Current activities on Processing and Verification(P&V) at Universidad Politécnica de Madrid (UPM)

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Outline

[1] Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

- *JEFF-JENDL Bilateral Meeting*, "First feedback on using FRENDY for processing of JEFF-3.3.", O. Cabellos. April 24, 2019. NEA Headquarters. … **efforts continued in July-August 2019**

[2] First steps to process JEFF-3.3 in CE using AMPX code

- *JEFDOC-1951*, "JEFF Processing, Verification, Benchmarking and Validation", O. Cabellos. November 2018.
- "About the impact of the Unresolved Resonance Region in Monte Carlo simulations of Sodium Fast Reactors", A. Jiménez-Carrascosa et al., ICAPP 2019 – International Congress on Advances in Nuclear Power Plants, France, Juan-les-Pins, May 12-15, 2019

[3-4] Contribution in "WPNCS/SG-3" and "Doppler Reactivity Defect" Benchmarks

- *JEFDOC-1953*, "WPNCS-SG3 Benchmark on the Effect of Temperature on the Keff for WPR Assemblies: UPM Preliminary Results", O. Cabellos. November 2018.
- *JEFDOC-1953, "Computational Benchmark for the Doppler Reactivity Defect: UPM Preliminary Results", O. Cabellos. November 2018.*

[5] Processing of JEFF-3.3 and ENDF/B-VIII.0 in WIMS-D5 format. B&V and UQ in PWRs

- *JEFDOC-1968*, "Comparison of JEFF-3.3 and ENDF/B-VIII.0 in PWR simulations", A. Ardura et al., April 2019
- "Comparison of JEFF-3.3 and ENDF/B-VIII.0 Nuclear Data Libraries in PWR Simulations", C. Gómez et al., WIN2019, June 21-23, 2019. Madrid, Spain

[6] Comments on P&V in the JEFF Stakeholders meeting held in NEA, 6-7 June 2019

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

- **FRENDY Code Release**
  - A. Koning by email (March 21, 2019) inform on *"…the NJOY-compatible code FRENDY by Dr. Tada."*
  - Released under the BSD license: https://rpg.jaea.go.jp/main/en/program_frendy/

- **Diversification of processing codes … is needed and positive!**
  - FRENDY code is very welcome because it provides new ways to generate ACE files

- **JEFF-JENDL Bilateral Meeting**
  - "First feedback on using FRENDY for processing of JEFF-3.3.", O. Cabellos. April 24, 2019.
  - … **efforts continuing in July-August 2019 in close collaboration with Dr. Tada-san**

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

```
reconr
 20  21 /
 'pendf  ' /
  9228
0.001 0.0 0.01 5.0000000000000004e-08 /
0 /
broadr
 20  21  22 /
  9228 1 0 0 0.0 /
0.001 1000000.0 0.01 5.0000000000000004e-08 /
293.6
0 /
purr
 20  22  25 /
  9228 1 3 16 64 1 /
293.6
1.0E+10 100.0 10.0  /
0 /
acer
 20  25 0 55 56 /
1 1 1 .33 /
'Lib----JEFF-3.3           Process: FRENDY    ' /
  9228 293.6  /
1 1 /
/
stop
```

Fig.1. An example of NJOY/FRENDY Input

- **Generation of fast ACE file**
  - NJOY and FRENDY use the same input
  - FRENDY can be easily integrated in NDEC system
  - This work:
    - FRENDY Version:1.00.005 (2019/03/14)
    - FRENDY Version:1.01.001 (2019/07/08)
    - **FRENDY Version:1.01.007 (2019/08/13)**
    - **NJOY2016.46**

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

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```
moder
30 -31
reconr
-31 -32
'pendf tape for h-1 from jeff33  '/
125 1/
0.001 0.0/
'1-h-1 from jeff33  '/
0/
broadr
-31 -32 -33
125 1 0 0 0.0 /
.001/
293.6
0/
thermr
34 -33 -35
1 125 16 1 2 0   2 222 2 /
293.6
0.001 10.0 /
acer
-31 -35 0 60 61
2 1 1 .33 /
'H(H2O)-JEFF33   and TSL-JEFF311'/
125  293.6 'lw00  ' /
1001 0 0 /
222  64 0 0 1 10.0 0 /
moder
-32 70
stop
```

Fig.2. An example of FRENDY Input

```
moder
30 -31
reconr
-31 -32
'pendf tape for h-1 from jeff33  '/
125 1/
0.001 0.0/
'1-h-1 from jeff33  '/
0/
broadr
-31 -32 -33
125 1 0 0 0.0 /
.001/
293.6
0/
thermr
34 -33 -35
1 125 16 1 2 0 0 2 222 2 /
293.6
0.001 10.0 /
acer
-31 -35 0 60 61
2 1 1 .33 /
'H(H2O)-JEFF33   and TSL-JEFF311'/
125  293.6 'lw00  ' /
1001 0 0 /
222  64 0 0 1 10.0 0 /
moder
-32 70
stop
```

Fig.3. An example of NJOY Input

- **Generation of thermal ACE file**
  - FRENDY uses NJOY99 option in THERMR
  - NJOY2012/2016 …

iform output format for inel. distributions

! 0 E-E'-mu ordering (MF6 special)

! 1 E-mu-E' ordering (MF6/Law7)

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

- **Feedback on using FRENDY for processing of JEFF-3.3**

  - **P&V** is an important step of nuclear data activities
  - **JEFF Processing & Verification (P&V) Working Group activities:** reconstruction, processing and internal consistency diagnosis of evaluated files using different codes such as NJOY, PREPRO, AMPX , CALENDF,… **FRENDY,…**
  - This P&V job depends of **end-user needs**: MCNP, SCALE,TRIPOLI,… and sometimes relying on **end-user capabilities** (e.g. CEA provides JEFF-3.3 beta processed files for TRIPOLI).
  - A close **collaboration with end-users leads a double benefit** for the ND community
    - Feedback/diagnosis of evaluated files
    - Feedback for code's developers
  - **Warnings/Errors** found in P&V activities can be solved in constructive ways

    … the following are examples of updating JEFF-3.3 evaluation using FRENDY warnings/errors

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

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- **Updated JEFF-3.3 file:** <Error Message> …MF = 1, MT = 1: The order of X data list in Tab1 record is not appropriate (X[i] < X[i-1])

```
[cabellos@nodo0 r_1-H-2g]$ diff 1-H-2g.jeff33 1-H-2g.jeff33.original

133c133
<  1.450000+7 8.024095-1 1.475000+7 7.716093-1 1.500000+7 7.612092-1 128 3  1   31
---
>  1.400000+7 8.024095-1 1.475000+7 7.716093-1 1.500000+7 7.612092-1 128 3  1   31

172c172
<  1.450000+7 6.364000-1 1.475000+7 6.047000-1 1.500000+7 5.941000-1 128 3  2   31
---
>  1.400000+7 6.364000-1 1.475000+7 6.047000-1 1.500000+7 5.941000-1 128 3  2   31

211c211
<  1.450000+7 1.660095-1 1.475000+7 1.669093-1 1.500000+7 1.671092-1 128 3  3   31
---
>  1.400000+7 1.660095-1 1.475000+7 1.669093-1 1.500000+7 1.671092-1 128 3  3   31

238c238
<  1.450000+7 1.660000-1 1.475000+7 1.669000-1 1.500000+7 1.671000-1 128 3 16   19
---
>  1.400000+7 1.660000-1 1.475000+7 1.669000-1 1.500000+7 1.671000-1 128 3 16   19

277c277
<  1.450000+7 9.500000-6 1.475000+7 9.298823-6 1.500000+7 9.235346-6 128 3102   31
---
>  1.400000+7 9.500000-6 1.475000+7 9.298823-6 1.500000+7 9.235346-6 128 3102   31
```

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

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- **Updated JEFF-3.3 file:** <Error Message> …MF = 6, MT = 102: The mass (AWR) is different

```
[cabellos@nodo0 r_26-Fe-54g]$ diff 26-Fe-54g.jeff33 26-Fe-54g.jeff33.original

26192c26192
<  2.605400+4 5.347625+1          0          3          1          02625 6102    1
---
>  2.605600+4 5.545440+1          0          3          1          02625 6102    1
```

- **Updated JEFF-3.3 file:** <Error Message> …MF = 6, MT = 102: The mass (AWR) is different

```
[cabellos@nodo0 r_26-Fe-58g]$ diff 26-Fe-58g.jeff33 26-Fe-58g.jeff33.original

23826c23826
<  2.605800+4 5.743561+1          0          3          1          02637 6102    1
---
>  2.605800+4 6.743560+0          0          3          1          02637 6102    1
```

- **Updated JEFF-3.3 file:** <Error Message> …MF = 1, MT = 91: The order of X data list in Tab1 record is not appropriate (X[i] < X[i-1])

```
[cabellos@nodo0 r_72-Hf-178g]$ diff 72-Hf-178g.jeff33 72-Hf-178g.jeff33.original

1968c1968
<  1.562810+6 0.000000+0 1.600000+6 0.000000+0 1.700000+6 0.000000-07237 3 91    4
---
>  1.562810+6 0.000000+0 1.800000+6 0.000000+0 1.700000+6 0.000000-07237 3 91    4
```

1. Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

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- **Updated JEFF-3.3 file:** <Error Message> …MF = 6, MT = 102: The material data (ZA) is different

```
[cabellos@nodo0 r_64-Gd-155g]$ diff 64-Gd-155g.jeff33 64-Gd-155g.jeff33.original

2544c2544
<  6.415500+4 1.535920+2          0          2          1          06434 6102    1
---
>  6.155500+4 1.535920+2          0          2          1          06434 6102    1
```

- **Updated JEFF-3.3 file :** <Error Message> …MF=01, MT=451 line no is smaller than NWD+NXC+4

```
[cabellos@nodo0 r_95-Am-243g]$ diff 95-Am-243g.jeff33 95-Am-243g.jeff33.original

