	0.20398	-79.72692	0.00000	0.00000	0.00000
2	1.00E+01	9.91E-04	9.87E-04	0.0038	1.51E-04	0.0074	-0.00430	-0.84789	0.00000	0.00000	0.00000
3	6.07E+00	6.34E-03	6.34E-03	0.0019	9.30E-03	0.0036	0.00003	0.46776	-0.00001	0.00000	0.00000
4	3.68E+00	4.11E-02	4.10E-02	0.0012	4.71E-02	0.0024	-0.00024	0.14708	-0.00010	0.00000	-0.00001
5	2.23E+00	7.95E-02	7.95E-02	0.0009	8.42E-02	0.0019	0.00007	0.05820	-0.00025	0.00000	-0.00001
6	1.35E+00	9.90E-02	9.89E-02	0.0008	1.00E-01	0.0019	-0.00073	0.01244	-0.00031	0.00000	0.00000
7	8.21E-01	1.52E-01	1.52E-01	0.0007	1.52E-01	0.0016	0.00036	-0.00085	-0.00084	0.00000	0.00000
8	4.98E-01	1.83E-01	1.83E-01	0.0006	1.83E-01	0.0014	-0.00052	0.00045	-0.00090	0.00000	0.00000
9	3.02E-01	2.17E-01	2.17E-01	0.0005	2.17E-01	0.0013	-0.00003	0.00136	-0.00126	0.00000	0.00000
10	1.83E-01	3.04E-01	3.04E-01	0.0005	3.04E-01	0.0013	-0.00027	0.00050	-0.00181	0.00000	0.00000
11	1.11E-01	4.09E-01	4.09E-01	0.0006	4.09E-01	0.0013	0.00043	0.00002	-0.00198	0.00000	0.00000
12	6.74E-02	5.57E-01	5.58E-01	0.0006	5.57E-01	0.0014	0.00085	-0.00006	-0.00208	0.00000	0.00000
13	4.09E-02	8.05E-01	7.06E-01	0.0007	7.07E-01	0.0016	-0.12264	-0.12250	-0.00233	0.00029	0.00029
14	2.48E-02	9.52E-01	8.74E-01	0.0008	8.76E-01	0.0017	-0.08159	-0.08040	-0.00230	0.00019	0.00018
15	1.50E-02	1.11E+00	1.10E+00	0.0009	1.10E+00	0.0021	-0.00912	-0.00840	-0.00193	0.00002	0.00002
16	9.12E-03	1.39E+00	1.38E+00	0.0011	1.39E+00	0.0023	-0.00728	-0.00543	-0.00142	0.00001	0.00001
17	5.53E-03	1.72E+00	1.73E+00	0.0013	1.73E+00	0.0027	0.00627	0.00632	-0.00100	-0.00001	-0.00001
18	3.35E-03	2.24E+00	2.28E+00	0.0021	2.29E+00	0.0043	0.01828	0.01965	-0.00047	-0.00001	-0.00001
19	2.03E-03	2.92E+00	2.90E+00	0.0021	2.87E+00	0.0042	-0.00801	-0.01584	-0.00173	0.00001	0.00003
20	1.23E-03	4.25E+00	4.19E+00	0.0030	4.16E+00	0.0067	-0.01343	-0.01904	-0.00148	0.00002	0.00003
21	7.49E-04	4.17E+00	4.37E+00	0.0056	4.30E+00	0.0119	0.04735	0.03206	-0.00067	-0.00003	-0.00002
22	4.54E-04	7.84E+00	7.95E+00	0.0094	8.04E+00	0.0209	0.01361	0.02602	-0.00035	0.00000	-0.00001
23	3.04E-04	8.24E+00	8.22E+00	0.0167	8.14E+00	0.0324	-0.00314	-0.01238	-0.00020	0.00000	0.00000
24	1.49E-04	1.45E+01	1.54E+01	0.0527	1.53E+01	0.1153	0.05916	0.05411	-0.00004	0.00000	0.00000
25	9.17E-05	2.19E+01	1.32E+01	0.1627	1.76E+01	0.2979	-0.39883	-0.19467	-0.00001	0.00000	0.00000
26	6.79E-05	2.66E+01	2.91E+01	0.2285	3.59E+01	0.7758	0.09524	0.34981	0.00000	0.00000	0.00000
27	4.02E-05	2.79E+01	1.58E+01	0.6419	6.72E-01	0.6872	-0.43300	-0.97590	0.00000	0.00000	0.00000
28	2.26E-05	2.34E+01							0.00000		0.00000
29	1.37E-05	3.06E-01							0.00000		0.00000
30	8.32E-06	1.42E+00							0.00000		0.00000
31	4.00E-06	7.34E+02							0.00000		0.00000
32	5.40E-07	1.88E+02							0.00000		0.00000
33	1.00E-07	2.35E+02							0.00000		0.00000
SOMME		5.30E-01	5.08E-01	0.0007	5.14E-01	0.0011	-0.04283	-0.03006	-0.02347	0.00048	0.00047

