Very Preliminary Uncertainty Calculation for ABR

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Calculation Data

- The provided RZ model with the detailed 15 core different densities was used
- ENDF/B-VII 33 group cross sections
- AFCI 1.3 covariance data
- Integral parameters: K_{eff} and sodium void only in core regions
- Uncertainties for: capture, fission, nu, elastic, inelastic, n,2n (not reported because quite negligible). Fission spectrum and averaged mubar not considered at the moment
- Reference K_{eff}:1.05977
- Reference Sodium Void: 1211 pcm

Uncertainty on K_{eff} (pcm)

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	Total
U238	294	31	118	29	559	644
PU239	332	238	201	9	77	462
FE56	161	0	0	243	146	325
PU240	53	20	86	1	14	104
NA23	27	0	0	16	82	88
O16	6	0	0	42	2	42
CR50	16	0	0	3	2	16
PU241	11	9	4	0	2	15
Total	476	241	248	249	589	869

U238 Uncertainty on K_{eff}

Uncertainty (pcm)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	-0.4	2.1	5.7	0.1	2.4
1.00E+07	-1.1	7.6	25.1	1.3	59.5
6.07E+06	-2.3	12.1	41.3	5.0	193.3
3.68E+06	6.6	17.8	72.5	9.2	333.0
2.23E+06	21.3	19.4	76.7	12.3	345.9
1.35E+06	23.5	5.9	17.4	11.2	190.7
8.21E+05	29.4	2.2	1.3	8.3	40.2
4.98E+05	33.1	0.8	0.5	4.6	20.9
3.02E+05	43.8	0.5	0.3	6.7	17.6
1.83E+05	53.9	0.7	0.4	8.0	22.9
1.11E+05	58.3	0.4	0.2	7.9	41.6
6.74E+04	61.9	0.5	0.3	8.1	12.3
4.09E+04	61.4	0.3	0.2	6.3	0.0
2.48E+04	115.6	0.6	0.2	8.0	0.0
1.50E+04	120.4	0.6	0.2	1.1	0.0
9.12E+03	91.0	0.6	0.2	0.5	0.0
5.53E+03	77.4	0.0	0.0	0.3	0.0
3.35E+03	55.6	0.0	0.0	0.3	0.0
2.03E+03	89.6	0.0	0.0	0.3	0.0
1.23E+03	82.6	0.2	0.4	0.5	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	22.3	0.6	1.4	7.4	31.6
2	21.2	0.7	1.4	12.3	30.3
3	19.9	0.6	1.3	13.1	20.1
4	5.9	0.6	1.3	15.1	19.4
5	6.1	0.6	1.3	18.8	20.6
6	3.1	1.8	1.1	9.5	16.9
7	1.7	4.9	2.0	2.6	5.6
8	1.5	5.1	2.0	2.2	4.3
9	1.5	6.8	2.0	1.8	4.1
10	1.7	5.2	2.0	1.9	6.0
11	1.7	5.1	2.0	2.8	19.2
12	1.7	5.1	2.0	3.4	17.9
13	1.6	5.2	2.0	4.3	0.0
14	3.2	100.0	2.0	2.3	0.0
15	3.9	98.8	2.0	0.9	0.0
16	3.3	100.0	2.0	0.8	0.0
17	2.8	14.5	2.0	0.7	0.0
18	2.9	66.8	2.0	0.8	0.0
19	2.9	68.0	2.0	0.8	0.0
20	2.8	6.9	2.0	1.0	0.0

Pu239 Uncertainty on K_{eff}

Uncertainty (pcm)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.0	2.4	0.3	0.0	0.2
1.00E+07	0.3	10.3	1.8	0.2	4.2
6.07E+06	1.8	19.7	3.9	0.8	17.9
3.68E+06	5.6	34.1	7.2	1.6	32.6
2.23E+06	11.2	43.6	9.4	2.4	34.2
1.35E+06	18.8	45.3	11.2	2.9	26.4
8.21E+05	48.7	63.4	17.6	4.2	34.6
4.98E+05	57.3	59.9	18.6	2.5	22.2
3.02E+05	65.5	63.1	29.7	3.4	14.5
1.83E+05	73.2	83.7	67.7	3.5	22.0
1.11E+05	81.1	77.5	50.8	2.5	18.3
6.74E+04	83.6	65.8	47.9	2.0	10.2
4.09E+04	84.9	57.6	39.3	1.3	4.3
2.48E+04	111.7	64.2	95.2	2.2	10.3
1.50E+04	117.1	53.9	100.1	1.4	12.1
9.12E+03	139.2	29.0	29.9	0.7	0.5
5.53E+03	139.0	25.7	28.4	0.5	0.0
3.35E+03	86.6	21.1	20.2	0.3	0.0
2.03E+03	21.6	54.7	51.3	0.0	0.0
1.23E+03	18.2	51.9	49.2	0.0	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	36.3	0.8	0.4	5.6	24.1
2	39.9	0.9	0.2	8.7	27.6
3	42.0	0.8	0.2	10.8	25.6
4	34.2	0.9	0.2	9.4	19.5
5	26.6	0.9	0.2	10.7	19.0
6	20.5	0.8	0.2	11.7	27.0
7	15.5	0.8	0.2	9.2	32.6
8	12.1	0.9	0.2	6.4	32.7
9	11.3	0.8	0.3	5.2	36.2
10	9.6	1.0	0.7	4.5	43.7
11	10.8	0.9	0.5	3.6	50.0
12	11.4	0.8	0.7	2.6	45.1
13	8.9	0.9	0.6	2.1	31.9
14	7.2	0.9	1.2	2.1	30.1
15	7.8	1.2	2.0	2.3	26.7
16	16.5	0.8	0.9	3.7	17.1
17	16.5	0.8	1.0	4.3	0.0
18	10.7	0.7	1.4	3.3	0.0
19	1.5	1.2	1.0	0.5	0.0
20	1.5	1.3	1.2	0.7	0.0