29c29
<   23/11/2016  P. Leconte on behalf of CEA Reverted MF=1/5, MT=455 9549 1451   28
---
>   23/11/2016  P. Leconte on behalf of CEA Reverted MF=1/5, MT=455 9543 1451   28
```

#	CASE	FRENDY 1.01.007		NJOY 2016.46		Diff. (FRENDY1.01.007 - NJOY2016.46) in pcm
		keff	Dkeff-stat	keff	Dkeff-stat	
1	heu-comp-inter-003-case7	1.00294	0.00011	1.00291	0.00011	3
2	heu-met-fast-001	1.00008	0.00008	1.00001	0.00009	7
3	heu-met-fast-003-case10	1.00524	0.00010	1.00493	0.00009	31
4	heu-met-fast-003-case11	1.00996	0.00010	1.00986	0.00009	10
5	heu-met-fast-003-case12	1.00537	0.00009	1.00538	0.00010	-1
6	heu-met-fast-003-case1	0.99574	0.00009	0.99596	0.00009	-22
7	heu-met-fast-003-case2	0.99507	0.00009	0.99528	0.00009	-21
8	heu-met-fast-003-case3	0.99999	0.00009	0.99998	0.00009	1
9	heu-met-fast-003-case4	0.99826	0.00009	0.99835	0.00009	-9
10	heu-met-fast-003-case5	1.00241	0.00009	1.00276	0.00009	-35
11	heu-met-fast-003-case6	1.00300	0.00010	1.00329	0.00009	-29
12	heu-met-fast-003-case7	1.00366	0.00010	1.00389	0.00009	-23
13	heu-met-fast-003-case8	1.00143	0.00009	1.00148	0.00009	-5
14	heu-met-fast-003-case9	1.00160	0.00009	1.00175	0.00009	-15
15	heu-met-fast-004-case1	0.99831	0.00011	0.99831	0.00011	0
16	heu-met-fast-008	0.99577	0.00008	0.99593	0.00009	-16
17	heu-met-fast-009-case1	0.99625	0.00009	0.99623	0.00009	2
18	heu-met-fast-009-case2	0.99499	0.00009	0.99510	0.00009	-11
19	heu-met-fast-011	0.99816	0.00011	0.99808	0.00011	8
20	heu-met-fast-012	0.99823	0.00009	0.99819	0.00008	4
21	heu-met-fast-013	0.99553	0.00009	0.99546	0.00009	7
22	heu-met-fast-014	0.99809	0.00008	0.99818	0.00009	-9
23	heu-met-fast-015	0.99443	0.00008	0.99444	0.00009	-1
24	heu-met-fast-018-case2	0.99997	0.00008	0.99981	0.00008	16
25	heu-met-fast-019-case2	1.00650	0.00009	1.00653	0.00009	-3
26	heu-met-fast-020-case2	1.00086	0.00010	1.00071	0.00010	15
27	heu-met-fast-021-case2	0.99651	0.00009	0.99659	0.00009	-8
28	heu-met-fast-022-case2	0.99727	0.00009	0.99724	0.00008	3
29	heu-met-fast-026-case9	0.98996	0.00010	0.98985	0.00010	11
30	heu-met-fast-028	1.00418	0.00009	1.00421	0.00009	-3
31	heu-met-fast-73	1.00727	0.00009	1.00713	0.00009	14
32	heu-met-inter-006-case1	0.99677	0.00011	0.99654	0.00010	23
33	heu-met-inter-006-case2	0.99855	0.00011	0.99859	0.00011	-4
34	heu-met-inter-006-case3	0.99902	0.00010	0.99891	0.00010	11
35	heu-met-inter-006-case4	1.00140	0.00011	1.00145	0.00011	-5

… using Mosteller's (123 Benchmarks)

- **R.D. Mosteller's Benchmark suite**
  - 123 ICSBEP Benchmarks
  - MCNP6.1.0
  - Histories: 5x10^7 (statistical uncertainty < 10 pcm)

- Larger differences than $3 \cdot \Delta\sigma_{stat}$ to be investigated …

$2*\Delta\sigma_{stat}$ > Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Table. HEU cases

1.1 Benchmarking using Mosteller's suite (123 Benchmarks)

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#	CASE	FRENDY 1.01.007 keff	FRENDY 1.01.007 Dkeff-stat	NJOY 2016.46 keff	NJOY 2016.46 DKeff-stat	Diff. (FRENDY1.01.007 - NJOY2016.46) in pcm
36	heu-sol-therm-004	0.99406	0.00013	0.99410	0.00012	-4
37	heu-sol-therm-013-case1	0.99802	0.00008	0.99802	0.00008	0
38	heu-sol-therm-013-case2	0.99680	0.00009	0.99711	0.00008	-31
39	heu-sol-therm-013-case3	0.99362	0.00009	0.99368	0.00009	-6
40	heu-sol-therm-013-case4	0.99507	0.00009	0.99503	0.00009	4
41	heu-sol-therm-032	0.99746	0.00005	0.99732	0.00005	14

Table. HEU cases

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$2*\Delta\sigma_{stat}$ > Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$
Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

using Mosteller's (123 Benchmarks)

#	CASE	FRENDY 1.01.007 keff	FRENDY 1.01.007 Dkeff-stat	NJOY 2016.46 keff	NJOY 2016.46 Dkeff-stat	Diff. (FRENDY1.01.007 - NJOY2016.46) in pcm
42	ieu-comp-therm-002-CASE_3	1.00149	0.00010	1.00140	0.00010	9
43	ieu-met-fast-001-case1	1.00016	0.00009	1.00009	0.00009	7
44	ieu-met-fast-001-case2	1.00029	0.00009	1.00024	0.00009	5
45	ieu-met-fast-001-case3	0.99999	0.00009	1.00012	0.00009	-13
46	ieu-met-fast-001-case4	1.00055	0.00009	1.00031	0.00009	24
47	ieu-met-fast-002	0.99628	0.00008	0.99645	0.00008	-17
48	ieu-met-fast-003-case2	1.00123	0.00009	1.00131	0.00009	-8
49	ieu-met-fast-004-case2	1.00550	0.00008	1.00555	0.00009	-5
50	ieu-met-fast-005-case2	0.99981	0.00009	0.99982	0.00009	-1
51	ieu-met-fast-006-case2	0.99387	0.00009	0.99381	0.00009	6
52	ieu-met-fast-007-case1	1.00485	0.00008	1.00507	0.00008	-22
53	leu-comp-ther-008-CASE_1	1.00246	0.00009	1.00221	0.00010	25
54	leu-comp-therm-008-CASE_11	1.00251	0.00009	1.00263	0.00009	-12
55	leu-comp-therm-008-CASE_2	1.00205	0.00010	1.00198	0.00009	7
56	leu-comp-therm-008-CASE_5	1.00164	0.00009	1.00161	0.00009	3