CELLULE PIT INFINIE

U238		FISSION									
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	1.06E+00	1.01E+00	0.0156	1.04E+00	0.0127	-0.04501	-0.02274	0.00028	-0.00001	-0.00001
2	1.00E+01	8.84E-01	8.77E-01	0.0038	8.84E-01	0.0031	-0.00791	-0.00036	0.00231	-0.00002	0.00000
3	6.07E+00	5.49E-01	5.50E-01	0.0017	5.48E-01	0.0015	0.00097	-0.00171	0.00542	0.00001	-0.00001
4	3.68E+00	5.30E-01	5.31E-01	0.0011	5.28E-01	0.0010	0.00179	-0.00328	0.00970	0.00002	-0.00003
5	2.23E+00	4.19E-01	4.18E-01	0.0009	4.17E-01	0.0008	-0.00126	-0.00509	0.01033	-0.00001	-0.00005
6	1.35E+00	2.94E-02	2.92E-02	0.0010	2.93E-02	0.0009	-0.00432	-0.00327	0.00086	0.00000	0.00000
7	8.21E-01	1.42E-03	1.42E-03	0.0008	1.42E-03	0.0007	-0.00025	0.00223	0.00008	0.00000	0.00000
8	4.98E-01	2.26E-04	2.26E-04	0.0006	2.26E-04	0.0006	0.00120	-0.00045	0.00001	0.00000	0.00000
9	3.02E-01	7.73E-05	7.72E-05	0.0005	7.69E-05	0.0005	-0.00061	-0.00462	0.00001	0.00000	0.00000
10	1.83E-01	2.00E-04	2.19E-04	0.0011	2.19E-04	0.0010	0.09932	0.09904	0.00002	0.00000	0.00000
11	1.11E-01	3.51E-05	3.51E-05	0.0007	3.70E-05	0.0006	-0.00003	0.05548	0.00000	0.00000	0.00000
12	6.74E-02	8.35E-05	9.32E-05	0.0013	8.85E-05	0.0012	0.11579	0.05955	0.00001	0.00000	0.00000
13	4.09E-02	3.39E-05	4.03E-05	0.0023	3.95E-05	0.0020	0.18979	0.16611	0.00000	0.00000	0.00000
14	2.48E-02	7.97E-05	9.47E-05	0.0036	9.53E-05	0.0031	0.18849	0.19539	0.00000	0.00000	0.00000
15	1.50E-02	4.24E-04	5.85E-04	0.0079	5.90E-04	0.0067	0.37999	0.39107	0.00002	0.00001	0.00001
16	9.12E-03	9.21E-05	9.23E-05	0.0060	9.25E-05	0.0052	0.00275	0.00429	0.00000	0.00000	0.00000
17	5.53E-03	7.70E-09	7.72E-09	0.0014	7.71E-09	0.0012	0.00289	0.00160	0.00000	0.00000	0.00000
18	3.35E-03	2.23E-09	2.32E-09	0.0017	2.33E-09	0.0014	0.04234	0.04613	0.00000	0.00000	0.00000
19	2.03E-03	1.59E-07	1.62E-07	0.0029	1.62E-07	0.0024	0.01661	0.02087	0.00000	0.00000	0.00000
20	1.23E-03	6.28E-04	6.87E-04	0.0139	6.91E-04	0.0122	0.09438	0.10062	0.00000	0.00000	0.00000
21	7.49E-04	2.55E-03	2.63E-03	0.0186	2.59E-03	0.0165	0.03170	0.01572	0.00001	0.00000	0.00000
22	4.54E-04	2.39E-06	2.49E-06	0.0171	2.42E-06	0.0152	0.04251	0.01377	0.00000	0.00000	0.00000
23	3.04E-04	1.66E-06	1.73E-06	0.0207	1.68E-06	0.0177	0.04433	0.00917	0.00000	0.00000	0.00000
24	1.49E-04	5.14E-07	5.15E-07	0.0578	5.46E-07	0.0488	0.00165	0.06118	0.00000	0.00000	0.00000
25	9.17E-05	3.24E-06	2.71E-06	0.2106	3.62E-06	0.1877	-0.16416	0.11940	0.00000	0.00000	0.00000
26	6.79E-05	1.01E-05	1.09E-05	0.1845	7.28E-06	0.1594	0.07569	-0.27990	0.00000	0.00000	0.00000
27	4.02E-05	3.00E-06	1.83E-06	0.5520	1.42E-06	0.3680	-0.38908	-0.52810	0.00000	0.00000	0.00000
28	2.26E-05	2.93E-05							0.00000		0.00000
29	1.37E-05	5.55E-07							0.00000		0.00000
30	8.32E-06	4.77E-06							0.00000		0.00000
31	4.00E-06	2.29E-06							0.00000		0.00000
32	5.40E-07	3.39E-06							0.00000		0.00000
33	1.00E-07	9.21E-06							0.00000		0.00000
SOMME		5.15E-02	5.19E-02	0.0007	5.13E-02	0.0006	0.00795	-0.00312	0.02905	-0.00002	-0.00009

