Comparison of ENDF/B-VIII.0 and ENDF/B-VII.1 libraries with MCS code

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Contents

Backgraound

- Recently, a new version of ENDF/B library is released to Cross Section Evaluation Working Group (CSEWG).

- ENDF/B library uses Monte Carlo(MC) for nuclear reactor physics analysis.

- The ENDF/B library validation work has been done, and ENDF/B library validation is important in the future.

- The propose of this study is to compare k_{eff} using ENDF/B-VII.1 and ENDF/B-VIII.0, the effect of nuclide is to investigate.

Background

- In the new ENDF/B-VIII.0 library, there are many major changes for the reaction cross-section of the major actinides and other nuclides.
- ENDF/B-VIII.0 library contains the improved results of the Collaboration International Evaluation Library Organization (CIELO) project focused on the six nuclide.

^{1}H, ^{16}O, ^{56}Fe, ^{235}U, ^{238}U, ^{239}Pu

Table. Number of Nuclides Provided Each ENDF/B Library in Each Sublibrary.

Sublibrary	Neutron	Thermal n-scattering
VIII.0	557	33
VII.1	423	21

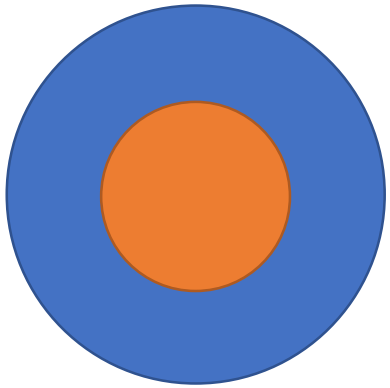
Background

- The code used for the calculation
  - MCS code
- The library used for the calculation
  - ENDF/B-VIII.0
  - ENDF/B-VII.1
- Used model for the calculation
  - ICSBEP Benchmark (158)
  - VERA pin model (1)
  - PMR compact model (1)

Background

- Used model for the calculation

ICSBEP Benchmark	HMF (High enriched uranium-MET-FAST) – (11)
	PMF (PU-MET-FAST) – (3)
	MMF (MIX-MET-FAST) – (4)
	LMT (Low enriched uranium-MET-THERM) – (6)
	LCT (Low enriched uranium-COMP-THERM) – (134)
VERA pin model(Virtual Environment for Reactor Application – (1)	
PMR compact model (Prismatic block of HTGR) – (1)	



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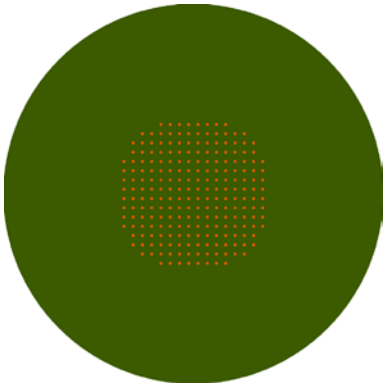

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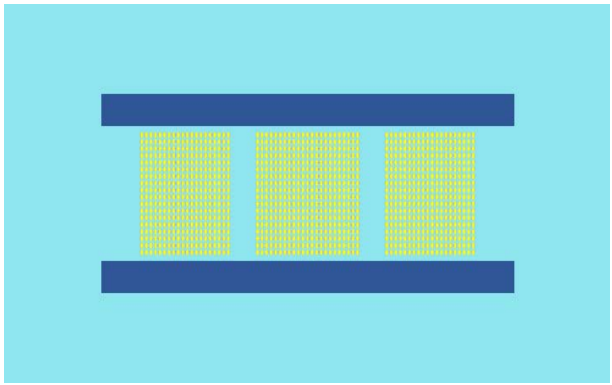

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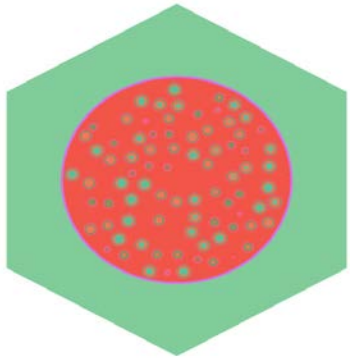


<PMR compact>

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (1/13)

➢ HMF model(11)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
1	HMF002C3	1.00000	1.00207	8	1.00033	7	-174	-33
2	HMF002C4	1.00000	1.00037	7	0.99841	7	-196	159
3	HMF002C5	1.00000	0.99931	8	0.99762	7	-169	238
4	HMF002C6	1.00000	0.99960	7	0.99780	7	-180	220
5	HMF002C7	1.00000	1.00086	8	0.99929	7	-157	71
6	HMF004	1.00200	1.00157	9	1.00064	8	-93	136
7	HMF027	1.00000	1.00083	7	1.00060	7	-23	-60
8	HMF032C1	1.00000	1.00485	8	1.00261	7	-224	-261
9	HMF032C2	1.00000	1.00564	7	1.00325	8	-239	-325
10	HMF032C3	1.00000	1.00071	7	0.99883	7	-188	-117
11	HMF032C4	1.00000	1.00119	7	1.00003	7	-116	-3

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (2/13)

➢ PMF (3), MMF (4), LMT (6)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
12	PMF005	1.00000	1.00148	7	1.00005	8	-143	-5
13	PMF006	1.00000	1.00173	8	1.00027	7	-146	-27
14	PMF010	1.00000	1.00020	8	0.99835	7	-185	165
15	MMF001	1.00000	0.99934	8	0.99931	7	-3	69
16	MMF002C1	1.00000	1.00555	8	1.00372	8	-183	-372
17	MMF002C2	1.00000	1.00557	8	1.00373	8	-184	-373
18	MMF002C3	1.00000	1.00562	8	1.00443	8	-119	-443
19	LMT007C1	1.00000	0.99950	10	0.99741	9	-209	259
20	LMT007C2	1.00000	0.99987	9	0.99823	10	-164	177
21	LMT007C3	1.00000	0.99930	9	0.99794	9	-136	206
22	LMT007C4	1.00000	0.99905	9	0.99784	9	-121	216
23	LMT007C5	1.00000	0.99866	8	0.99747	8	-119	253
24	LMT007C6	1.00000	0.99626	8	0.99482	8	-144	518