57	leu-comp-therm-008-CASE_7	1.00139	0.00009	1.00126	0.00009	13
58	leu-comp-therm-008-CASE_8	1.00098	0.00010	1.00093	0.00009	5
59	leu-sol-therm-002-case1	0.99918	0.00008	0.99915	0.00008	3
60	leu-sol-therm-002-case2	0.99563	0.00009	0.99573	0.00009	-10
61	leu-sol-therm-007-CASE14	0.99508	0.00010	0.99532	0.00009	-24
62	leu-sol-therm-007-CASE30	0.99728	0.00010	0.99723	0.00010	5
63	leu-sol-therm-007-CASE32	0.99567	0.00010	0.99588	0.00009	-21
64	leu-sol-therm-007-CASE36	0.99822	0.00009	0.99811	0.00009	11
65	leu-sol-therm-007-CASE49	0.99693	0.00009	0.99694	0.00008	-1
66	mix-comp-therm-002-case-pnl30	1.00082	0.00011	1.00094	0.00010	-12
67	mix-comp-therm-002-case-pnl31	1.00343	0.00011	1.00334	0.00012	9
68	mix-comp-therm-002-case-pnl32	1.00082	0.00011	1.00101	0.00010	-19
69	mix-comp-therm-002-case-pnl33	1.00577	0.00011	1.00586	0.00011	-9
70	mix-comp-therm-002-case-pnl34	1.00134	0.00010	1.00152	0.00011	-18
71	mix-comp-therm-002-case-pnl35	1.00412	0.00010	1.00402	0.00010	10
72	mix-met-fast-001-CASE_1	0.99897	0.00009	0.99889	0.00008	8
73	mix-met-fast-003	1.00014	0.00009	1.00055	0.00008	-41
74	mix-met-fast-008-case7	1.02625	0.00006	1.02618	0.00005	7

- **R.D. Mosteller's Benchmark suite**
  - 123 ICSBEP Benchmarks
  - MCNP6.1.0
  - Histories: $5x10^7$ (statistical uncertainty < 10 pcm)

- Larger differences than $3 \cdot \Delta\sigma_{stat}$ to be investigated …

$2*\Delta\sigma_{stat}$ > Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Table. IEU-MIX cases

…g using Mosteller's (123 Benchmarks)

#	CASE	FRENDY 1.01.007 Keff	FRENDY 1.01.007 Dkeff-stat	NJOY 2016.46 keff	NJOY 2016.46 DKeff-stat	Diff. (FRENDY1.01.007 - NJOY2016.46) in pcm
75	pu-comp-inter-001	0.99833	0.00008	0.99833	0.00007	0
76	pu-met-fast-001-CASE_1	0.99925	0.00008	0.99929	0.00008	-4
77	pu-met-fast-002-CASE_1	1.00148	0.00008	1.00117	0.00009	31
78	pu-met-fast-003-case103	0.99672	0.00009	0.99671	0.00010	1
79	pu-met-fast-005-CASE_1	1.00132	0.00009	1.00129	0.00010	3
80	pu-met-fast-006	1.00322	0.00010	1.00341	0.00010	-19
81	pu-met-fast-008-case2	0.99656	0.00009	0.99655	0.00009	1
82	pu-met-fast-009-CASE_1	0.99882	0.00009	0.99894	0.00009	-12
83	pu-met-fast-010-CASE_1	1.00039	0.00009	1.00037	0.00009	2
84	pu-met-fast-011-CASE_1	0.99984	0.00011	0.99982	0.00011	2
85	pu-met-fast-018-CASE_1	0.99820	0.00009	0.99833	0.00009	-13
86	pu-met-fast-019	1.00008	0.00009	1.00022	0.00009	-14
87	pu-met-fast-020	0.99924	0.00009	0.99921	0.00009	3
88	pu-met-fast-021-case1	1.00415	0.00009	1.00401	0.00009	14
89	pu-met-fast-021-case2	0.99318	0.00009	0.99291	0.00010	27
90	pu-met-fast-022	0.99782	0.00008	0.9979	0.00008	-8
91	pu-met-fast-023	0.99917	0.00009	0.99926	0.00008	-9
92	pu-met-fast-024	1.00145	0.00009	1.00164	0.00010	-19
93	pu-met-fast-025	0.99671	0.00009	0.99667	0.00009	4
94	pu-met-fast-026	0.99853	0.00009	0.99848	0.00009	5
95	pu-sol-therm-009-case3a	1.01367	0.00006	1.01397	0.00005	-30
96	pu-sol-therm-009	1.00999	0.00006	1.00999	0.00006	0
97	pu-sol-therm-011-CASE_1.18	0.99059	0.00012	0.99066	0.00011	-7
98	pu-sol-therm-011-CASE_5.16	1.00240	0.00013	1.00236	0.00013	4
99	pu-sol-therm-011-CASE_6.18	0.99625	0.00012	0.99649	0.00012	-24
100	pu-sol-therm-018-case_9	1.00026	0.00010	1.00057	0.00010	-31
101	pu-sol-therm-021-case_1.t9a	1.00146	0.00013	1.00163	0.00012	-17
102	pu-sol-therm-021-CASE_3.T9A	1.00241	0.00015	1.00231	0.00014	10
103	pu-sol-therm-034-case_01	0.99576	0.00013	0.99595	0.00013	-19

Table. PU cases

- **R.D. Mosteller's Benchmark suite**
  - 123 ICSBEP Benchmarks
  - MCNP6.1.0
  - Histories: $5x10^7$ (statistical uncertainty < 10 pcm)

- Larger differences than $3 \cdot \Delta\sigma_{stat}$ to be investigated …

$2*\Delta\sigma_{stat}$ > Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

1.1 Benchmarking using Mosteller's suite (123 Benchmarks)

#	CASE	FRENDY 1.01.007 keff	FRENDY 1.01.007 Dkeff-stat	NJOY 2016.46 keff	NJOY 2016.46 Dkeff-stat	Diff. (FRENDY1.01.007 - NJOY2016.46) in pcm
104	spec-met-fast-008	0.99422	0.00008	0.99431	0.00008	-9
105	u233-comp-therm-001-case3	1.00365	0.00015	1.00342	0.00015	23
106	u233-comp-therm-001-case6	1.00379	0.00012	1.00386	0.00013	-7
107	u233-met-fast-001	1.00099	0.00008	1.00102	0.00008	-3
108	u233-met-fast-002-CASE_1	0.99982	0.00008	0.99992	0.00008	-10
109	u233-met-fast-002-CASE_2	1.00137	0.00009	1.00123	0.00008	14
110	u233-met-fast-003-CASE_1	1.00085	0.00008	1.00078	0.00009	7
111	u233-met-fast-003-CASE_2	1.00097	0.00009	1.00091	0.00009	6
112	u233-met-fast-004-CASE_1	1.00024	0.00009	1.00018	0.00009	6
113	u233-met-fast-004-CASE_2	0.99834	0.00009	0.99821	0.00009	13
114	u233-met-fast-005-CASE_1	0.99733	0.00009	0.99721	0.00009	12