CELLULE PIT INFINIE

U238 CAPTURE											
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	9.98E-04	1.18E-03	0.0156	-3.41E-02	0.0297	0.18201	-35.20399	0.00000	0.00000	0.00001
2	1.00E+01	1.18E-03	1.18E-03	0.0038	9.84E-04	0.0074	-0.00439	-0.16671	0.00000	0.00000	0.00000
3	6.07E+00	4.10E-03	4.12E-03	0.0018	5.14E-03	0.0036	0.00286	0.25346	-0.00006	0.00000	-0.00001
4	3.68E+00	2.24E-02	2.25E-02	0.0012	2.43E-02	0.0024	0.00376	0.08511	-0.00079	0.00000	-0.00007
5	2.23E+00	5.97E-02	5.98E-02	0.0009	6.09E-02	0.0020	0.00132	0.02014	-0.00267	0.00000	-0.00005
6	1.35E+00	1.12E-01	1.12E-01	0.0008	1.12E-01	0.0019	-0.00011	0.00118	-0.00504	0.00000	-0.00001
7	8.21E-01	1.14E-01	1.14E-01	0.0007	1.14E-01	0.0016	-0.00020	0.00004	-0.00901	0.00000	0.00000
8	4.98E-01	1.12E-01	1.12E-01	0.0006	1.12E-01	0.0014	-0.00064	0.00004	-0.00784	0.00001	0.00000
9	3.02E-01	1.22E-01	1.23E-01	0.0005	1.23E-01	0.0013	0.00268	0.00334	-0.01012	-0.00003	-0.00003
10	1.83E-01	1.46E-01	1.47E-01	0.0005	1.47E-01	0.0013	0.00723	0.00793	-0.01234	-0.00009	-0.00010
11	1.11E-01	1.96E-01	1.99E-01	0.0006	1.99E-01	0.0013	0.01386	0.01330	-0.01353	-0.00019	-0.00018
12	6.74E-02	3.06E-01	3.12E-01	0.0006	3.12E-01	0.0014	0.02139	0.02063	-0.01616	-0.00035	-0.00033
13	4.09E-02	4.18E-01	4.30E-01	0.0007	4.30E-01	0.0016	0.03000	0.03007	-0.01714	-0.00051	-0.00052
14	2.48E-02	5.11E-01	5.37E-01	0.0008	5.37E-01	0.0017	0.05026	0.05148	-0.01752	-0.00088	-0.00090
15	1.50E-02	6.08E-01	6.46E-01	0.0010	6.46E-01	0.0021	0.06204	0.06284	-0.01505	-0.00093	-0.00095
16	9.12E-03	6.79E-01	6.79E-01	0.0013	6.78E-01	0.0027	-0.00060	-0.00202	-0.00982	0.00001	0.00002
17	5.53E-03	7.83E-01	7.85E-01	0.0016	7.84E-01	0.0035	0.00267	0.00164	-0.00645	-0.00002	-0.00001
18	3.35E-03	1.06E+00	1.06E+00	0.0022	1.07E+00	0.0046	-0.00056	0.00638	-0.00312	0.00000	-0.00002
19	2.03E-03	8.78E-01	8.79E-01	0.0023	8.81E-01	0.0046	0.00161	0.00357	-0.00740	-0.00001	-0.00003
20	1.23E-03	1.21E+00	1.22E+00	0.0031	1.21E+00	0.0068	0.00609	0.00001	-0.00597	-0.00004	0.00000
21	7.49E-04	1.28E+00	1.29E+00	0.0052	1.28E+00	0.0110	0.01194	0.00703	-0.00291	-0.00003	-0.00002
22	4.54E-04	1.18E+00	1.19E+00	0.0113	1.22E+00	0.0248	0.01010	0.03503	-0.00075	-0.00001	-0.00003
23	3.04E-04	1.67E+00	1.72E+00	0.0145	1.67E+00	0.0335	0.02684	-0.00401	-0.00058	-0.00002	0.00000
24	1.49E-04	1.92E+00	1.96E+00	0.0449	1.92E+00	0.0945	0.01889	-0.00443	-0.00007	0.00000	0.00000
25	9.17E-05	1.65E+00	1.33E+00	0.1700	1.13E+00	0.3431	-0.19236	-0.31126	-0.00001	0.00000	0.00000
26	6.79E-05	4.49E+00	4.81E+00	0.1843	2.66E+00	0.4250	0.07262	-0.40694	0.00000	0.00000	0.00000
27	4.02E-05	6.01E+00	4.37E+00	0.5470	5.68E+00	0.8557	-0.27277	-0.05468	0.00000	0.00000	0.00000
28	2.26E-05	1.24E+01							0.00000		0.00000
29	1.37E-05	5.32E-01							0.00000		0.00000
30	8.32E-06	9.02E+00							0.00000		0.00000
31	4.00E-06	5.73E-01							0.00000		0.00000
32	5.40E-07	8.03E-01							0.00000		0.00000
33	1.00E-07	2.13E+00							0.00000		0.00000
SOMME		2.58E-01	2.59E-01	0.0006	2.62E-01	0.0012	0.00530	0.01593	-0.16436	-0.00309	-0.00322

CELLULE PIT INFINIE

U238		ELASTIQUE									
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	2.94E+00	2.88E+00	0.0155	2.84E+00	0.0212	-0.01991	-0.03371	0.00000	0.00000	0.00000
2	1.00E+01	3.53E+00	3.51E+00	0.0038	3.54E+00	0.0054	-0.00564	0.00237	-0.00001	0.00000	0.00000
3	6.07E+00	4.22E+00	4.22E+00	0.0017	4.22E+00	0.0025	0.00033	0.00055	0.00000	0.00000	0.00000
4	3.68E+00	3.97E+00	3.98E+00	0.0011	3.97E+00	0.0017	0.00115	-0.00191	-0.00004	0.00000	0.00000
5	2.23E+00	3.48E+00	3.48E+00	0.0009	3.48E+00	0.0014	0.00028	-0.00079	-0.00010	0.00000	0.00000
6	1.35E+00	4.28E+00	4.28E+00	0.0008	4.28E+00	0.0013	-0.00059	-0.00041	-0.00009	0.00000	0.00000
7	8.21E-01	6.10E+00	6.10E+00	0.0007	6.10E+00	0.0011	0.00025	0.00014	-0.00044	0.00000	0.00000
8	4.98E-01	7.67E+00	7.66E+00	0.0006	7.67E+00	0.0010	-0.00079	0.00054	-0.00048	0.00000	0.00000
9	3.02E-01	9.12E+00	9.15E+00	0.0005	9.15E+00	0.0009	0.00276	0.00334	-0.00084	0.00000	0.00000
10	1.83E-01	1.04E+01	1.05E+01	0.0005	1.05E+01	0.0009	0.00606	0.00672	-0.00078	0.00000	-0.00001
11	1.11E-01	1.15E+01	1.16E+01	0.0006	1.16E+01	0.0009	0.01170	0.01054	-0.00076	-0.00001	-0.00001
12	6.74E-02	1.24E+01	1.26E+01	0.0006	1.26E+01	0.0010	0.01865	0.01869	-0.00054	-0.00001	-0.00001
13	4.09E-02	1.29E+01	1.32E+01	0.0007	1.32E+01	0.0011	0.02768	0.02750	-0.00035	-0.00001	-0.00001
14	2.48E-02	1.31E+01	1.38E+01	0.0008	1.38E+01	0.0013	0.05408	0.05381	-0.00012	-0.00001	-0.00001
15	1.50E-02	1.32E+01	1.41E+01	0.0009	1.41E+01	0.0015	0.06310	0.06644	-0.00001	0.00000	0.00000
16	9.12E-03	1.37E+01	1.37E+01	0.0011	1.37E+01	0.0017	-0.00240	-0.00094	0.00004	0.00000	0.00000
17	5.53E-03	1.43E+01	1.43E+01	0.0013	1.43E+01	0.0019	0.00023	0.00088	0.00002	0.00000	0.00000
18	3.35E-03	1.61E+01	1.61E+01	0.0016	1.61E+01	0.0025	-0.00086	0.00057	0.00003	0.00000	0.00000
19	2.03E-03	1.36E+01	1.37E+01	0.0017	1.37E+01	0.0024	0.00394	0.00845	0.00001	0.00000	0.00000
20	1.23E-03	1.31E+01	1.32E+01	0.0023	1.32E+01	0.0036	0.00240	0.00784	0.00003	0.00000	0.00000
21	7.49E-04	1.24E+01	1.25E+01	0.0034	1.25E+01	0.0053	0.00543	0.00603	0.00000	0.00000	0.00000
22	4.54E-04	1.26E+01	1.27E+01	0.0057	1.26E+01	0.0093	0.00624	0.00124	0.00001	0.00000	0.00000
23	3.04E-04	1.47E+01	1.50E+01	0.0092	1.50E+01	0.0148	0.01988	0.02190	0.00000	0.00000	0.00000
24	1.49E-04	1.44E+01	1.42E+01	0.0277	1.51E+01	0.0421	-0.01104	0.04825	0.00000	0.00000	0.00000
25	9.17E-05	1.09E+01	1.05E+01	0.0683	1.17E+01	0.1113	-0.03795	0.06990	0.00000	0.00000	0.00000
26	6.79E-05	1.42E+01	1.34E+01	0.1328	1.33E+01	0.2055	-0.05748	-0.06064	0.00000	0.00000	0.00000
27	4.02E-05	1.80E+01	1.38E+01	0.5440	7.87E+00	0.6574	-0.23164	-0.56276	0.00000	0.00000	0.00000
28	2.26E-05	1.36E+01							0.00000		0.00000
29	1.37E-05	9.23E+00							0.00000		0.00000
30	8.32E-06	9.60E+00							0.00000		0.00000
31	4.00E-06	9.20E+00							0.00000		0.00000
32	5.40E-07	9.30E+00							0.00000		0.00000
33	1.00E-07	9.36E+00							0.00000		0.00000
SOMME		9.62E+00	9.73E+00	0.0004	9.76E+00	0.0007	0.01176	0.01496	-0.00441	-0.00004	-0.00004