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (3/13)

➢ LCT001(8), LCT007(1)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
25	LCT001C1	1.00000	1.00075	16	1.00030	16	-45	-30
26	LCT001C2	1.00000	1.00019	16	0.99972	16	-47	28
27	LCT001C3	1.00000	0.99971	16	0.99903	16	-68	97
28	LCT001C4	1.00000	1.00004	16	0.99944	16	-60	56
29	LCT001C5	1.00000	0.99831	16	0.99764	16	-67	236
30	LCT001C6	1.00000	1.00009	16	0.99960	16	-49	40
31	LCT001C7	1.00000	0.99938	16	0.99906	15	-32	94
32	LCT001C8	1.00000	0.99838	16	0.99790	15	-48	210
33	LCT007C2	1.00000	1.00015	19	0.99937	19	-78	63

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (4/13)

➢ LCT008(17)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
34	LCT008C1	1.00070	1.00175	16	1.00054	16	-121	16
35	LCT008C2	1.00070	1.00203	16	1.00112	15	-91	-42
36	LCT008C3	1.00070	1.00230	16	1.00164	15	-66	-94
37	LCT008C4	1.00070	1.00142	16	1.00071	15	-71	-1
38	LCT008C5	1.00070	1.00130	16	1.00052	15	-78	18
39	LCT008C6	1.00070	1.00153	16	1.00047	16	-106	23
40	LCT008C7	1.00070	1.00071	16	1.00002	16	-69	68
41	LCT008C8	1.00070	1.00014	16	0.99948	16	-66	122
42	LCT008C9	1.00070	1.00071	16	0.99934	16	-137	136
43	LCT008C10	1.00070	1.00159	16	1.00049	15	-110	21
44	LCT008C11	1.00070	1.00216	15	1.00154	15	-62	-84
45	LCT008C12	1.00070	1.00154	15	1.00070	16	-84	0
46	LCT008C13	1.00070	1.00154	15	1.00070	16	-84	0
47	LCT008C14	1.00070	1.00155	16	1.00122	15	-33	-52
48	LCT008C15	1.00070	1.00136	15	1.00055	16	-81	15
49	LCT008C16	1.00070	1.00171	16	1.00079	16	-92	-9
50	LCT008C17	1.00070	1.00054	15	0.99962	15	-92	108

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (5/13)

➢ LCT017(29)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
51	LCT017C1	1.00000	1.00267	16	1.00194	15	-73	-194
52	LCT017C2	1.00000	1.00258	16	1.00158	16	-100	-158
53	LCT017C3	1.00000	1.00114	16	1.00058	16	-56	-58
54	LCT017C4	1.00000	0.99960	15	0.99855	15	-105	145
55	LCT017C5	1.00000	1.00098	16	0.99987	15	-111	13
56	LCT017C6	1.00000	1.00065	15	1.00041	15	-24	-41
57	LCT017C7	1.00000	1.00125	15	1.00040	15	-85	-40
58	LCT017C8	1.00000	0.99963	15	0.99922	15	-41	78
59	LCT017C9	1.00000	0.99878	15	0.9984	15	-38	160
60	LCT017C10	1.00000	0.99912	15	0.99878	16	-34	122
61	LCT017C11	1.00000	0.99937	16	0.99899	15	-38	101
62	LCT017C12	1.00000	0.99979	15	0.99891	16	-88	108
63	LCT017C13	1.00000	0.99995	16	0.99951	15	-44	49
64	LCT017C14	1.00000	1.00056	16	0.99981	15	-75	19
65	LCT017C15	1.00000	0.99818	17	0.99796	17	-22	204

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (6/13)

➢ LCT017(29), LCT035(2)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
66	LCT017C16	1.00000	0.99942	17	0.99906	16	-36	94
67	LCT017C17	1.00000	1.00117	17	1.00031	17	-86	-31
68	LCT017C18	1.00000	0.99996	17	0.99900	17	-96	100
69	LCT017C19	1.00000	1.00016	17	0.99958	17	-58	42
70	LCT017C20	1.00000	0.99916	17	0.99858	17	-58	142
71	LCT017C21	1.00000	0.99967	17	0.99849	17	-118	151
72	LCT017C22	1.00000	0.99882	14	0.99781	14	-101	219
73	LCT017C23	1.00000	1.00095	14	1.00012	14	-83	-12
74	LCT017C24	1.00000	1.00131	17	1.00099	17	-32	-99
75	LCT017C25	1.00000	0.99972	17	0.99893	17	-79	107
76	LCT017C26	1.00000	0.99744	16	0.99637	16	-107	363
77	LCT017C27	1.00000	0.99969	16	0.99807	16	-162	193
78	LCT017C28	1.00000	0.99998	16	0.99966	16	-32	34
79	LCT017C29	1.00000	1.00114	16	0.99959	16	-155	41
80	LCT035C1	1.00000	1.00151	18	1.00028	18	-123	-28
81	LCT035C2	1.00000	1.00031	18	0.99947	18	-84	53

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (7/13)

➢ LCT039(17)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
82	LCT039C1	1.00000	0.99825	20	0.99701	19	-124	299
83	LCT039C2	1.00000	0.99707	20	0.99619	20	-88	381
84	LCT039C3	1.00000	0.99680	20	0.99518	20	-162	482
85	LCT039C4	1.00000	0.99700	20	0.99548	20	-152	452
86	LCT039C5	1.00000	0.99758	20	0.99697	19	-61	303
87	LCT039C6	1.00000	0.99560	19	0.99490	19	-70	510
88	LCT039C7	1.00000	0.99607	21	0.99503	20	-104	497
89	LCT039C8	1.00000	0.99609	20	0.99491	20	-118	508
90	LCT039C9	1.00000	0.99528	20	0.99441	20	-87	559
91	LCT039C10	1.00000	0.99545	20	0.99437	20	-108	563
92	LCT039C11	1.00000	0.99576	20	0.99464	20	-112	536
93	LCT039C12	1.00000	0.99555	20	0.99438	20	-117	562
94	LCT039C13	1.00000	0.99563	20	0.99408	19	-155	592
95	LCT039C14	1.00000	0.99586	20	0.99467	20	-119	533
96	LCT039C15	1.00000	0.99586	20	0.99488	21	-98	512
97	LCT039C16	1.00000	0.99657	20	0.99515	20	-142	485
98	LCT039C17	1.00000	0.99577	20	0.99467	19	-110	533