115	u233-met-fast-005-CASE_2	0.99631	0.00010	0.99634	0.00009	-3
116	u233-met-fast-006	1.00330	0.00010	1.00333	0.00010	-3
117	u233-sol-inter-001-case1	0.98527	0.00016	0.98513	0.00015	14
118	u233-sol-therm-001-case1	1.00232	0.00008	1.00254	0.00008	-22
119	u233-sol-therm-001-case2	1.00216	0.00008	1.00229	0.00008	-13
120	u233-sol-therm-001-case3	1.00182	0.00008	1.00181	0.00008	1
121	u233-sol-therm-001-case4	1.00179	0.00008	1.00184	0.00008	-5
122	u233-sol-therm-001-case5	1.00113	0.00009	1.00122	0.00009	-9
123	u233-sol-therm-008	1.00199	0.00006	1.00212	0.00005	-13

Table. U233 cases

- **R.D. Mosteller's Benchmark suite**
  - 123 ICSBEP Benchmarks
  - MCNP6.1.0
  - Histories: 5×10^7 (statistical uncertainty < 10 pcm)

$2*\Delta\sigma_{stat}$ > Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

Diff. (FRENDY-NJOY) > $3*\Delta\sigma_{stat}$

2. First steps to process JEFF-3.3 in CE using AMPX code

- **H2020/ESFR-SMART Project: WP1.2: Normal operation of the ESFR-SMART**
  - **T1.2.1: Initial core performance and burn-up calculations**

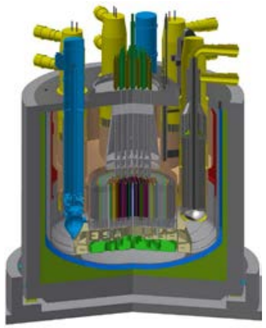
    The objective of this work is to analyze the observed discrepancies between the employed Monte Carlo codes.

Institution	Code	Library
UPM	KENO-VI	ENDF/B-VII.1 – AMPX-format (SCALE 6.2.3)
HZDR	Serpent 2.1.29 / MCNP5	ENDF/B-VII.1 – native Serpent ACE files
CIEMAT	MCNP6.1	ENDF/B-VII.1 – generated by CIEMAT

  - In all cases (**ASTRID-BoC-BoL, ALFRED–BoC, MYRRHA-BoL, ESFR–BoL**), k_{eff} predicted by KENO-VI was systematically higher using the same nuclear data library.

ESFR-SMART project ESFR - BoL	KENO-VI (ENDF/B-VII.1)	**Diff. in k-eff** 638 pcm
	Serpent (ENDF/B-VII.1)	

Table. Example of differences between KENO-VI and SERPENT using ENDF/B-VII.1



2. First steps to process JEFF-3.3 in CE using AMPX code

INDUSTRIALES ETSII | UPM

1.2 Summary of P&V activities

INDUSTRIALES ETSII | UPM

❑ News on JEFF-3.3 Processing

- UPM & CIEMAT collaboration: **AMPX processing (on going)**
- Carlos J. Diez (collaboration/free-time)
- Quantification of the unresolved resonance region effect on the multiplication factor.

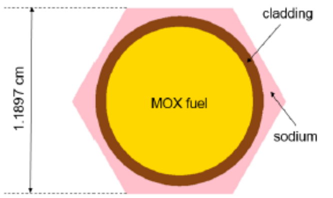


Fig.: Simplified 2-D SFR pin-cell Benchamrk

Table 2 (*): KENO-VI calculation/SCALE-6.2.3. Statistical unc. < 5 pcm

#	Code	Library	k_{inf} with P-T	k_{inf} without P-T	URR effect $\Delta\rho$ [pcm]
1	MCNP-6.1	ENDF/B-VII.1 – MCNP-6.1	1.31853	1.31683	+98
2	KENO-VI	ENDF/B-VII.1 – SCALE-6.2.3	1.32607	1.31689	+526
3	KENO-VI	ENDF/B-VII.1 – **AMPX/SCALE-6.2.3**	1.32610	1.31688	+528
4	KENO-VI	JEFF-3.3 – **AMPX/SCALE-6.2.3**	1.32428	1.32264	+94
		Δρ [4] – [1] in pcm	+329	+334	

Calculation with ENDF/B-VII.1

UPM processing

[*] Paper to be presented at : ICAPP 2019 – International Congress on Advances in Nuclear Power Plants, France, Juan-les-pins – 2019, May 12-15. "About the impact of the Unresolved Resonance Region in Monte Carlo simulations of Sodium Fast Reactors", A. Jiménez-Carrascosa, E. Fridman, N. García-Herranz, F. Alvarez-Velarde, P. Romojaro

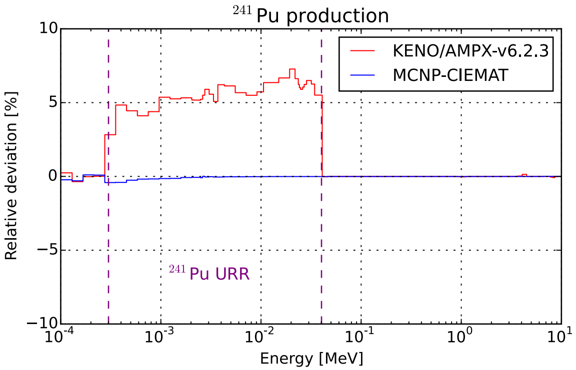
❑ Processing with AMPX/SCALE-6.2.3

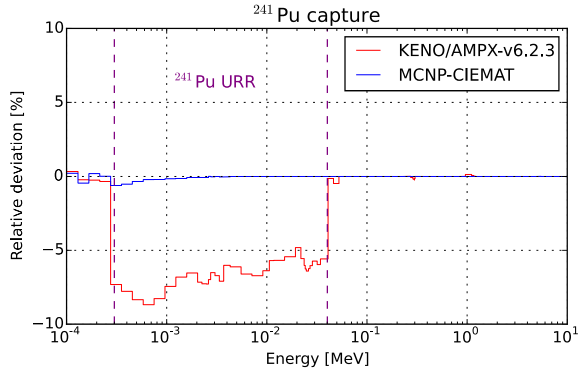
- ENDF/B-VII.1
- JEFF-3.1
- JEFF-3.3

2. First steps to process JEFF-3.3 in CE using AMPX code

❑ Analysis of the discrepancies between MC codes & processed ND

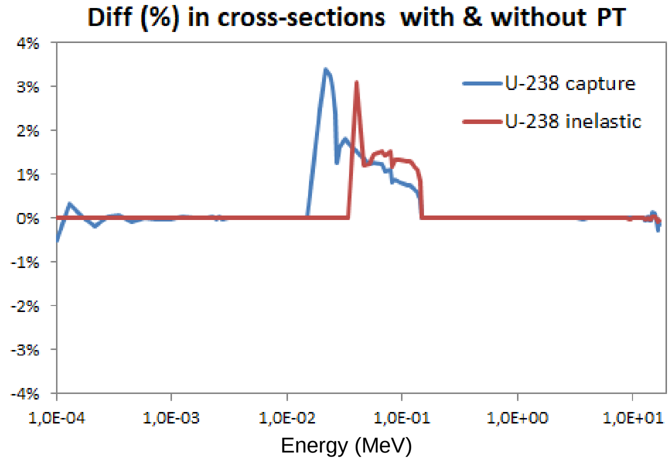
- An important effect of the unresolved resonance region (URR) can be clearly observed.





- Since KENO-VI is overestimating the production cross section while capture is underestimated, KENO-VI highly overstimates the URR effect

- This issue is related with AMPX (SCALE 6.2.3) code for data processing

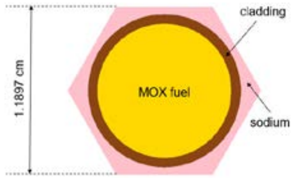


2. First steps to process JEFF-3.3 in CE using AMPX code

❑ NEWS!!! Updated AMPX library (AMPX code) in SCALE 6.3.0.

- The issue has recently been fixed by SCALE Team and the next SCALE release (i.e. 6.3.0) will include updated nuclear data libraries

- In this work, a pre-release of the corrected ENDF/B-VII.1 data library has been tested on the same pin-cell benchmark.



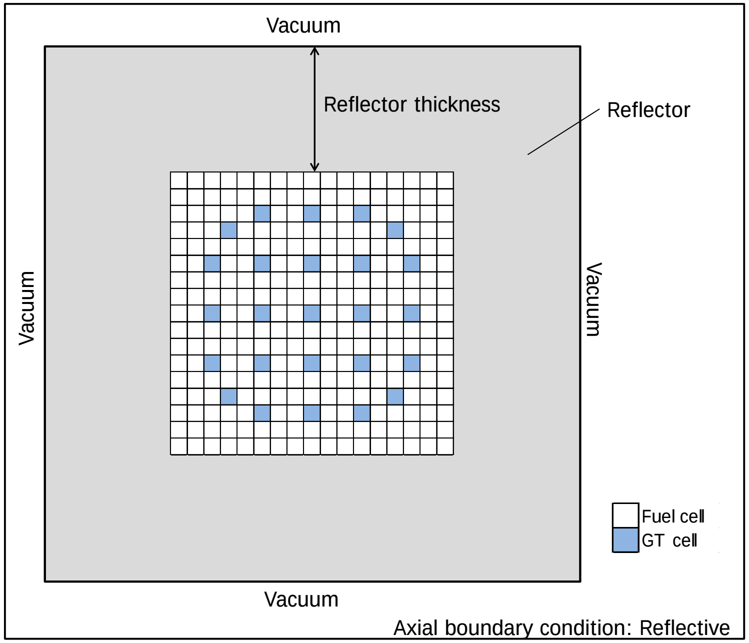
Code	Library	k_{inf} with P-T	$\Delta\rho$ [pcm]
Serpent2	ENDF/B-VII.1 – Serpent	1.31687(2)	**reference**
MCNP-5	ENDF/B-VII.1 – Serpent	1.31685(5)	**-1**
MCNP-6.1	ENDF/B-VII.1 – MCNP-6.1	1.31853(5)	**+96**
KENO-VI	ENDF/B-VII.1 – SCALE-6.2.3	1.32607(2)	**+527**
KENO-VI	**ENDF/B-VII.1 – SCALE-6.3.0 (pre-release)**	**1.31838(2)**	+87

3. Contribution in WPNCS-SG3 benchmark

❑ WPNCS/SG-3 Benchmark

- The aim of this work is to assess the variation of keff associated with temperature dependent criticality calculations