CELLULE PIT INFINIE

Fe56 ELASTIQUE											
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	1.40E+00	1.53E+00	0.0156	1.51E+00	0.0213	0.09334	0.07585	0.00000	0.00000	0.00000
2	1.00E+01	2.04E+00	2.02E+00	0.0038	2.04E+00	0.0054	-0.00587	0.00213	-0.00002	0.00000	0.00000
3	6.07E+00	2.32E+00	2.31E+00	0.0017	2.31E+00	0.0025	-0.00533	-0.00500	-0.00001	0.00000	0.00000
4	3.68E+00	2.36E+00	2.33E+00	0.0011	2.33E+00	0.0017	-0.01055	-0.01379	-0.00030	0.00000	0.00000
5	2.23E+00	2.15E+00	2.14E+00	0.0009	2.14E+00	0.0015	-0.00251	-0.00432	-0.00059	0.00000	0.00000
6	1.35E+00	2.20E+00	2.21E+00	0.0009	2.21E+00	0.0014	0.00244	0.00382	-0.00038	0.00000	0.00000
7	8.21E-01	2.76E+00	2.76E+00	0.0007	2.76E+00	0.0012	-0.00036	0.00059	-0.00163	0.00000	0.00000
8	4.98E-01	3.29E+00	3.29E+00	0.0006	3.29E+00	0.0010	-0.00092	0.00121	-0.00049	0.00000	0.00000
9	3.02E-01	3.34E+00	3.34E+00	0.0006	3.34E+00	0.0010	-0.00110	-0.00072	-0.00188	0.00000	0.00000
10	1.83E-01	3.11E+00	3.10E+00	0.0006	3.10E+00	0.0011	-0.00239	-0.00194	-0.00111	0.00000	0.00000
11	1.11E-01	4.47E+00	4.47E+00	0.0006	4.47E+00	0.0010	0.00029	-0.00051	-0.00068	0.00000	0.00000
12	6.74E-02	4.09E+00	4.10E+00	0.0007	4.10E+00	0.0010	0.00138	0.00169	-0.00127	0.00000	0.00000
13	4.09E-02	1.25E+01	1.26E+01	0.0007	1.26E+01	0.0012	0.00154	0.00108	-0.00018	0.00000	0.00000
14	2.48E-02	1.60E+00	1.59E+00	0.0009	1.59E+00	0.0013	-0.00435	-0.00234	-0.00013	0.00000	0.00000
15	1.50E-02	3.75E+00	3.75E+00	0.0009	3.76E+00	0.0015	-0.00102	0.00217	-0.00001	0.00000	0.00000
16	9.12E-03	4.99E+00	4.98E+00	0.0011	4.99E+00	0.0017	-0.00142	0.00077	0.00009	0.00000	0.00000
17	5.53E-03	6.02E+00	6.03E+00	0.0013	6.03E+00	0.0019	0.00007	0.00126	0.00005	0.00000	0.00000
18	3.35E-03	7.46E+00	7.46E+00	0.0015	7.47E+00	0.0023	-0.00055	0.00033	0.00008	0.00000	0.00000
19	2.03E-03	8.38E+00	8.36E+00	0.0016	8.39E+00	0.0024	-0.00227	0.00115	0.00002	0.00000	0.00000
20	1.23E-03	9.37E+00	9.38E+00	0.0022	9.43E+00	0.0035	0.00082	0.00633	0.00013	0.00000	0.00000
21	7.49E-04	1.02E+01	1.02E+01	0.0033	1.02E+01	0.0053	0.00222	0.00276	0.00001	0.00000	0.00000
22	4.54E-04	1.08E+01	1.08E+01	0.0056	1.07E+01	0.0091	0.00315	-0.00172	0.00006	0.00000	0.00000
23	3.04E-04	1.12E+01	1.13E+01	0.0090	1.14E+01	0.0143	0.00487	0.01460	0.00000	0.00000	0.00000
24	1.49E-04	1.16E+01	1.15E+01	0.0261	1.23E+01	0.0409	-0.01088	0.05907	0.00000	0.00000	0.00000
25	9.17E-05	1.18E+01	1.14E+01	0.0660	1.25E+01	0.1088	-0.03373	0.06179	0.00000	0.00000	0.00000
26	6.79E-05	1.19E+01	1.11E+01	0.1408	1.05E+01	0.2274	-0.06461	-0.11591	0.00000	0.00000	0.00000
27	4.02E-05	1.20E+01	6.09E+00	0.7497	6.49E+00	0.8765	-0.49069	-0.45685	0.00000	0.00000	0.00000
28	2.26E-05	1.20E+01							0.00000		0.00000
29	1.37E-05	1.20E+01							0.00000		0.00000
30	8.32E-06	1.21E+01							0.00000		0.00000
31	4.00E-06	1.21E+01							0.00000		0.00000
32	5.40E-07	1.21E+01							0.00000		0.00000
33	1.00E-07	1.22E+01							0.00000		0.00000
SOMME		4.08E+00	4.06E+00	0.0004	4.07E+00	0.0007	-0.00477	-0.00147	-0.00824	0.00001	0.00001