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (8/13)

➢ LCT050(8)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
99	LCT050C1	1.00000	1.00078	20	0.99921	19	-157	79
100	LCT050C2	1.00000	1.00027	19	0.99915	20	-112	85
101	LCT050C3	1.00000	1.00095	20	0.99977	20	-118	23
102	LCT050C4	1.00000	1.00065	20	0.99935	20	-130	65
103	LCT050C5	1.00000	1.00191	20	1.00065	20	-126	-65
104	LCT050C6	1.00000	1.00214	20	1.00045	19	-169	-45
105	LCT050C7	1.00000	1.00655	20	1.00542	20	-113	-542
106	LCT050C8	1.00000	0.99904	20	0.99776	20	-128	224

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (9/13)

➢ LCT051(8)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
107	LCT051C11A	1.00000	1.00145	16	1.00091	16	-54	-91
108	LCT051C11B	1.00000	1.00114	23	1.00035	23	-79	-35
109	LCT051C11C	1.00000	1.00140	17	1.00042	16	-98	-42
110	LCT051C11D	1.00000	1.00169	16	1.00011	16	-158	-11
111	LCT051C11E	1.00000	1.00169	17	1.00036	16	-133	-36
112	LCT051C11F	1.00000	1.00095	16	1.00029	17	-66	-29
113	LCT051C11G	1.00000	1.00209	17	1.00100	16	-109	-100
114	LCT051C12	1.00000	1.00063	16	0.99903	16	-160	97

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (10/13)

➢ LCT054(8)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
115	LCT054C1	1.00070	1.00276	17	1.00177	17	-99	-107
116	LCT054C2	1.00050	1.00245	17	1.00200	17	-45	-150
117	LCT054C3	1.00040	1.00274	17	1.00199	17	-75	-159
118	LCT054C4	1.00060	1.00296	17	1.00193	17	-103	-133
119	LCT054C5	1.00050	1.00260	17	1.00152	17	-108	-102
120	LCT054C6	1.00020	1.00249	18	1.00188	17	-61	-168
121	LCT054C7	1.00050	1.00218	17	1.00178	17	-40	-128
122	LCT054C8	1.00020	1.00238	17	1.00169	17	-69	-149

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (11/13)

➢ LCT065(16)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1 C/E [B]	ENDF/B-VII.1 STD (pcm)	ENDF/B-VIII.0 C/E [C]	ENDF/B-VIII.0 STD (pcm)	Diff. [C-B] (pcm)	Error* [A-C] (pcm)
123	LCT065C2	1.00000	1.00508	18	1.00329	18	-179	-329
124	LCT065C3	1.00000	1.00434	18	1.00242	18	-192	-242
125	LCT065C4	1.00000	1.00496	18	1.00240	18	-256	-240
126	LCT065C5	1.00000	1.00499	18	1.00327	17	-172	-327
127	LCT065C6	1.00000	1.00505	18	1.00376	18	-129	-376
128	LCT065C7	1.00000	0.97796	18	0.97706	18	-90	2294
129	LCT065C8	1.00000	1.00486	18	1.00372	18	-114	-372
130	LCT065C9	1.00000	1.00455	18	1.00281	18	-174	-281
131	LCT065C10	1.00000	1.00368	17	1.00245	18	-123	-245
132	LCT065C11	1.00000	1.00354	18	1.00273	18	-81	-273
133	LCT065C12	1.00000	1.00369	18	1.00237	18	-132	-237
134	LCT065C13	1.00000	1.00295	18	1.00199	18	-96	-199
135	LCT065C14	1.00000	1.00430	18	1.00335	18	-95	-335
136	LCT065C15	1.00000	1.00382	18	1.00300	18	-82	-300
137	LCT065C16	1.00000	1.00381	18	1.00256	18	-125	-256
138	LCT065C17	1.00000	1.00365	18	1.00227	18	-138	-227

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (12/13)

➢LCT071(4), LCT072(3), LCT089(4)

- Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
139	LCT071C1	1.00000	0.99919	20	0.99678	20	-241	322
140	LCT071C2	1.00000	0.99865	20	0.99643	20	-222	357
141	LCT071C3	1.00000	0.99780	20	0.99604	19	-176	396
142	LCT071C4	1.00000	0.99773	20	0.99567	19	-206	433
143	LCT072C1	1.00000	1.00052	19	0.99994	19	-58	6
144	LCT072C2	1.00000	1.00024	19	0.99955	19	-69	45
145	LCT072C3	1.00000	0.99129	19	0.99076	19	-53	924
146	LCT089C1	1.00030	1.00119	17	1.00054	17	-65	-24
147	LCT089C2	1.00050	1.00095	17	1.00065	16	-30	-5
148	LCT089C3	1.00030	1.00036	17	0.99958	17	-78	72
149	LCT089C4	1.00030	1.00159	17	1.00064	17	-95	-34

Comparison of MCS results

- Results of Multiplication factors using ENDF libraries (13/13)

➢ LCT090(9), VERA pin(1), PMR compact(1)

• Error = Experiment value – C/E (ENDF/B-VIII.0)