- Fuel assembly geometry, a typical 17 × 17 type PWR fuel assembly

Figure. A schematic model for PWR benchmark problem



Benchmark specifications:
http://www.oecd-nea.org/science/wpncs/

- 1 meter thick water reflector
- kept consistently at room temperature and pressure i.e. 293 K
- Two cases:
  - A **single PWR-type** fuel assembly within a thick water reflector
  - An **infinite array** of PWR fuel assemblies

3. Contribution in WPNCS-SG3 benchmark

❑ Example results table and Case IDs

Table. Example results table for **Single Unit** (Case 1) and calculation IDs

Burn-up (GWd/t)	Temperature (K)				
	233	253	293	333	588
0	SU-T233-0	SU-T253-0	SU-T293-0	SU-T333-0	SU-T588-0
30	SU-T233-30	SU-T253-30	SU-T293-30	SU-T333-30	SU-T588-30
45	SU-T233-45	SU-T253-45	SU-T293-45	SU-T333-45	SU-T588-45

Table. Example results table for **Infinite Array** (Case 2) and calculation IDs

Burn-up (GWd/t)	Temperature (K)				
	233	253	293	333	588
0	INF-T233-0	INF-T253-0	INF-T293-0	INF-T333-0	INF-T588-0
30	INF-T233-30	INF-T253-30	INF-T293-30	INF-T333-30	INF-T588-30
45	INF-T233-45	INF-T253-45	INF-T293-45	INF-T333-45	INF-T588-45

in WPNCS-SG3 benchmark

ID	Participants	Institutes	Country	Code	Nuclear Data
UJV	Radim Vocka	UJV	Czech Republic	HELIOS 2.1	ENDF/B-VII.1*1
CEA1	Yi-Kang Lee	CEA Saclay	France	TRIPOLI-4	JEFF-3.3
CEA2	Marion Tiphine	CEA Cadarache		TRIPOLI-4.9	JEFF-3.3
CEA3	Coralie Carmouze				JEFF-3.1.1
IRSN1	Mathieu Milin	IRSN	France	MORET 5.D.1	JEFF-3.3
IRSN2	Nicolas Leclaire				JEFF-3.3*2
GRS1	Fabian Sommer	GRS	Germany	SCALE 6.2.2	ENDF/B-VII.1*3
GRS2	Matthias Behler				ENDF/B-VII.1*4
GRS3	Volker Hannstein				ENDF/B-VII.1
GRS4					ENDF/B-VIII
GRS5				OpenMC	ENDF/B-VIII
GRS6				MCNP 6.1	ENDF/B-VIII
MTA1	Gabor Hordosy	MTA	Hungary	MCNP 6.1.1	ENDF/B-VIII
MTA2					ENDF/B-VII
NRA	Shigeki Shiba Toshisha Yamamoto	NRA	Japan	MVP3	JENDL-4.0
UPM1	Oscar Cabellos	UPM	Spain	MCNP 6.1	ENDF/B-VII.1
UPM2					ENDF/B-VIII.0
UPM3					ENDF/B-VIII.0
UPM4					ENDF/B-VIII.0
UPM5					ENDF/B-VIII.0
UPM6					JEFF 3.1.1
UPM7					JEFF 3.3
UPM8					JEFF 3.3
UPM9					JEFF 3.3
UPM10					JEFF 3.3
EMS1	Dennis Mennerdahl	EMS	Sweden	SCALE 6.2.3	ENDF/B-VII.1
EMS2				MCNP 6.2	ENDF/B-VIII.0
EMS3				MCNP 6.2	ENDF/B-VII.1
SL1	James Ryan	SL	United Kingdom	MONK 9A	JEF-2.2
WOOD1	David Hanlon	Wood	United Kingdom	MONK 10B	JEFF-3.1.2
WOOD2				MONK 11 (Dev)	JEFF-3.1.2
ORNL1	BJ Marshall Bradley Rearden Douglas Bowen	ORNL	United States	SCALE 6.2.3	ENDF/B-VIII
ORNL2					ENDF/B-VIII*4

Table. List of participants WPNCS SG-3 benchmark: *33 sets of results,12 institutions and 9 countries*

(Draft in preparation).

NOTE:
*1: 49 Energy Groups
*2: Hydrogen S(α,β)data from ENDF/B-VIII.0 was used
*3: 56 Energy Groups
*4: 252 Energy Groups

http://www.oecd-nea.org/science/wpncs/

3. Contribution in WPNCS-SG3 benchmark

	Nuclear Data Evaluations				
	BENCHMARK	ENDF/B-VIII.0	ENDF/B-VII.1	JEFF-3.3	JEFF-3.1.1
Ice Water	**233**	233	-	233	-
	253	253	-	253	-
Light Water	**293.6**	293.6	293.6	293.6	293.6
		300.0			
		323.6	**323.6***	323.6	323.6
	333.0	**333.0***			
		350.0	350.0		
		373.6		373.6	373.6
		400.0	400.0		
		423.6		423.6	423.6
		450.0	450.0		
		473.6		473.6	473.6
		500.0	500.0		
		523.6		523.6	523.6
		550.0	550.0		
		573.6	**573.6***	573.6	573.6
	588.0	**588.0***			
		600.0	600.0		
		623.6		623.6	623.6
				647.2	647.2
		650.0	650.0		

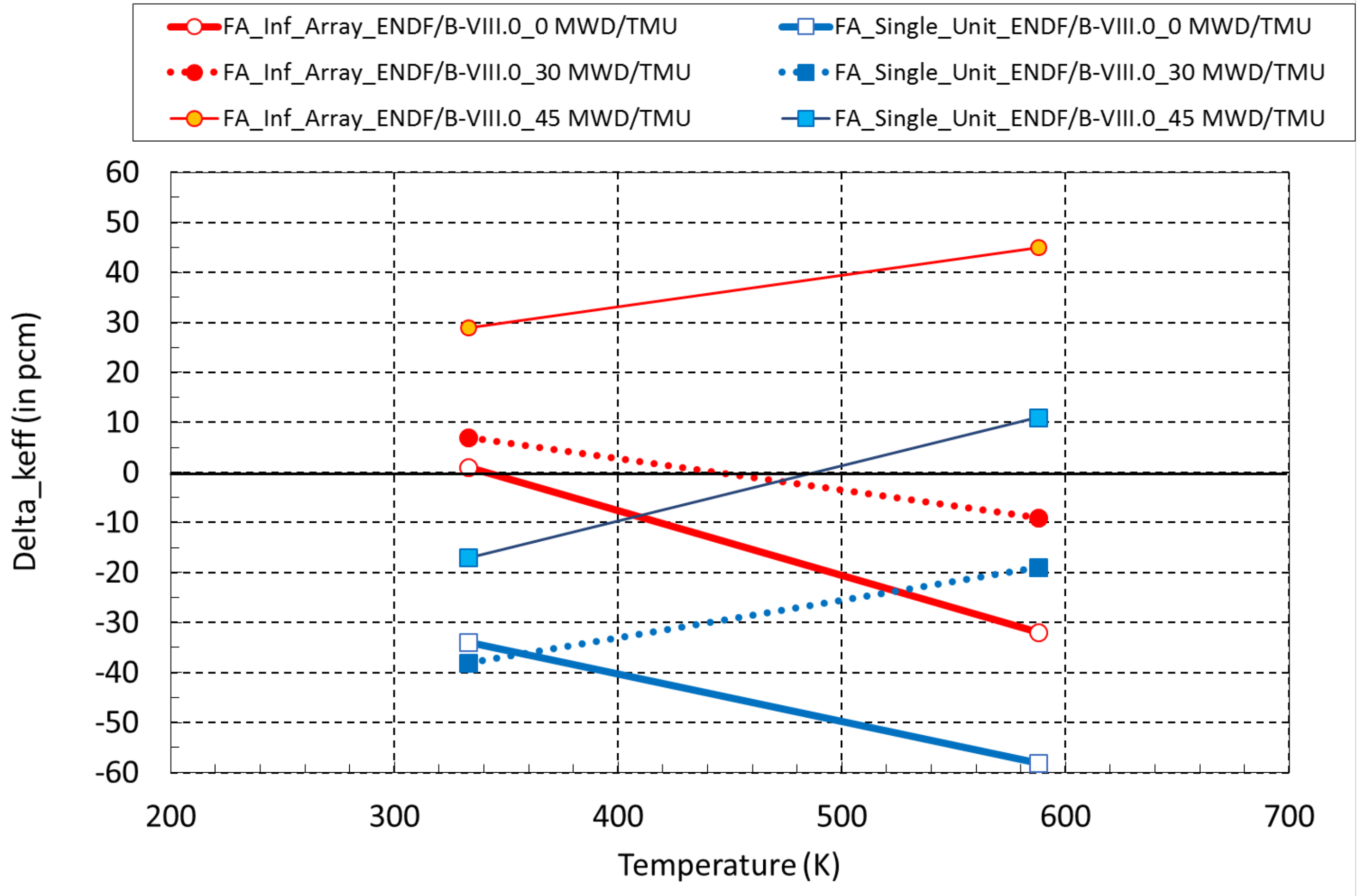
Table. Temperature Benchmark specifications.

And, temperatures for TSLs in different nuclear data evaluations.

[*] Values interpolated using TSL Library Generation developed by J.I. Marquez (Bariloche, Argentina)

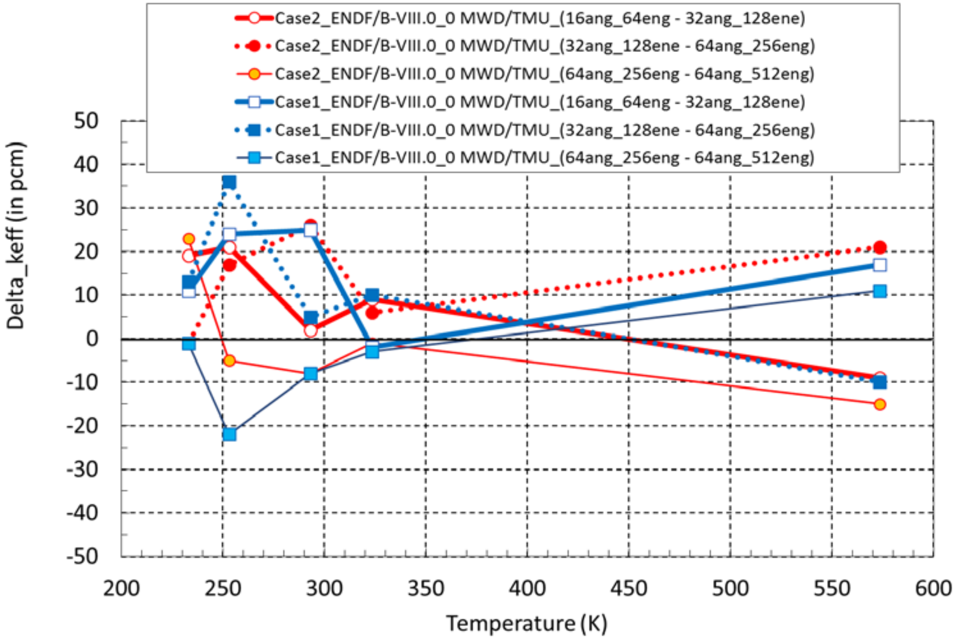
3. Contribution in WPNCS-SG3 benchmark

Figure. Δkeff for Infinite Array (Case 2) and Single Unit (Case 1) using **TSL Interpolator from "323.6K -> 333 K" and "573.6K -> 588K"**



3. Contribution in WPNCS-SG3 benchmark

Figure. Impact of NJOY options for processing TSLs: **THERM (ang. bin) - ACER(secondary energy bin)**. Results for Infinite Array (Case 2).

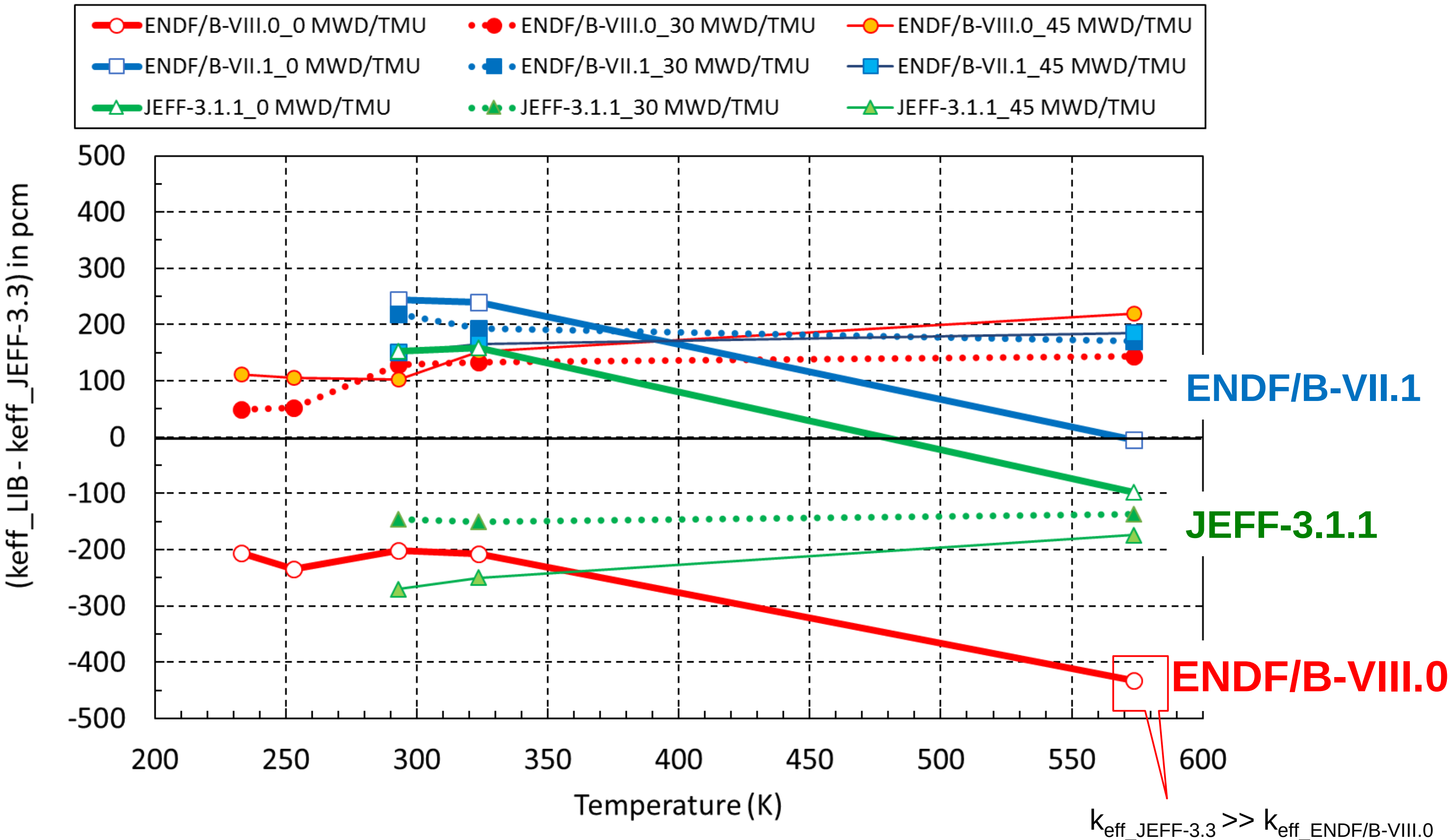


All cases, temperatures and burnup	Diff in pcm		
	(16ANG_64ENG - 32ANG_128ENE)	(32ANG_128ENE - 64ANG_256ENG)	(64ANG_256ENG - 64ANG_512ENG)
Average Diffs	11	7	1
DST Diffs	10	11	11

Table. Changes in keff due to different processing option for angular bins (in THERMR) and secondary energy bins (in ACER).

3. Contribution in WPNCS-SG3 benchmark

Figure. For Infinite Array (Case 2): Δkeff versus Temperature.
Here, **JEFF-3.3 is used as reference.**



3. Contribution in WPNCS-SG3 benchmark

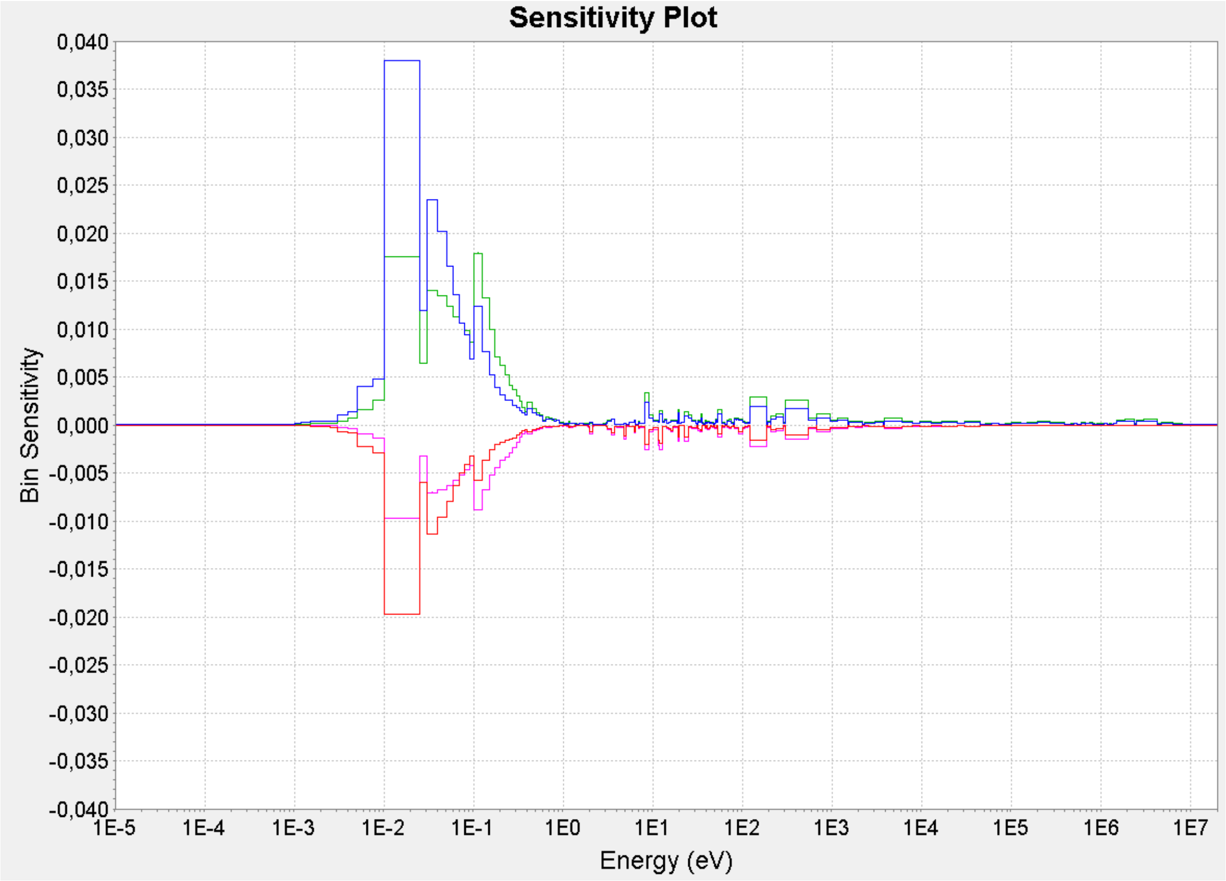
Table. Changes in keff due to individual changes (contributors) for **Infinite Array** (Case 2) at **0 MWD/TMU.**