CELLULE PIT INFINIE

Cr52 ELASTIQUE		Section mic	Section mic		Section mic						
Groupe	Energie (MeV)	ECCO	MCNP	Sigma MCNP	T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	1.29E+00	1.40E+00	0.0156	1.38E+00	0.0213	0.09121	0.07336	0.00000	0.00000	0.00000
2	1.00E+01	2.01E+00	2.00E+00	0.0038	2.02E+00	0.0054	-0.00396	0.00402	-0.00001	0.00000	0.00000
3	6.07E+00	2.49E+00	2.50E+00	0.0017	2.50E+00	0.0025	0.00094	0.00118	0.00000	0.00000	0.00000
4	3.68E+00	2.79E+00	2.80E+00	0.0011	2.79E+00	0.0017	0.00232	-0.00093	-0.00010	0.00000	0.00000
5	2.23E+00	3.14E+00	3.14E+00	0.0009	3.14E+00	0.0014	-0.00008	-0.00095	-0.00026	0.00000	0.00000
6	1.35E+00	3.59E+00	3.59E+00	0.0008	3.59E+00	0.0013	-0.00014	0.00031	-0.00014	0.00000	0.00000
7	8.21E-01	4.06E+00	4.07E+00	0.0007	4.38E+00	0.0011	0.00133	0.07919	-0.00056	0.00000	-0.00004
8	4.98E-01	3.68E+00	3.67E+00	0.0006	3.67E+00	0.0011	-0.00221	-0.00095	-0.00017	0.00000	0.00000
9	3.02E-01	3.13E+00	3.13E+00	0.0006	3.13E+00	0.0010	-0.00124	-0.00034	-0.00046	0.00000	0.00000
10	1.83E-01	5.80E+00	5.79E+00	0.0006	5.79E+00	0.0010	-0.00076	-0.00043	-0.00053	0.00000	0.00000
11	1.11E-01	5.80E+00	5.80E+00	0.0007	5.80E+00	0.0012	0.00011	-0.00079	-0.00008	0.00000	0.00000
12	6.74E-02	4.70E+00	4.73E+00	0.0009	4.72E+00	0.0014	0.00692	0.00519	-0.00001	0.00000	0.00000
13	4.09E-02	8.38E-01	8.36E-01	0.0010	8.37E-01	0.0016	-0.00225	-0.00052	-0.00004	0.00000	0.00000
14	2.48E-02	1.30E+00	1.30E+00	0.0010	1.30E+00	0.0015	-0.00020	0.00011	-0.00002	0.00000	0.00000
15	1.50E-02	1.57E+00	1.57E+00	0.0009	1.57E+00	0.0015	-0.00079	0.00239	0.00000	0.00000	0.00000
16	9.12E-03	1.86E+00	1.86E+00	0.0011	1.86E+00	0.0017	-0.00148	0.00068	0.00001	0.00000	0.00000
17	5.53E-03	2.11E+00	2.11E+00	0.0013	2.11E+00	0.0019	0.00005	0.00122	0.00000	0.00000	0.00000
18	3.35E-03	2.40E+00	2.40E+00	0.0015	2.40E+00	0.0023	-0.00060	0.00023	0.00001	0.00000	0.00000
19	2.03E-03	2.57E+00	2.56E+00	0.0016	2.57E+00	0.0024	-0.00290	0.00051	0.00000	0.00000	0.00000
20	1.23E-03	2.68E+00	2.68E+00	0.0022	2.70E+00	0.0035	0.00078	0.00635	0.00001	0.00000	0.00000
21	7.49E-04	2.78E+00	2.79E+00	0.0033	2.79E+00	0.0053	0.00221	0.00274	0.00000	0.00000	0.00000
22	4.54E-04	2.84E+00	2.85E+00	0.0056	2.84E+00	0.0091	0.00317	-0.00180	0.00000	0.00000	0.00000
23	3.04E-04	2.88E+00	2.90E+00	0.0090	2.93E+00	0.0143	0.00496	0.01459	0.00000	0.00000	0.00000
24	1.49E-04	2.92E+00	2.89E+00	0.0261	3.09E+00	0.0409	-0.01082	0.05922	0.00000	0.00000	0.00000
25	9.17E-05	2.93E+00	2.84E+00	0.0660	3.12E+00	0.1088	-0.03378	0.06169	0.00000	0.00000	0.00000
26	6.79E-05	2.94E+00	2.75E+00	0.1408	2.60E+00	0.2273	-0.06445	-0.11546	0.00000	0.00000	0.00000
27	4.02E-05	2.95E+00	1.50E+00	0.7496	1.60E+00	0.8765	-0.49033	-0.45722	0.00000	0.00000	0.00000
28	2.26E-05	2.95E+00							0.00000		0.00000
29	1.37E-05	2.96E+00							0.00000		0.00000
30	8.32E-06	2.96E+00							0.00000		0.00000
31	4.00E-06	2.96E+00							0.00000		0.00000
32	5.40E-07	2.96E+00							0.00000		0.00000
33	1.00E-07	2.98E+00							0.00000		0.00000
SOMME		3.59E+00	3.60E+00	0.0004	3.63E+00	0.0007	0.00364	0.00982	-0.00234	0.00000	-0.00004