Case No .	Case name	Experiment Value [A]	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-B] (pcm)	Error* [A-C] (pcm)
			C/E [B]	STD (pcm)	C/E [C]	STD (pcm)		
150	LCT090C1	1.00050	1.00230	17	1.00201	17	-29	-151
151	LCT090C2	1.00040	1.00265	17	1.00185	17	-80	-145
152	LCT090C3	1.00040	1.00233	17	1.00199	17	-34	-159
153	LCT090C4	1.00050	1.00323	17	1.00247	17	-76	-197
154	LCT090C5	1.00050	1.00318	17	1.00195	17	-123	-145
155	LCT090C6	1.00050	1.00273	17	1.00213	17	-60	-163
156	LCT090C7	1.00040	1.00266	17	1.00153	17	-113	-113
157	LCT090C8	1.00050	1.00265	17	1.00161	17	-104	-111
158	LCT090C9	1.00050	1.00238	17	1.00193	18	-45	-143
159	VERA pin model	-	1.18307	22	1.18380	20	73	-
160	PMR compact model	-	1.24817	26	1.25005	25	-188	-

Comparison of MCS results

- Frequency chart for calculated multiplication factor of 158 ICSBEP experiment.

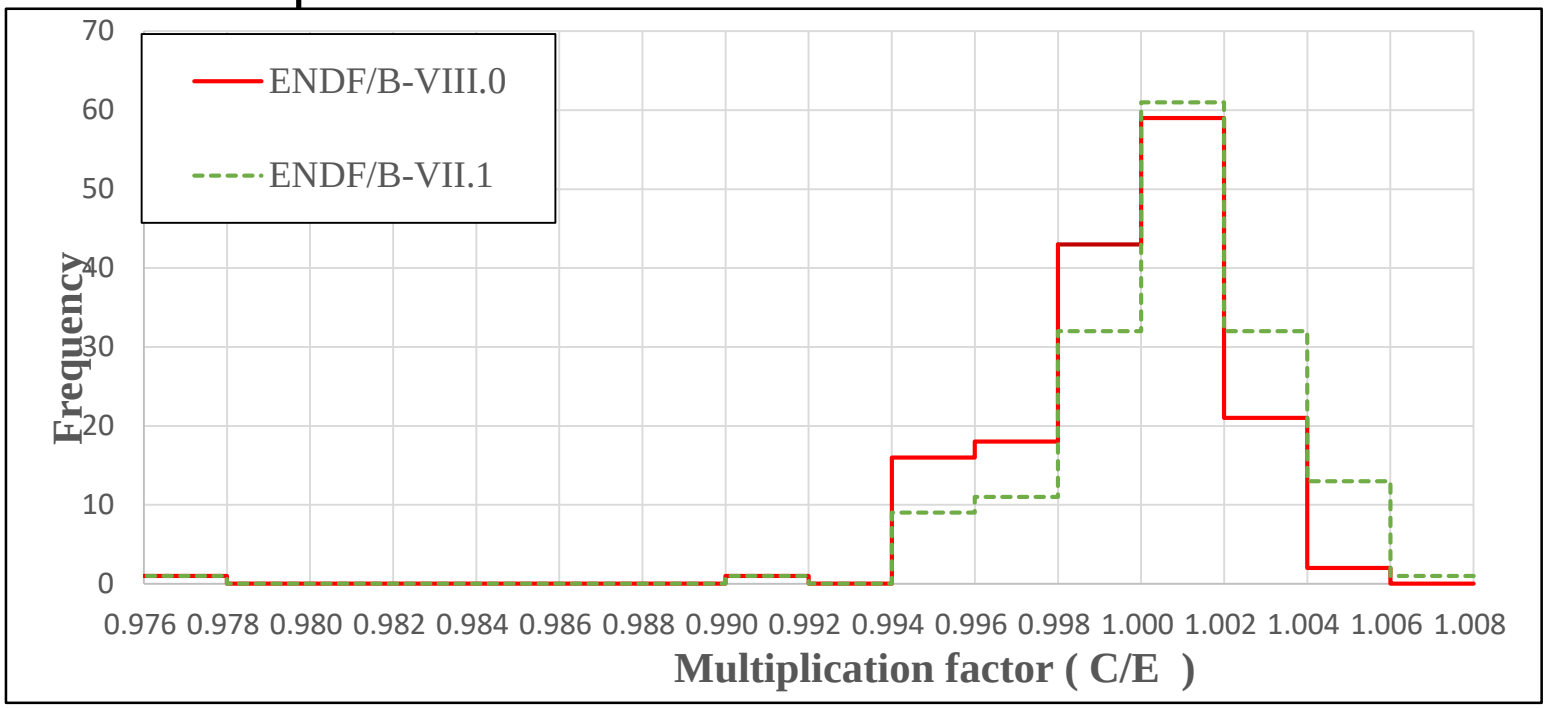


Table. Descriptive statistics of 158 ICSBEP experiment.

	No. of Exp.	C/E range	$\overline{C/E}$	$\pm\sigma_k$ [pcm]
ENDF/B-VIII.0	158	0.97706 - 1.00542	0.99968	313
ENDF/B-VII.1		0.97796 - 1.00655	1.00071	314

Comparison of results by nuclides

- Tests are conducted on the nuclides used in the experiments to determine the cause of the difference in the multiplication factor by two libraries.

Table. Result calculated using ENDF/B-VII.1 or ENDF/B-VIII.0

Case No .	Case name	ENDF/B-VII.1		ENDF/B-VIII.0		Diff. [C-A] (pcm)
		C/E [A]	STD (pcm)	C/E [C]	STD (pcm)	
ICSBEP Benchmark	PMF006	1.00173	8	1.00027	7	-146
	LCT017 C17	0.99969	16	0.99807	16	-162
	LCT065 C4	1.00496	18	1.00240	18	-256
VERA	VERA pin	1.18307	22	1.18380	20	73
PMR	PMR compact model	1.24817	26	1.25005	25	-188

- Changed Nuclide for the calculation
  - ^{1}H, ^{16}O, ^{56}Fe, ^{235}U, ^{238}U, ^{239}Pu

Comparison of results by nuclides

- Comparison method of results by nuclide
  - Evaluation of nuclide impact by library.
  - ENDF/B-VII.1 and ENDF/B-VIII.0 library is used.