"case"== Individual changes of materials in Fuel Assembly	Changes in reactivity (pcm) "case" –"All files JEFF3.3"		
	233K	293K	588K
All JEFF3.3 + 1H is ENDF/B-VIII.0 in moderator	-12	-15	-11
All JEFF3.3 + 16O is ENDF/B-VIII.0 in moderator	-94	-100	-84
All JEFF3.3 + TSL is ENDF/B-VIII.0 in moderator	+60	+56	+7
All JEFF3.3 + 16O is ENDF/B-VIII.0 in fuel	-53	-61	-85
All JEFF3.3 + 235U is ENDF/B-VIII.0 in fuel	-25	-25	-268
All JEFF3.3 + 238U is ENDF/B-VIII.0 in fuel	-60	-44	-68
All JEFF3.3 + 90Zr is ENDF/B-VIII.0 in clad	+31	+33	+20
All JEFF3.3 + 91Zr is ENDF/B-VIII.0 in clad	+35	+32	+18
All JEFF3.3 + 92Zr is ENDF/B-VIII.0 in clad	+17	+15	+13
All JEFF3.3 + 94Zr is ENDF/B-VIII.0 in clad	-9	+8	+2
All JEFF3.3 + 96Zr is ENDF/B-VIII.0 in clad	+13	+6	+11
All files ENDF/B-VIII.0	-202	-191	-446

*Note: Statistical uncertainty <6 pcm

3. Contribution in WPNCS-SG3 benchmark

Figure. 235U sensitivities for the Infinite Array (Case 2) at 293K and 588K. Calculation with KSEN/MCNP6.1



3. Contribution in WPNCS-SG3 benchmark

Figure. 235U-Δkeff/keff plot for the Infinite Array (Case 2) at 293K and 588K. Calculation with OECD/NEA-NDaST tool.

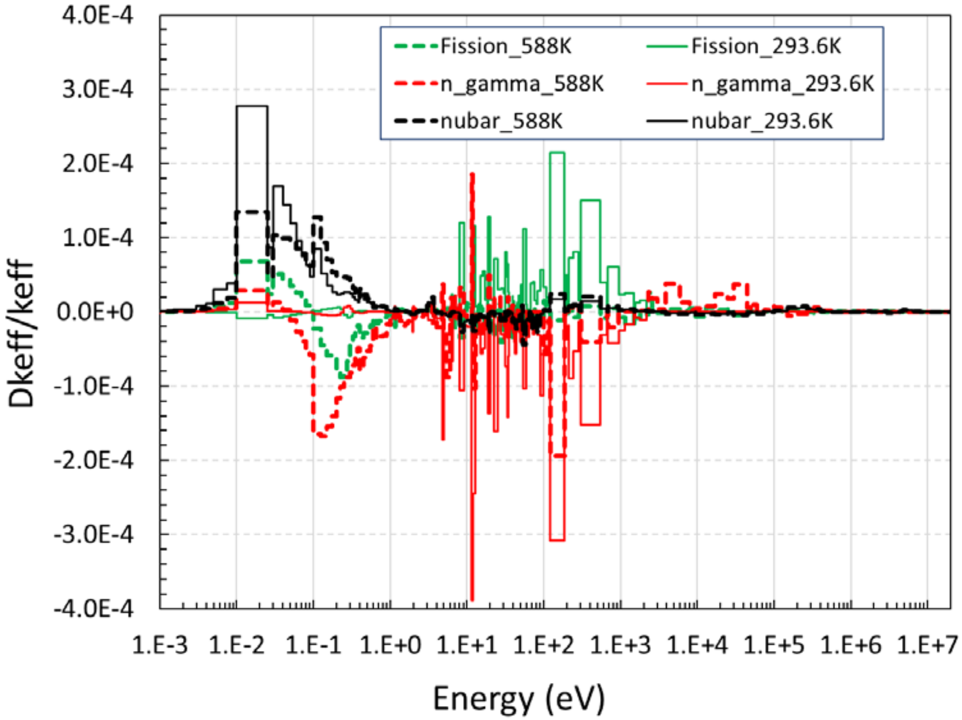


Table. Δkeff for Infinite Array (Case 2) at 0 MWD/TMU due to changes in 235U evaluation.

Ratio ND at different temperatures	Δkeff (pcm)				
	Fission	n,gamma	Nubar	chi	Total
ENDFB8 / JEFF33 at 293.6K	231	-357	145	17	36
ENDFB8 / JEFF33 at 588K	-90	-249	133	21	-185

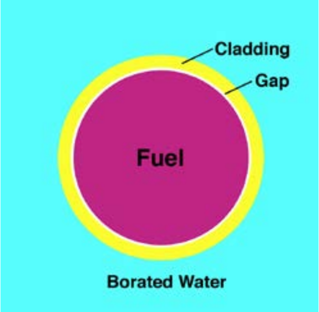
4. Contribution in Doppler Reactivity Defect Benchmark

❑ Doppler Reactivity Defect Benchmark

- o The aim of this work is to calculate the Doppler defect between HFP (900K) and HZP(600K) conditions

- o Benchmark specifications:

  "R. D. Mosteller, Computational Benchmarks for the Doppler Reactivity Defect, LA-UR-06-2968 (April 2006)"

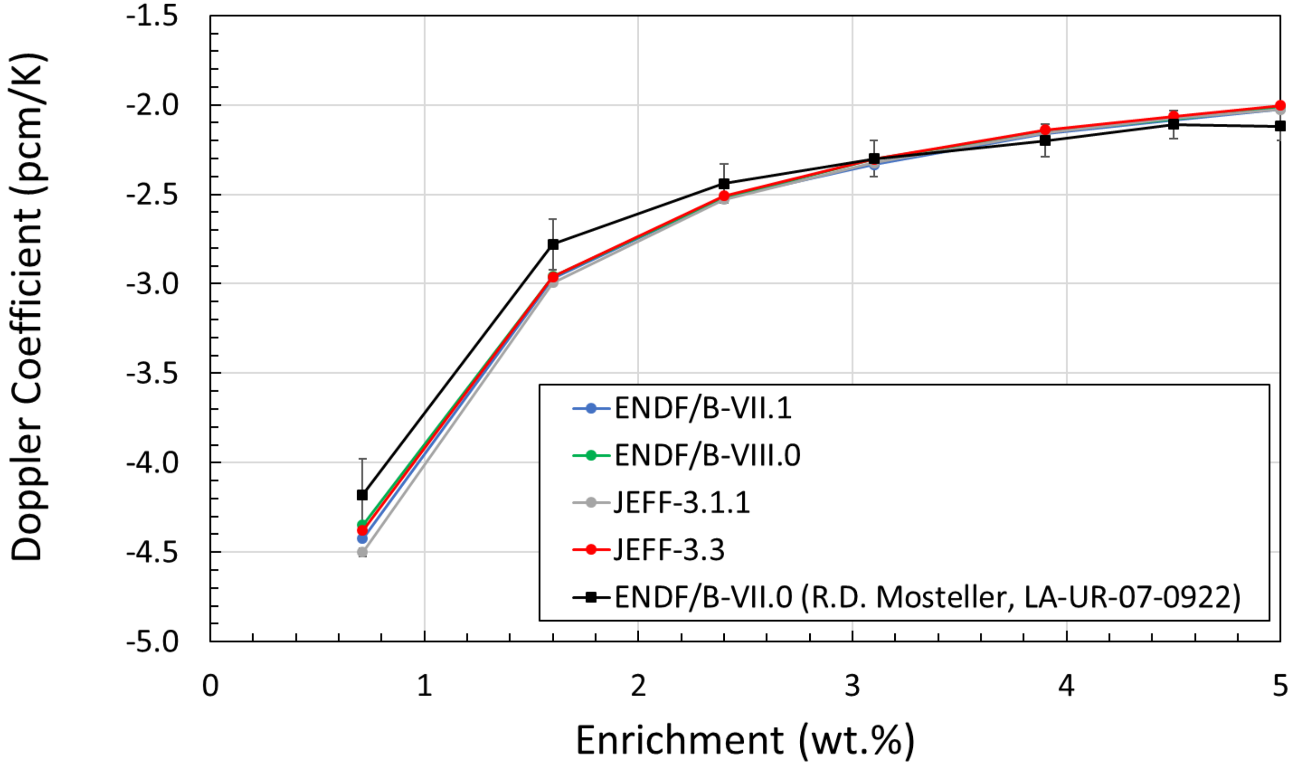


- o In this work, only UO2 benchmark (up to 5 wt.%) is computed
  - ▪ Nuclear Data Library: ENDF/B-VIII.0, ENDF/B-VII.1, JEFF-3.3 and JEFF-3.1.1
  - ▪ Methods used to process nuclear data libraries: NJOY2016.43
  - ▪ Processing TSLs: angular bins (32), secondary energy bins (acer 128)
  - ▪ **Temperature correction: Nearest data point used for light water: 573.6 ->600.0K**
  - ▪ If required: Interpolation using TSL Library Generator (IAEA/Bariloche)

- o Neutronics Code: MCNP6.1.0
  - ▪ "kcode 100000 1.0 100 5100" -> statisctical unc. < 3 pcm

❑ Doppler Coefficient for normal and enriched UO2 Fuel

Figure. Values for the Doppler coefficients for the UO2 cases

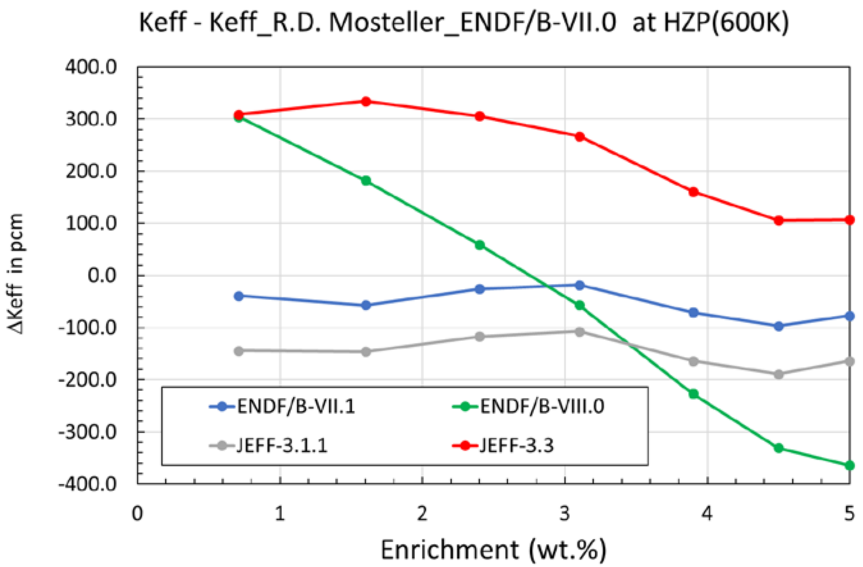


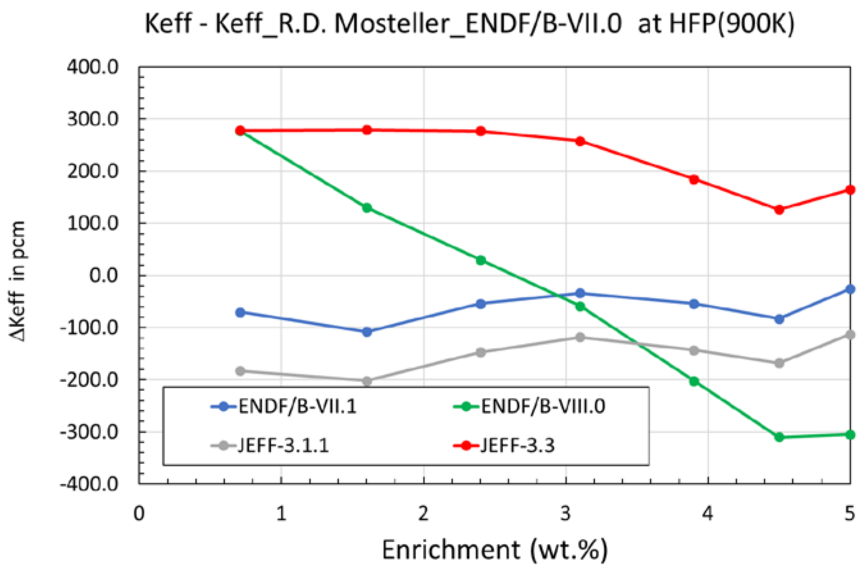
*Note: All **TSLs processed at 573.6K**, with 32 angular bins and 128 secondary energy bins*

4. Contribution in Doppler Reactivity Defect Benchmark

❑ Comparison of keff for normal and enriched UO2 Fuel

Figure. Comparison of keff values for different nuclear data libraries at HZP and HFP.
Reference keff is the R.D. Mosteller calculation using ENDF/B-VII.0 (LA-UR-07-0922)



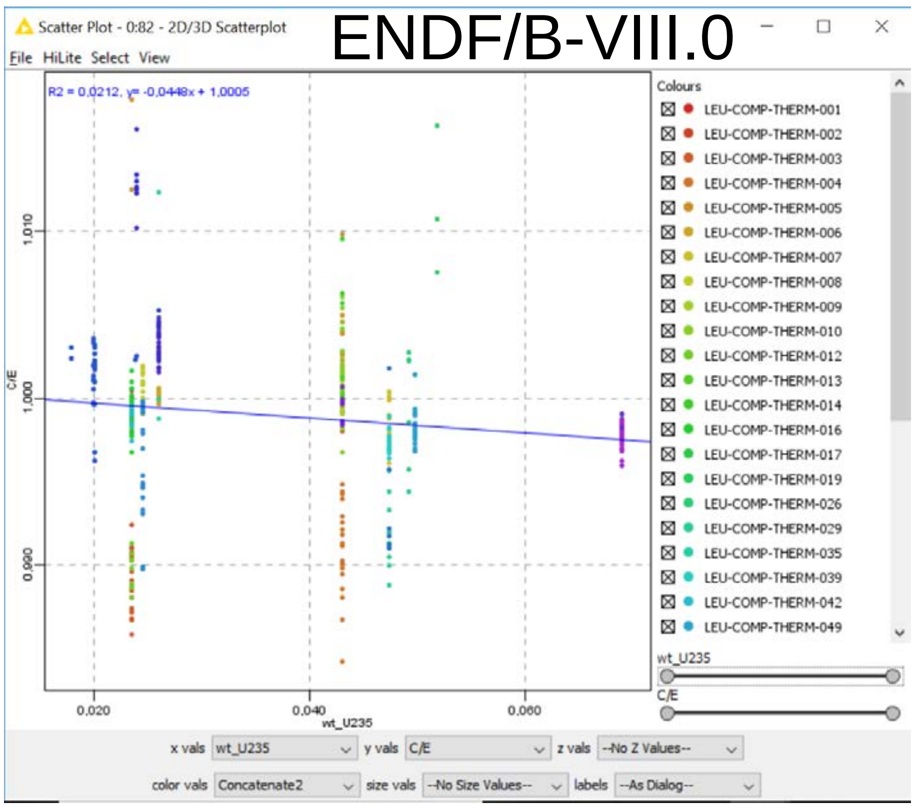


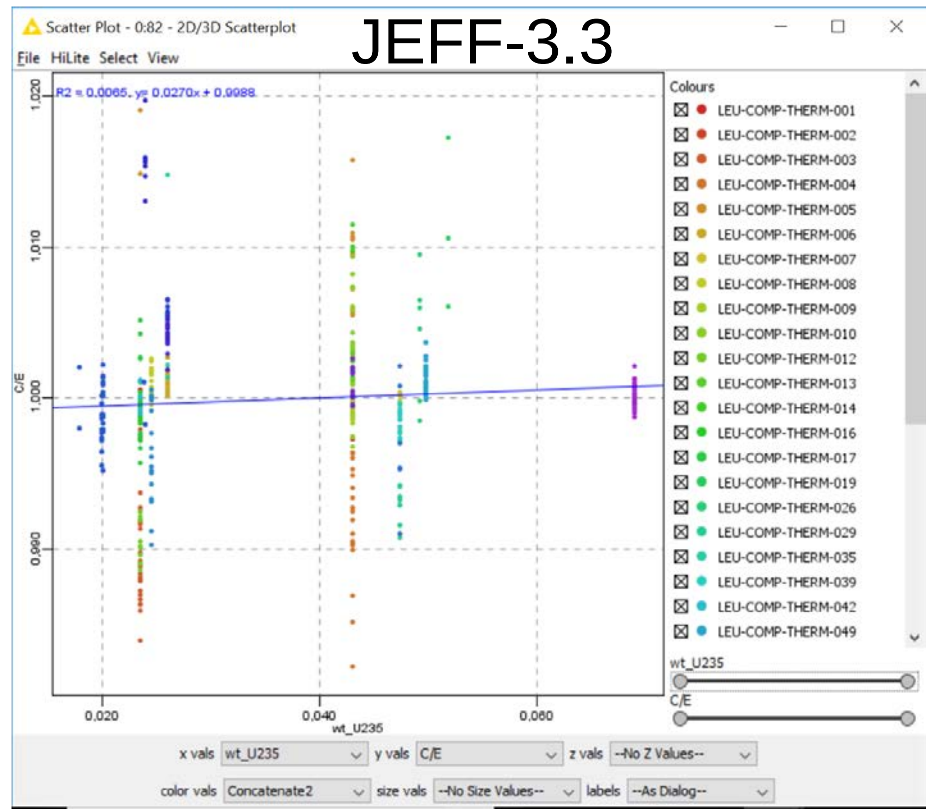
*Note: All **TSLs processed at 573.6K**, with 32 angular bins and 128 secondary energy bins*

4. Contribution in Doppler Reactivity Defect Benchmark

❑ Comparison of C/E for ICSBEP/LCTs cases .versus. wt%U235

- 463 ICSBEP/LTCs from Steven van der Marck's Benchmarking
- It shows a different trend!





4. Contribution in Doppler Reactivity Defect Benchmark

❑ Change in reactivity due to different TSL temperature

- o 573.6K or 600K ?

Figure. Impact of TSL temperature on keff calculations. TSL processed at 573.6K and 600K

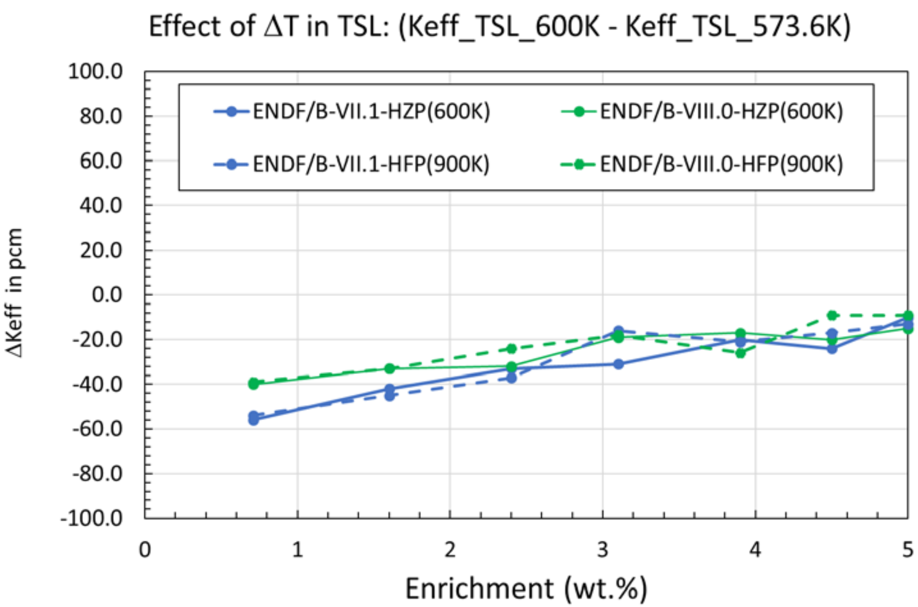


Table. Temperature for Benchmark specification. See also temperatures for TSLs in different nuclear data evaluations.

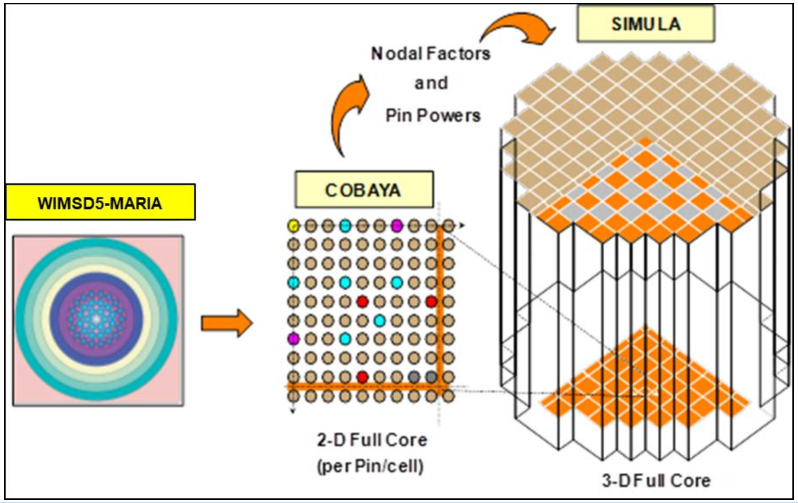
TSL Nuclear Data Evaluations				
BENCHMARK	ENDF/B-VIII.0	ENDF/B-VII.1	JEFF-3.3	JEFF-3.1.1
	573.6	573.6*	573.6	573.6
600	600.0	600.0		

[*] Values interpolated using TSL Library Generation developed by J.I. Marquez (Bariloche, Argentina)

5. Processing JEFF-3.3 & ENDF/B-VIII.0 in WIMS-D5 format

- The aim of this work is to test/validate JEFF-3.3 and ENDF/B-VIII.0 in a typical 1000 Mwe Westinghouse PWR and compare calculations to measured data.
  - Processing JEFF-3.3 & ENDF/B-VIII.0 into WIMSD5 format
  - Update of our SEANAP system with these processed data libraries
  - Validation of SEANAP (JEFF-3.3 & ENDF/B-VIII.0) along different cycles and reactors
  - Uncertainty propagation (UQ) assessment of nuclear data uncertainties in PWRs