CELLULE PIT INFINIE

Ni58 ELASTIQUE											
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	1.44E+00	1.59E+00	0.0156	1.57E+00	0.0214	0.11050	0.09290	0.00000	0.00000	0.00000
2	1.00E+01	1.94E+00	1.93E+00	0.0038	1.95E+00	0.0054	-0.00495	0.00306	0.00000	0.00000	0.00000
3	6.07E+00	2.07E+00	2.07E+00	0.0017	2.07E+00	0.0025	-0.00059	-0.00051	0.00000	0.00000	0.00000
4	3.68E+00	2.32E+00	2.33E+00	0.0011	2.32E+00	0.0017	0.00574	0.00176	-0.00003	0.00000	0.00000
5	2.23E+00	2.75E+00	2.75E+00	0.0009	2.75E+00	0.0014	0.00104	0.00007	-0.00009	0.00000	0.00000
6	1.35E+00	3.21E+00	3.20E+00	0.0008	3.20E+00	0.0014	-0.00067	-0.00064	-0.00005	0.00000	0.00000
7	8.21E-01	3.31E+00	3.32E+00	0.0007	3.32E+00	0.0012	0.00202	0.00216	-0.00018	0.00000	0.00000
8	4.98E-01	4.42E+00	4.42E+00	0.0006	4.42E+00	0.0010	0.00103	0.00156	-0.00020	0.00000	0.00000
9	3.02E-01	6.05E+00	6.05E+00	0.0006	6.06E+00	0.0010	-0.00036	0.00059	-0.00015	0.00000	0.00000
10	1.83E-01	5.85E+00	5.83E+00	0.0006	5.83E+00	0.0011	-0.00281	-0.00258	-0.00021	0.00000	0.00000
11	1.11E-01	8.43E+00	8.43E+00	0.0006	8.42E+00	0.0010	-0.00004	-0.00129	-0.00066	0.00000	0.00000
12	6.74E-02	9.18E+00	9.19E+00	0.0008	9.18E+00	0.0013	0.00043	-0.00078	-0.00015	0.00000	0.00000
13	4.09E-02	1.09E+01	1.09E+01	0.0007	1.09E+01	0.0011	-0.00073	-0.00033	-0.00024	0.00000	0.00000
14	2.48E-02	4.27E+01	4.26E+01	0.0009	4.27E+01	0.0014	-0.00380	-0.00181	-0.00066	0.00000	0.00000
15	1.50E-02	1.07E+01	1.07E+01	0.0013	1.08E+01	0.0019	0.00310	0.00824	0.00000	0.00000	0.00000
16	9.12E-03	1.03E+01	1.02E+01	0.0011	1.03E+01	0.0017	-0.00154	0.00062	0.00002	0.00000	0.00000
17	5.53E-03	1.46E+01	1.46E+01	0.0013	1.47E+01	0.0019	-0.00005	0.00119	0.00001	0.00000	0.00000
18	3.35E-03	1.87E+01	1.87E+01	0.0015	1.87E+01	0.0023	-0.00058	0.00048	0.00002	0.00000	0.00000
19	2.03E-03	2.05E+01	2.04E+01	0.0016	2.05E+01	0.0024	-0.00223	0.00119	0.00000	0.00000	0.00000
20	1.23E-03	2.20E+01	2.20E+01	0.0022	2.21E+01	0.0035	0.00079	0.00636	0.00003	0.00000	0.00000
21	7.49E-04	2.30E+01	2.31E+01	0.0033	2.31E+01	0.0053	0.00221	0.00278	0.00000	0.00000	0.00000
22	4.54E-04	2.36E+01	2.37E+01	0.0056	2.36E+01	0.0091	0.00317	-0.00181	0.00001	0.00000	0.00000
23	3.04E-04	2.41E+01	2.42E+01	0.0090	2.44E+01	0.0143	0.00495	0.01459	0.00000	0.00000	0.00000
24	1.49E-04	2.44E+01	2.42E+01	0.0261	2.59E+01	0.0409	-0.01083	0.05921	0.00000	0.00000	0.00000
25	9.17E-05	2.46E+01	2.37E+01	0.0660	2.61E+01	0.1088	-0.03377	0.06170	0.00000	0.00000	0.00000
26	6.79E-05	2.46E+01	2.30E+01	0.1408	2.18E+01	0.2273	-0.06446	-0.11549	0.00000	0.00000	0.00000
27	4.02E-05	2.47E+01	1.26E+01	0.7496	1.34E+01	0.8765	-0.49036	-0.45720	0.00000	0.00000	0.00000
28	2.26E-05	2.47E+01							0.00000		0.00000
29	1.37E-05	2.48E+01							0.00000		0.00000
30	8.32E-06	2.48E+01							0.00000		0.00000
31	4.00E-06	2.48E+01							0.00000		0.00000
32	5.40E-07	2.48E+01							0.00000		0.00000
33	1.00E-07	2.50E+01							0.00000		0.00000
SOMME		9.10E+00	9.00E+00	0.0005	9.07E+00	0.0009	-0.01049	-0.00245	-0.00252	0.00000	0.00000