Case No .	Case name	ENDF/B-VII.1 k_eff [A]	ENDF/B-VII.1 STD (pcm)	ENDF/B-VIII.0 k_eff [C]	ENDF/B-VIII.0 STD (pcm)	Diff. [C-A] (pcm)
ICSBEP Benchmark	PMF006	1.00173	8	1.00027	7	-146
	LCT017 C17	0.99969	16	0.99807	16	-162
	LCT065 C4	1.00196	18	1.00240	18	-256
VERA	VERA pin	1.18307	22	1.18380	20	73
PMR	PMR compact model	1.24817	26	1.25005	25	-118

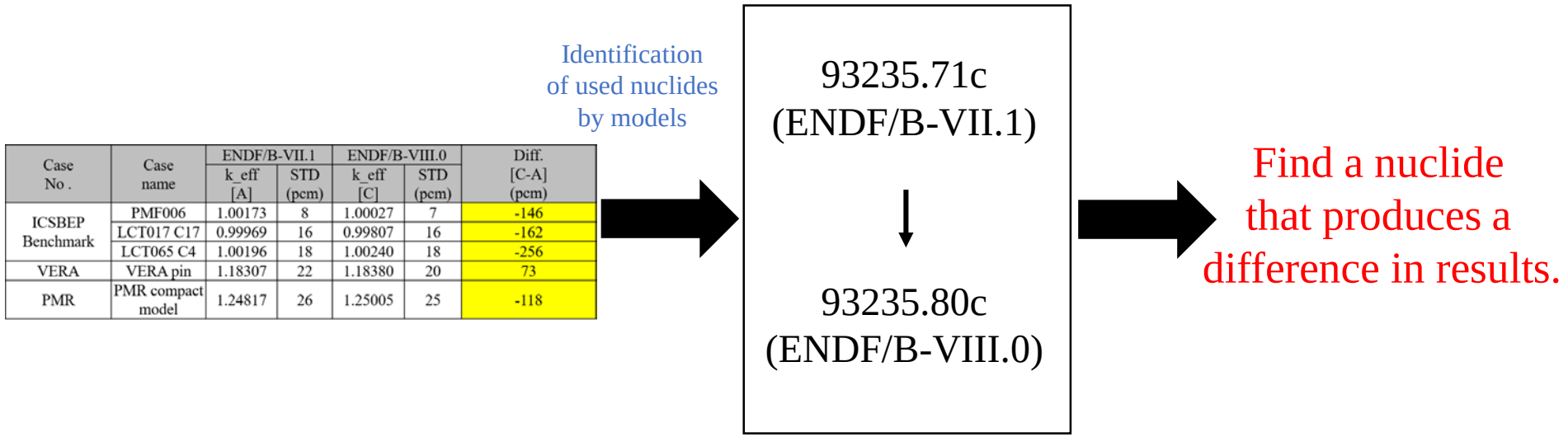
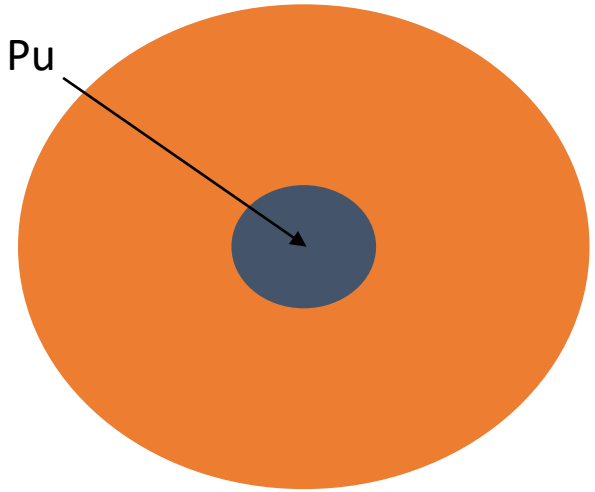


Fig. The process of finding a nuclide that produces a difference in results.

Comparison of results by nuclides

- Experiment of PMF006



<Topview of PMF006 experiment>

Table. Specification of PMF006 experiment

Parameter	Value
Core sphere radius [cm]	4.5332
Reflector sphere radius [cm]	24.1420
Core density [g/cm^3]	15.53
Reflector density [g/cm^3]	19.00

Table. Nuclide information used in PMF006 experiment

	Pu	U
Nuclide ID	94239	92234
	94240	92235
	94241	92238
	31069	
	31071	

Table. Atom Density of PMF006 experiment

Isotope	Atom Density	Isotope	Atom Density
Core		Reflector	
^{239}Pu	3.6697x10^{-2}	^{234}U	2.6438x10^{-6}
^{240}Pu	1.8700x10^{-3}	^{235}U	3.4610x10^{-4}
^{241}Pu	1.1639x10^{-4}	^{238}U	4.7721x10^{-2}
Ga	1.4755x10^{-3}		

Comparison of results by nuclides

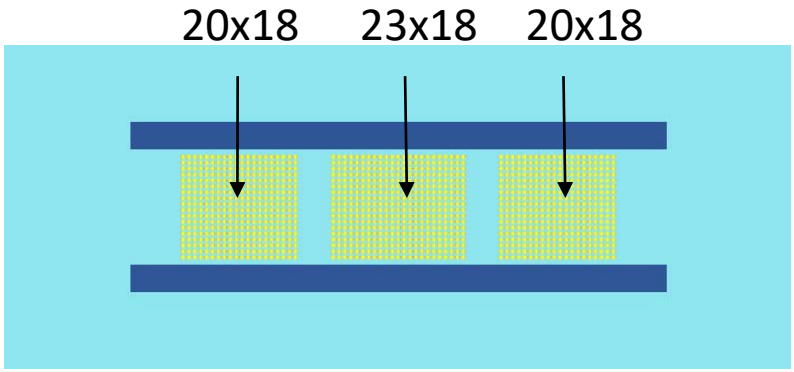
- Experiment of PMF006

Nuclide	Nuclide ID	ENDF/B-VII.1 => ENDF/B-VIII.0		Δk^*
		k_{eff}	STD (pcm)	
Initial Models		1.00173	8	0
H	1001	1.00141	8	-32
Fe	26054	1.00141	8	-32
O	8016	1.00141	8	-32
U	92235	1.00159	8	-14
	92238	1.00025	8	-148
Pu	94239	1.00121	8	-52