    - Using a Monte Carlo technique with SANDY code to generate random files of nuclear data

Figure. SEANAP system:
- Lattice code: WIMS-D5 (ND-JEFF-3.3 - ENDF/B-VIII.0)
- COBAYA: 2D/2G and SIMULA: 3D/1G



UPM/INGENIA Course

- "CDIO Course Development for Design and Simulation of PWRs", C. Gómez et al. WIN2019, June 21-23, 2019. Madrid, Spain
- "Comparison of JEFF-3.3 and ENDF/B-VIII.0 Nuclear Data Libraries in PWR Simulations", D. Ostilla et al., WIN2019, June 21-23, 2019. Madrid, Spain

5. Processing JEFF-3.3&ENDF/B-VIII.0 in WIMS-D5: B&V and UQ in PWRs

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❑ Processing and Benchmarking new WIMSD5 libraries

- Processed ND libraries (JEFF-3.3 and ENDF/B-VIII.0) for WIMS-D5 using NJOY2016.46
- Processed libraries are created using programs and procedures of the IAEA/WIMS Library Update Project: https://www-nds.iaea.org/wimsd/
- The library is tested/validated with WLUP Benchmark suite

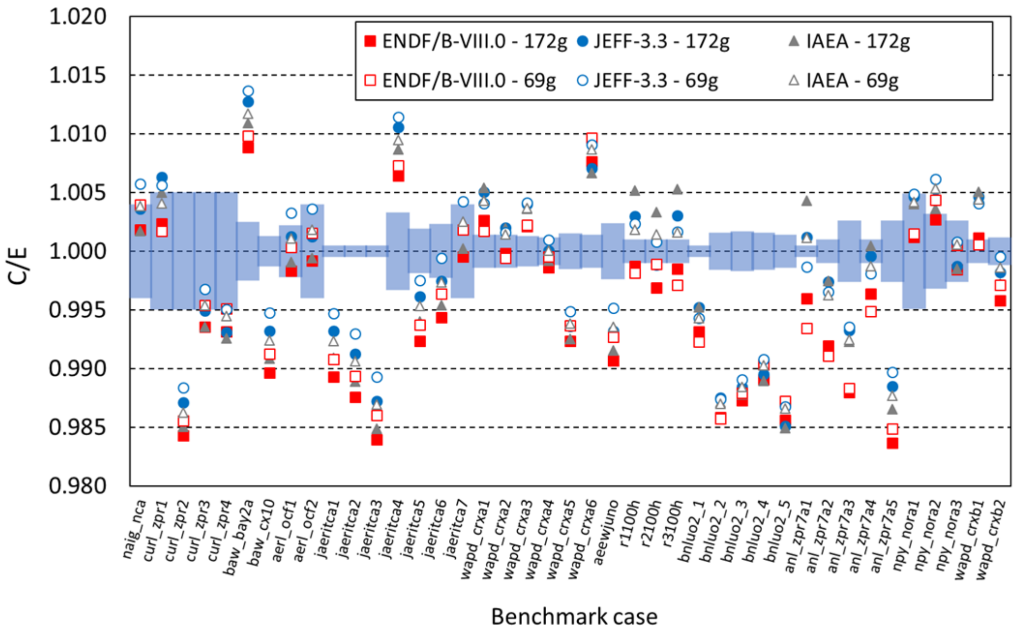

Figure. C/E for H2O moderated UO2 lattices with wt% >2 and <4 wt% U^{235}

5. Processing JEFF-3.3&ENDF/B-VIII.0 in WIMS-D5: B&V and UQ in PWRs

Validation of SEANAP System

- Comparison for the Critical Boron: Calculations versus Measurements

Core parameter	Design criteria	Acceptance criteria
Critical boron concentration ARO	$\lvert(C_B)^M_{ARO}-(C_B)^C_{ARO}\rvert$ <50 ppm Boron	$\lvert(C_B)^M_{ARO}-(C_B)^C_{ARO}\rvert$ <100 ppm Boron

Table. Comparison for the Critical Boron concentration in ppm. Calculations (C) versus Measurements (M)

- Cycle 5 of a PWR (Westinghouse), 3 loops. Power 2775 MWth and 157 FAs.
- ND processed in 69 energy groups.

	Burnup	Meas.	WIMS-D4 ND-1981		WIMSD5 ND-JEFF-3.3		WIMSD5 ND-ENDF/B-VIII.0	
Power (%)	(GWd/tHM)	(ppm)	C	C-M	C	C-M	C	C-M
50	0.015	1200	1150	-50	1172	-28	1200	0
75	0.031	1113	1071	-42	1092	-21	1119	6
100	0.134	985	1000	15	1017	32	1045	60
100	1.340	870	897	27	900	30	935	65
100	2.487	779	806	27	802	23	843	64
100	2.842	755	778	23	773	18	815	60
100	3.591	688	714	26	705	17	752	64
100	4.441	604	645	41	634	30	685	81
100	5.549	504	544	40	531	27	588	84
100	6.692	412	439	27	425	13	487	75
100	7.716	319	340	21	325	6	393	74
100	8.823	227	239	12	223	-4	296	69
100	10.284	101	100	-1	83	-18	162	61
100	11.351	4	-7	-7	-24	-28	60	56

5. Processing JEFF-3.3&ENDF/B-VIII.0 in WIMS-D5: B&V and UQ in PWRs

❑ Uncertainty Propagation of Nuclear Data in PWRs

- Monte Carlo technique is used to assess the impact of nuclear data uncertainties.
- SANDY code is able to create random libraries for each isotope&nuclear-data's covariance matrix. In this work, 300 randoms were used for each one.

Table. Uncertainties (1σ) in Critical Boron Concentration (in ppm). PWR-W in cycle-5.

		JEFF-3.3 covariance data							ENDF/B-VIII.0 covariance data											
		Pu239			U235			U238	Pu239				U235				U238			
Power (%)	Burnup (GWd/tHM)	XS	ν	χ	XS	ν	χ	XS	XS	ν	χ	Ang	XS	ν	χ	Ang	XS	ν	χ	Ang
50	0.015	18	14	9	27	46	9	24	34	9	15	0	-	31	-	0	23	11	0	1
75	0.031	18	15	9	27	46	10	24	35	9	15	0	-	31	-	0	24	11	0	1
100	0.134	19	15	9	27	46	10	25	37	10	16	0	-	31	-	0	25	11	0	1
100	1.340	22	16	9	25	47	10	24	43	11	15	0	-	29	-	0	24	11	0	1
100	2.487	24	17	9	24	45	10	24	47	12	15	0	-	28	-	0	23	11	0	1
100	2.842	25	19	9	24	43	10	24	49	12	15	0	-	28	-	0	23	11	0	1
100	3.591	27	19	9	24	43	10	24	52	12	15	0	-	27	-	0	23	11	0	1
100	4.441	28	20	9	23	41	10	24	55	13	15	0	-	27	-	0	23	11	0	1
100	5.549	30	21	9	22	40	10	24	59	14	15	0	-	26	-	0	22	11	0	1
100	6.692	32	22	9	22	39	10	23	63	14	15	0	-	25	-	0	22	11	0	1
100	7.716	34	23	9	21	38	10	23	66	15	15	0	-	24	-	0	22	11	0	1
100	8.823	35	24	9	21	37	10	23	69	15	15	0	-	24	-	0	22	11	0	1
100	10.284	37	25	9	20	35	10	23	73	16	15	0	-	23	-	0	21	11	0	1
100	11.351	39	26	9	20	34	10	23	76	16	15	0	-	22	-	0	21	11	0	1

NOTE: Problems for processing ENDF/B-VIII.0 U235 with SANDY code were found in this work :

- In PFNS: Bug in SANDY code, now it is solved!!
- Cross-sections (SANDY predicts large negative eigenvalues for the full covariance matrix)

JEFDOC-1968, "Comparison of JEFF-3.3 and ENDF/B-VIII.0 in PWR simulations", A. Ardura et al., NEA . (April 2019)

6. Comments on P&V in the JEFF Stakeholders meeting

❑ JEFF Stakeholders meeting, June 6-7, 2019

http://www.oecd-nea.org/dbdata/meetings/jeff_stakeholders_2019/

…

"This initial workshop aimed at:

- *Communicating, to the broad spectrum of **JEFF stakeholders** on the preparatory phase of the JEFF-4 library and serve as an **initial survey on needs and expectations** from nuclear data libraries among the end-user community;*