CELLULE PIT INFINIE

O ELASTIQUE											
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	9.11E-01	8.90E-01	0.0158	8.73E-01	0.0213	-0.02297	-0.04137	-0.00003	0.00000	0.00000
2	1.00E+01	7.96E-01	7.90E-01	0.0038	7.97E-01	0.0055	-0.00728	0.00133	-0.00021	0.00000	0.00000
3	6.07E+00	1.71E+00	1.70E+00	0.0018	1.70E+00	0.0025	-0.00298	-0.00258	-0.00007	0.00000	0.00000
4	3.68E+00	1.39E+00	1.39E+00	0.0012	1.39E+00	0.0019	0.00033	-0.00285	-0.00097	0.00000	0.00000
5	2.23E+00	1.98E+00	1.97E+00	0.0009	1.97E+00	0.0014	-0.00273	-0.00366	-0.00511	0.00001	0.00002
6	1.35E+00	3.98E+00	3.97E+00	0.0008	3.97E+00	0.0013	-0.00079	-0.00064	-0.00423	0.00000	0.00000
7	8.21E-01	3.17E+00	3.17E+00	0.0007	3.18E+00	0.0011	0.00031	0.00135	-0.01027	0.00000	-0.00001
8	4.98E-01	6.11E+00	6.11E+00	0.0006	6.12E+00	0.0010	-0.00044	0.00178	-0.01266	0.00001	-0.00002
9	3.02E-01	3.48E+00	3.48E+00	0.0005	3.49E+00	0.0009	-0.00063	0.00069	-0.01143	0.00001	-0.00001
10	1.83E-01	3.59E+00	3.59E+00	0.0005	3.59E+00	0.0009	-0.00111	-0.00063	-0.01351	0.00002	0.00001
11	1.11E-01	3.70E+00	3.70E+00	0.0006	3.70E+00	0.0009	0.00067	-0.00068	-0.01081	-0.00001	0.00001
12	6.74E-02	3.77E+00	3.77E+00	0.0006	3.77E+00	0.0010	0.00093	0.00084	-0.00732	-0.00001	-0.00001
13	4.09E-02	3.81E+00	3.81E+00	0.0007	3.81E+00	0.0011	0.00006	-0.00014	-0.00356	0.00000	0.00000
14	2.48E-02	3.84E+00	3.84E+00	0.0008	3.84E+00	0.0013	-0.00091	-0.00121	-0.00148	0.00000	0.00000
15	1.50E-02	3.86E+00	3.86E+00	0.0009	3.87E+00	0.0015	-0.00093	0.00209	-0.00010	0.00000	0.00000
16	9.12E-03	3.87E+00	3.86E+00	0.0011	3.87E+00	0.0017	-0.00171	0.00029	0.00055	0.00000	0.00000
17	5.53E-03	3.88E+00	3.88E+00	0.0013	3.88E+00	0.0019	-0.00001	0.00097	0.00029	0.00000	0.00000
18	3.35E-03	3.88E+00	3.88E+00	0.0015	3.88E+00	0.0023	-0.00064	0.00011	0.00026	0.00000	0.00000
19	2.03E-03	3.88E+00	3.88E+00	0.0016	3.89E+00	0.0024	-0.00213	0.00127	0.00006	0.00000	0.00000
20	1.23E-03	3.89E+00	3.89E+00	0.0022	3.91E+00	0.0035	0.00077	0.00629	0.00044	0.00000	0.00000
21	7.49E-04	3.89E+00	3.90E+00	0.0033	3.90E+00	0.0053	0.00220	0.00274	0.00004	0.00000	0.00000
22	4.54E-04	3.89E+00	3.90E+00	0.0056	3.88E+00	0.0091	0.00318	-0.00183	0.00014	0.00000	0.00000
23	3.04E-04	3.89E+00	3.91E+00	0.0090	3.94E+00	0.0143	0.00502	0.01460	0.00001	0.00000	0.00000
24	1.49E-04	3.89E+00	3.85E+00	0.0261	4.12E+00	0.0409	-0.01079	0.05930	0.00001	0.00000	0.00000
25	9.17E-05	3.89E+00	3.76E+00	0.0659	4.13E+00	0.1087	-0.03380	0.06164	0.00000	0.00000	0.00000
26	6.79E-05	3.89E+00	3.64E+00	0.1408	3.44E+00	0.2273	-0.06437	-0.11523	0.00000	0.00000	0.00000
27	4.02E-05	3.89E+00	1.98E+00	0.7496	2.11E+00	0.8765	-0.49015	-0.45741	0.00000	0.00000	0.00000
28	2.26E-05	3.89E+00							0.00000		0.00000
29	1.37E-05	3.89E+00							0.00000		0.00000
30	8.32E-06	3.89E+00							0.00000		0.00000
31	4.00E-06	3.89E+00							0.00000		0.00000
32	5.40E-07	3.90E+00							0.00000		0.00000
33	1.00E-07	3.98E+00							0.00000		0.00000
SOMME		3.68E+00	3.68E+00	0.0004	3.68E+00	0.0007	-0.00063	0.00020	-0.07999	0.00003	0.00000