*Δk = keff (modified model) – keff (initial model)

Comparison of results by nuclides

- Experiment of LCT017 C27



<Topview of LCT017 C27model experiment>

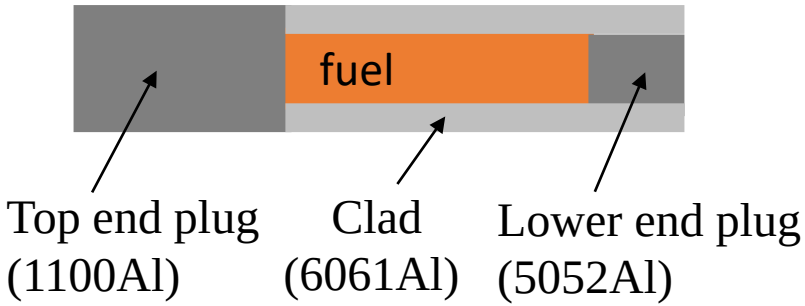


Table. Nuclide information used in LCT017 C27 experiment

	UO2	1100Al	5052Al		6061Al		lead
Nuclide ID	8016	13027	13027	26054	13027	22050	82204
	8017	14028	12024	26056	12024	24050	82206
	92234	14029	12025	26057	12025	24052	82207
	92235	14030	12026	26058	12026	24053	82208
	92238	25055	14028	29063	14028	24054	
		26054	14029	29065	14029	26054	
	H2O	26056	14030		14030	26056	
	1001	26057	24050		22046	26057	
	1002	26058	24052		22047	26058	
	8016	29063	24053		22048	29063	
	8017	29065	24054		22049	29065	

Table Specification of LCT017 C27 experiment

Case Name	Enrich (wt %)	Clad Matl	Pitch (cm)	Refl. Wall Matl	Refl.Wall Thick. (cm)	Refl. Matl	Wall Sep. (cm)	Assem Separ. (cm)
LCT017 C27	2.35	Al	1.684	lead	17.85	H2O	0.076	9.096

Comparison of results by nuclides

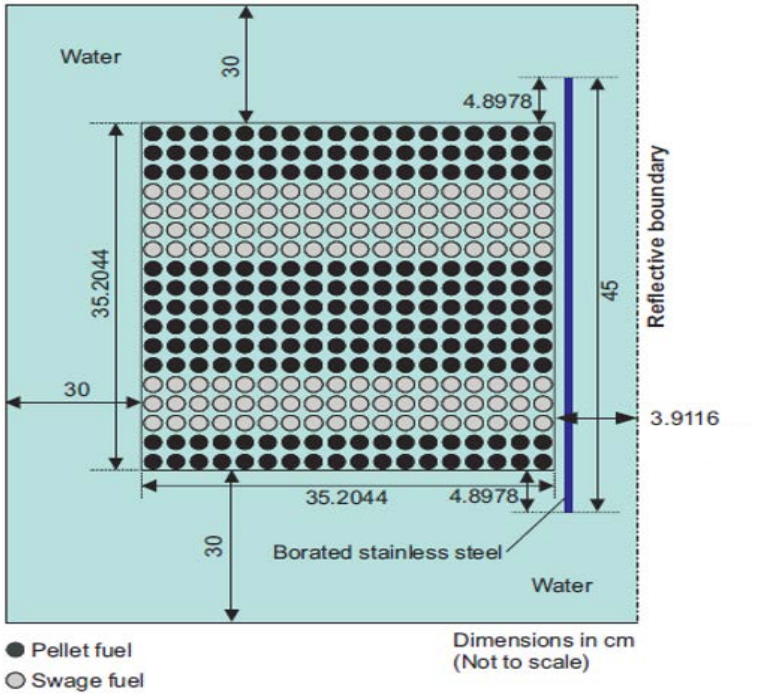
- Experiment of LCT017 C27

Nuclide	Nuclide ID	ENDF/B-VII.1 => ENDF/B-VIII.0		Δk^*
		k_{eff}	STD (pcm)	
Initial Models		0.99998	16	0
H	1001	1.00002	16	4
Fe	26054	1.00014	16	16
O	8016	0.99883	16	-115
U	92235	0.99995	16	-3
	92238	1.00140	16	142
Pu	94239	1.00030	16	32

*Δk = keff (modified model) – keff (initial model)

Comparison of results by nuclides

- Experiment of LCT065 C4



<Topview of PMR compact model experiment>

Table. Nuclide information used in LCT065 C4 experiment

	Pellet-typeUO2	H2O	Stainless Steel		
Nuclide ID	8016	1001	5010	24050	42095
	8017	1002	5011	24052	42096
	92234	8016	6000	24053	42097
	92235	8017	14028	24054	42098
	92238	h_h2o (sab)	14029	25055	42100
	Swage-type UO2	d_d2o (sab)	14030	26054	
	8016		15031	26056	
	8017		16032	26057	
	92234		16033	26058	
	92235		16034	42092	
	92238		16036	42094	

Table Specification of LCT065 C4 experiment

Case Name	Enrich (wt %)	Clad Matl	Pitch (cm)	Plate Matl	Plate Thick. (cm)	Refl. Wall Matl	Wall Sep. (cm)	Boron Conc. (ppm)
LCT065 C4	2.60/ 2.58	Al	1.9558	Stainless Steel	0.6194	-	2.9337	0.98