- *Rebuilding and enlarging the panorama of **JEFF stakeholders** while actively **involving them** in the JEFF-4 development phase, particularly in the **testing and validation phases**, as a community of JEFF end-users;*
- *Ensuring that, by design, foreseen **JEFF-4 developments are addressing pertinent industry applications** so that JEFF libraries can be taken on board in these in the future."*

…

55 participants from 27 different institutions	
Safety Authority and TSOs	ASN, ENSI, IRSN
Industry	ORANO, Tractebel Engie, Preussen Elektra, Framatom, NAGRA, SKB, Studsvick
Research Centers and Universities	CEA, CNRS, SCK·CEN, PSI, JAEA, PTB, CIEMAT, CCFE, IPPE, Goethe University, UPM, BNL, ORNL, Subatech
International Organizations	EC/JRC, IAEA, NEA

6. Comments on P&V in the JEFF Stakeholders meeting

Summary and main conclusions. Reported by K. Suyama, Head of NEA/DB, 30th Meeting of NSC, 12-14 June 2019.

- Need for better collaboration/**communication** with end-users during preparation of future release of Nuclear Data
- Need for better **infrastructure** to make collaboration more efficient
- Alert of **critical situation** in expertise and knowledge transfer
- **On the importance of robust V&V processes**
  - Acknowledging that present **Nuclear Data is mature** and adequate **for existing plants** **… foreseen developments in the back-end of the fuel cycle and final disposal**
  - **Safety authority** recognizes the importance of **transparent validation processes** with version control

Foreseen ND Needs…

"…

- *New fuel developments applications (ATF's, higher enrichments, innovative FC)*
- *Small Modular Reactors*
- *Decommissioning, waste and final disposal applications*
- *ADS applications (MYRRHA)*
- *Fusion applications and related irradiation facilities like IFMIF/DONES*
- *Non-energy applications such as:*
  - *Medical applications and Radioisotopes production*
  - *Others in academia : Astrophysics (active community of ND users/requesters)*

…"

6. Comments on P&V in the JEFF Stakeholders meeting

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- **See "Official Workshop Statement: NEA/MBDAV/DOC(2019)5 (July 24, 2019)"….**
  http://www.oecd-nea.org/dbdata/meetings/jeff_stakeholders_2019/

Appendix: Recommendations from JEFF stakeholders to the MBDAV and the JEFF CG

…

II. Demonstrate the impact, in applications of interest, of updating to a new JEFF library

a. …

*b. JEFF should provide **transparent track history** of modifications or developments, including associated testing that the library went through before release (**QA processes**).*

- *This is dependent of the underlying infrastructure that is needed to track and document this by design of the future JEFF-4 library, not retrospectively after the release.*

*c. On the necessity for JEFF **to cater to specific codes/formats** as impactful delivery vectors to ensure JEFF's use in above applications or in examples of industry licensing processes.*

- *Including but not limited to, for example TRIPOLI, APOLLO, SCALE, CASMO or WIMS.*

…

III. Function of the Data Bank: strengthen QA infrastructure dedicated to JEFF and actively manage JEFF's user base

a. …

*b. Enhance the unifying role of the Data Bank in the pre-release **V&V phases of JEFF libraries** through the work of its Nuclear Data Service*

- *On the necessity for JEFF application libraries to be represented by a larger, **more international share of processing and transport codes**. …*
- *Implement, at DB/NDS, with the appropriate resources, **V&V pipelines that take on board the processing and application libraries destined to the codes of interest**, and use these in cross-comparison exercises as a means to improve confidence in the quality and performance of future releases. …*

Conclusion

[1] Activities on P&V of JEFF-3.3 using FRENDY and NJOY2016

- To be continued within the JEFF Project

[2] First steps to process JEFF-3.3 in CE using AMPX code

- To be continued within the JEFF project
- To be continued within the SANDA and ESFR/H2020 projects

[3 - 4] Contribution in "WPNCS/SG-3" and "Doppler Reactivity Defect" Benchmarks

- WPNCS-SG3 Meeting. September 23, 2019
- WPNCS-SG3 Benchmark extended to evaluate ND uncertainties?
- Doppler benchmarks for testing ACE files at different temperatures?

[5] Processing of JEFF-3.3 and ENDF/B-VIII.0 in WIMS-D5 format. B&V and UQ in PWRs

- To be continued within the INGENIA/UPM course
- Needs of ND for ATFs??

[6] Comments on P&V in the JEFF Stakeholders meeting held in NEA, 6-7 June 2019

- **Processing&Verification** - B&V activities are important issues for JEFF4 roadmap
- P&V … new codes,.. new formats … improved Q&A

Thank you for your attention!!