CELLULE PIT INFINIE

Na ELASTIQUE											
Groupe	Energie (MeV)	Section mic ECCO	Section mic MCNP	Sigma MCNP	Section mic T4	Sigma T4	(M-E)/E	(T-E)/E	Sens.	S*(M-E)/E	S*(T-E)/E
1	1.96E+01	7.54E-01	7.13E-01	0.0156	7.04E-01	0.0213	-0.05453	-0.06637	-0.00001	0.00000	0.00000
2	1.00E+01	7.87E-01	7.84E-01	0.0038	7.90E-01	0.0055	-0.00406	0.00301	-0.00007	0.00000	0.00000
3	6.07E+00	1.14E+00	1.15E+00	0.0017	1.15E+00	0.0025	0.00369	0.00451	-0.00002	0.00000	0.00000
4	3.68E+00	1.79E+00	1.79E+00	0.0011	1.78E+00	0.0017	0.00235	-0.00143	-0.00089	0.00000	0.00000
5	2.23E+00	2.10E+00	2.09E+00	0.0009	2.09E+00	0.0014	-0.00062	-0.00144	-0.00182	0.00000	0.00000
6	1.35E+00	3.18E+00	3.18E+00	0.0008	3.18E+00	0.0013	0.00004	0.00011	-0.00162	0.00000	0.00000
7	8.21E-01	4.45E+00	4.44E+00	0.0007	4.45E+00	0.0011	-0.00044	0.00058	-0.00418	0.00000	0.00000
8	4.98E-01	3.42E+00	3.42E+00	0.0006	3.43E+00	0.0010	0.00173	0.00326	-0.00438	-0.00001	-0.00001
9	3.02E-01	4.18E+00	4.17E+00	0.0005	4.17E+00	0.0009	-0.00124	-0.00074	-0.00594	0.00001	0.00000
10	1.83E-01	3.38E+00	3.38E+00	0.0005	3.39E+00	0.0009	0.00032	0.00090	-0.00541	0.00000	0.00000
11	1.11E-01	3.62E+00	3.62E+00	0.0006	3.62E+00	0.0009	0.00028	-0.00092	-0.00474	0.00000	0.00000
12	6.74E-02	5.03E+00	4.97E+00	0.0007	4.97E+00	0.0011	-0.01078	-0.01077	-0.00339	0.00004	0.00004
13	4.09E-02	3.98E+00	3.98E+00	0.0007	3.98E+00	0.0011	-0.00030	-0.00060	-0.00193	0.00000	0.00000
14	2.48E-02	4.27E+00	4.27E+00	0.0008	4.26E+00	0.0013	-0.00090	-0.00140	-0.00074	0.00000	0.00000
15	1.50E-02	4.96E+00	4.96E+00	0.0009	4.98E+00	0.0015	0.00035	0.00328	-0.00006	0.00000	0.00000
16	9.12E-03	6.92E+00	6.91E+00	0.0011	6.92E+00	0.0017	-0.00173	0.00046	0.00053	0.00000	0.00000
17	5.53E-03	1.82E+01	1.82E+01	0.0013	1.82E+01	0.0019	-0.00031	0.00075	0.00133	0.00000	0.00000
18	3.35E-03	6.97E+01	6.96E+01	0.0014	6.97E+01	0.0021	-0.00185	-0.00025	0.00078	0.00000	0.00000
19	2.03E-03	8.14E+00	8.14E+00	0.0016	8.19E+00	0.0023	0.00033	0.00553	0.00004	0.00000	0.00000
20	1.23E-03	4.10E+00	4.10E+00	0.0022	4.13E+00	0.0035	0.00094	0.00782	0.00018	0.00000	0.00000
21	7.49E-04	3.41E+00	3.42E+00	0.0033	3.43E+00	0.0053	0.00237	0.00359	0.00001	0.00000	0.00000
22	4.54E-04	3.21E+00	3.22E+00	0.0056	3.20E+00	0.0091	0.00325	-0.00175	0.00005	0.00000	0.00000
23	3.04E-04	3.12E+00	3.14E+00	0.0089	3.17E+00	0.0142	0.00511	0.01466	0.00000	0.00000	0.00000
24	1.49E-04	3.07E+00	3.03E+00	0.0261	3.25E+00	0.0408	-0.01069	0.05949	0.00000	0.00000	0.00000
25	9.17E-05	3.05E+00	2.95E+00	0.0659	3.24E+00	0.1087	-0.03377	0.06165	0.00000	0.00000	0.00000
26	6.79E-05	3.04E+00	2.85E+00	0.1407	2.69E+00	0.2272	-0.06425	-0.11496	0.00000	0.00000	0.00000
27	4.02E-05	3.03E+00	1.55E+00	0.7496	1.65E+00	0.8765	-0.48996	-0.45757	0.00000	0.00000	0.00000
28	2.26E-05	3.03E+00							0.00000		0.00000
29	1.37E-05	3.03E+00							0.00000		0.00000
30	8.32E-06	3.03E+00							0.00000		0.00000
31	4.00E-06	3.02E+00							0.00000		0.00000
32	5.40E-07	3.02E+00							0.00000		0.00000
33	1.00E-07	3.04E+00							0.00000		0.00000
SOMME		4.45E+00	4.41E+00	0.0004	4.44E+00	0.0008	-0.00864	-0.00255	-0.03229	0.00003	0.00003

CELLULE PIT INFINIE

MCNP							
ISOTOPE	FISSION	CAPTURE	ELASTIQUE	SOMME			
Pu239	0.00832	-0.00224		0.00608			
Pu240	-0.00001	0.00048		0.00047			
U238	-0.00002	-0.00309	-0.00004	-0.00315			
Fe56			0.00001	0.00001			
Cr52			0.00000	0.00000			
Ni58			0.00000	0.00000			
O			0.00003	0.00003			
Na			0.00003	0.00003			
SOMME	0.00829	-0.00485	0.00003	0.00348	Kinf ECCO	1.64606	
					Kinf MCNP	1.65304	(M-E)/E = 0.00424
					sigma	0.00032	sigma 0.00019
T4							
ISOTOPE	FISSION	CAPTURE	ELASTIQUE	SOMME			
Pu239	-0.00073	-0.00172		-0.00246			
Pu240	-0.00003	0.00047		0.00044			
U238	-0.00009	-0.00322	-0.00004	-0.00335			
Fe56			0.00001	0.00001			
Cr52			-0.00004	-0.00004			
Ni58			0.00000	0.00000			
O			0.00000	0.00000			
Na			0.00003	0.00003			
SOMME	-0.00086	-0.00447	-0.00005	-0.00538	Kinf ECCO	1.64606	
					Kinf T4	1.63541	(T-E)/E = -0.00647
					sigma	0.00065	sigma 0.00039