Comparison of results by nuclides

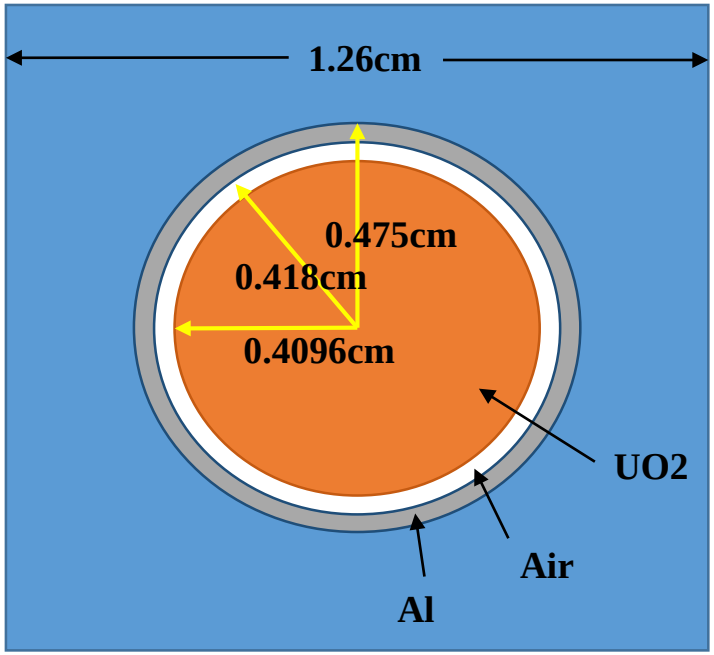
- Experiment of LCT065 C4

Nuclide	Nuclide ID	ENDF/B-VII.1 => ENDF/B-VIII.0		Δk^*
		k_{eff}	STD (pcm)	
Initial Models		1.00496	18	0
H	1001	1.00416	18	-80
Fe	26054	1.00440	18	-56
O	8016	1.00326	17	-170
U	92235	1.00496	17	0
	92238	1.00516	18	20
Pu	94239	1.00444	18	-52

*Δk = keff (modified model) – keff (initial model)

Comparison of results by nuclides

- Experiment of VERA pin model



<Topview of PMR compact model experiment>

Table. Nuclide information used in VERA pin model experiment

	UO2	H2O +Boron	Zr		
Nuclide ID	8016	1001	24050	40094	50124
	8017	1002	24052	40096	72174
	92234	5010	24053	50112	72176
	92235	5011	24054	50114	72177
	92236	8016	26054	50115	72178
	92238	8017	26056	50116	72179
		h_h2o (sab)	26057	50117	72180
		d_d2o (sab)	26058	50118	
			40090	50119	
			40091	50120	
			40092	50122	

Table Specification of VERA pin model experiment

Case Name	Enrich (wt %)	Outside diameter (cm)	Cladding thickness (cm)	Pellet diameter (cm)	Pin pitch (cm)	Fuel Density (g/cm^3)
VERA model	3.1	0.95	0.057	0.8192	1.26	10.254

Comparison of results by nuclides

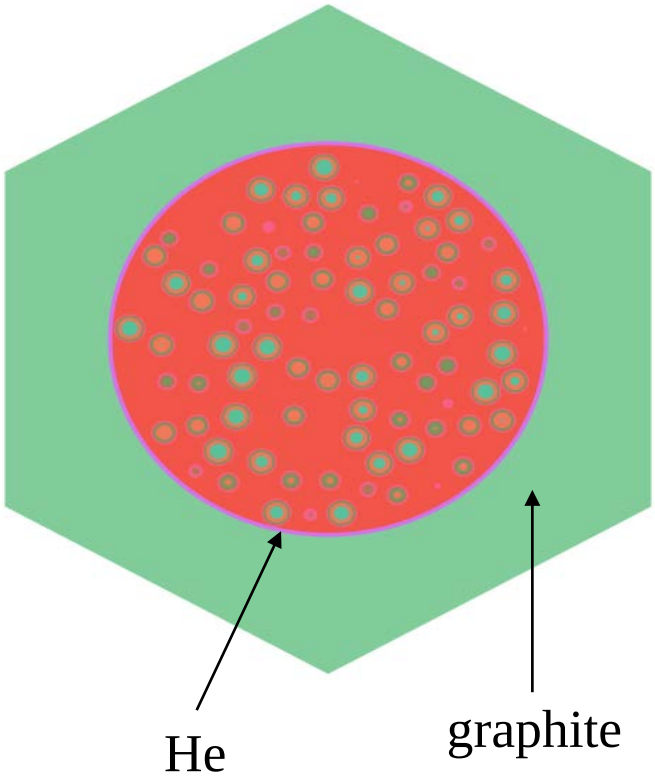
- Experiment of VERA model

Nuclide	Nuclide ID	ENDF/B-VII.1 => ENDF/B-VIII.0		Δk^*
		k_{eff}	STD (pcm)	
Initial Models		1.18392	22	0
H	1001	1.18458	20	66
Fe	26054	1.18496	20	104
O	8016	1.18288	17	-104
U	92235	1.18269	19	-123
	92238	1.18690	18	298
Pu	94239	1.18435	22	43

*Δk = keff (modified model) – keff (initial model)

Comparison of results by nuclides

- Experiment of PMR compact model



<Topview of PMR compact model experiment>

Table. Nuclide information used in PMR compact model experiment

	UO2	Triso_r1	Triso_r3	Triso_r4
Nuclide ID	8016	6000	6000	6000
	8017		14028	
	92235	Triso_r2	14029	
	92238	6000	14030	

Table Specification of PMR compact model experiment

Parameter	Value
Triso_r1 (cm)	0.025
Triso_r2 (cm)	0.035
Triso_r3 (cm)	0.039
Triso_r4 (cm)	0.0425
Triso_r5 (cm)	0.0465
Fuel density (g/cm^3)	10.3998

Comparison of results by nuclides

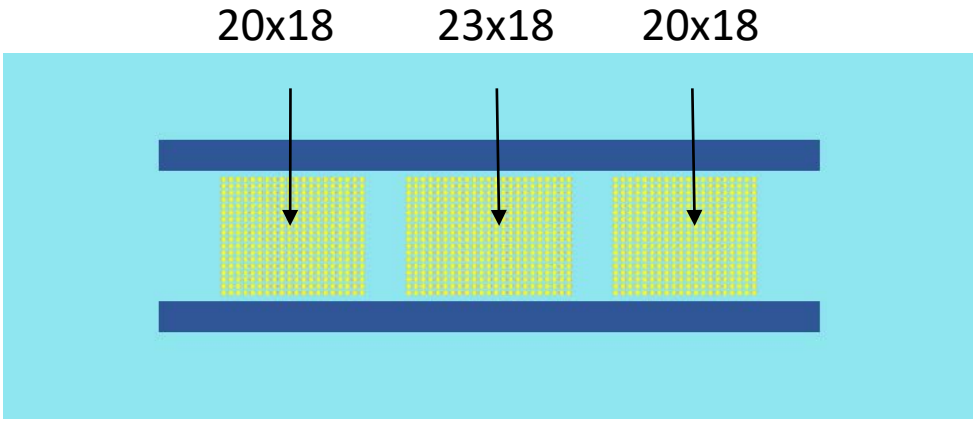
- Experiment of PMR compact model

Nuclide	Nuclide ID	ENDF/B-VII.1 => ENDF/B-VIII.0		Δk^*
		k_{eff}	STD (pcm)	
Initial Models		1.24817	116	0
H	1001	1.24721	69	-96
Fe	26054	1.24721	69	-96
O	8016	1.24677	91	-140
U	92235	1.23913	66	-904
	92238	1.24675	63	-142
Pu	94239	1.24721	69	96

*Δk = keff (modified model) – keff (initial model)

Comparison of one-group XS

- For comparison of one-group XS (fission, absorption), a 2D pin-cell in the LCT017C27 experiment is used.
- MCS code is used for calculations.
- Moderator material : H2O



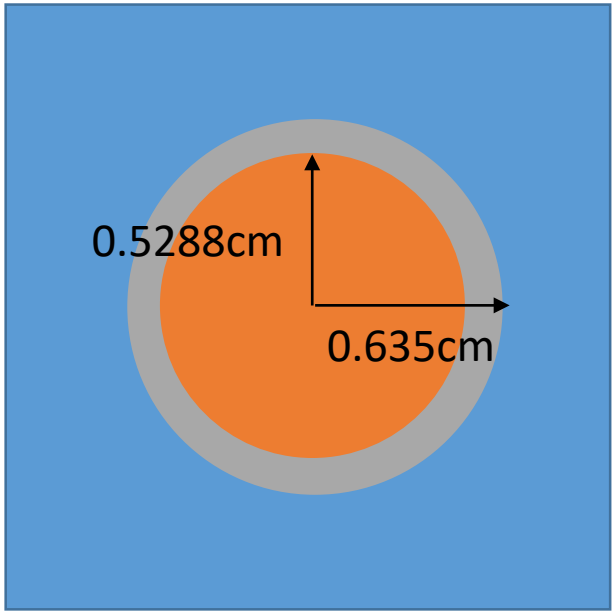


Table Specification of LCT017 C27 Pin experiment

Case Name	Enrich (wt %)	Clad Matl	Pitch (cm)	Cladding Matl
LCT017 C27	2.35	Al	1.684	Al

Comparison of one-group XS

- Effect of reactivity on library variation by nuclides

$$\Delta\rho = \frac{1}{k_\infty} - \frac{1}{\hat{k}_\infty}$$

$$k_\infty = \frac{\nu\Sigma_f\phi}{\Sigma_a\phi}$$

$$\Delta\rho_f^i = \left[\frac{\sum_j N^j \sigma_a^j \phi}{\sum_j N^j \nu\sigma_f^j \phi} - \frac{\sum_j N^j \sigma_a^j \phi}{\sum_j N^j \nu\sigma_f^j \phi - N^i (\nu\sigma_f^i \phi - \nu\hat{\sigma}_f^i \hat{\phi})} \right]$$

$$\Delta\rho_a^i = \left[\frac{\sum_j N^j \sigma_a^j \phi}{\sum_j N^j \nu\sigma_f^j \phi} - \frac{\sum_j N^j \sigma_a^j \phi - N^i (\sigma_a^i \phi - \hat{\sigma}_a^i \hat{\phi})}{\sum_j N^j \nu\sigma_f^j \phi} \right]$$

Table. Results of microscopic XS comparison according to libraries

Nuclide ID	ENDF/B-VII.1 [A]		ENDF/B-VII.1 => VIII.0 [B]		Diff. [(B-A)/A]		VII.1 vs VIII.0	
	(n,abs.)	(n,fis.)	(n,abs.)	(n,fis.)	(n,abs.)	(n,fis.)	$\Delta\rho_a^i$ [pcm]	$\Delta\rho_f^i$ [pcm]
92235	2.12E+02	8.90E+02	2.15E+02	8.91E+02	1.53%	0.20%	-134	-96
92238	1.91E+01	2.27E+00	1.90E+01	2.30E+00	-0.56%	1.35%	181	34
8016	5.68E-02	-	7.85E-02	-	38.15%	-	-75	-

Conclusions

- For the 158 ICSBEP benchmark and VERA pin and PMR compact, the calculations for ENDF/B-VII.1 and ENDF/B-VIII.0 library were performed using the MCS code.
- The results calculated using the ENDF/B-VIII.0 showed lower k_{eff} value than ENDF/B-VII.1.
- The results calculated using the ENDF/B-VIII.0 library have a maximum of -256pcm difference from the results calculated using ENDF/B-VII.1.
- The difference of k_{eff} values using ENDF/B-VII.1 and ENDF/B-VIII.0 was larger in ^{16}O, ^{235}U and ^{238}U.

Thank you