Fe56 Uncertainty on K_{eff}

Uncertainty (pcm)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	4.4	0.0	0.0	0.1	3.0
1.00E+07	8.7	0.0	0.0	0.7	8.3
6.07E+06	2.1	0.0	0.0	6.1	17.0
3.68E+06	4.2	0.0	0.0	12.4	31.8
2.23E+06	7.2	0.0	0.0	22.6	114.5
1.35E+06	13.8	0.0	0.0	29.8	81.9
8.21E+05	72.5	0.0	0.0	101.8	0.0
4.98E+05	64.4	0.0	0.0	100.9	0.0
3.02E+05	49.4	0.0	0.0	74.3	0.0
1.83E+05	44.3	0.0	0.0	81.8	0.0
1.11E+05	50.5	0.0	0.0	74.3	0.0
6.74E+04	31.3	0.0	0.0	43.4	0.0
4.09E+04	53.1	0.0	0.0	69.6	0.0
2.48E+04	31.7	0.0	0.0	50.3	0.0
1.50E+04	9.5	0.0	0.0	46.8	0.0
9.12E+03	7.7	0.0	0.0	32.8	0.0
5.53E+03	9.1	0.0	0.0	23.2	0.0
3.35E+03	9.9	0.0	0.0	27.0	0.0
2.03E+03	18.2	0.0	0.0	18.1	0.0
1.23E+03	56.6	0.0	0.0	65.2	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	61.5	0.0	0.0	5.4	7.6
2	23.8	0.0	0.0	5.9	4.3
3	18.2	0.0	0.0	4.8	4.3
4	21.2	0.0	0.0	6.1	4.5
5	16.6	0.0	0.0	8.8	12.0
6	18.9	0.0	0.0	6.0	11.0
7	25.2	0.0	0.0	12.5	0.0
8	25.2	0.0	0.0	14.1	0.0
9	13.5	0.0	0.0	13.3	0.0
10	10.7	0.0	0.0	12.4	0.0
11	7.0	0.0	0.0	11.5	0.0
12	7.6	0.0	0.0	16.5	0.0
13	10.3	0.0	0.0	10.1	0.0
14	12.4	0.0	0.0	7.7	0.0
15	12.4	0.0	0.0	7.7	0.0
16	12.4	0.0	0.0	7.7	0.0
17	12.4	0.0	0.0	7.7	0.0
18	12.4	0.0	0.0	7.7	0.0
19	9.4	0.0	0.0	7.7	0.0
20	4.8	0.0	0.0	7.7	0.0

Pu240 Uncertainty on K_{eff}

Uncertainty (pcm)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.2	0.4	0.6	0.0	0.2
1.00E+07	1.0	1.3	6.1	0.1	1.8
6.07E+06	3.5	2.2	13.7	0.2	4.6
3.68E+06	9.6	3.5	23.5	0.3	7.8
2.23E+06	16.9	3.7	27.9	0.4	8.0
1.35E+06	13.8	6.0	42.7	0.5	5.2
8.21E+05	12.2	10.4	45.3	0.7	3.1
4.98E+05	9.5	6.2	23.4	0.3	2.3
3.02E+05	9.5	5.1	17.7	0.4	1.8
1.83E+05	9.2	4.7	15.4	0.3	2.0
1.11E+05	9.6	4.9	15.0	0.2	2.4
6.74E+04	10.9	5.7	14.4	0.2	0.4
4.09E+04	12.1	5.2	13.1	0.0	0.0
2.48E+04	14.2	4.9	13.2	0.0	0.0
1.50E+04	13.0	3.4	10.4	0.0	0.0
9.12E+03	10.1	2.2	7.1	0.0	0.0
5.53E+03	9.8	2.1	1.4	0.0	0.0
3.35E+03	6.1	1.2	0.7	0.0	0.0
2.03E+03	14.1	3.7	2.4	0.1	0.0
1.23E+03	14.7	3.1	2.0	0.1	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	94.8	0.6	1.1	6.6	17.2
2	94.9	0.5	2.2	14.8	34.3
3	94.7	0.5	2.7	16.8	31.4
4	94.7	0.5	2.7	16.3	30.8
5	89.1	0.5	2.7	18.5	32.0
6	39.4	0.6	3.7	17.9	40.9
7	11.9	1.6	4.4	9.5	33.9
8	6.0	3.0	4.8	4.6	21.9
9	3.9	3.6	4.8	3.1	15.7
10	2.3	2.8	4.8	3.0	12.5
11	2.2	3.9	4.8	3.2	16.0
12	2.9	6.1	4.8	4.1	79.8
13	3.6	6.0	4.8	0.4	0.0
14	3.7	5.0	4.8	0.3	0.0
15	3.8	4.0	4.8	0.3	0.0
16	3.3	3.5	4.8	0.3	0.0
17	3.5	3.3	4.4	1.7	0.0
18	4.0	3.1	4.2	5.8	0.0
19	4.6	2.9	4.0	5.8	0.0
20	4.6	2.9	4.0	5.8	0.0

Uncertainty on Sodium Void (%)

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	Total
U238	3.9	0.1	0.5	0.6	4.1	5.8
NA23	1.5	0.0	0.0	1.5	4.9	5.3
PU239	1.4	3.2	2.9	0.2	0.8	4.6
FE56	1.2	0.0	0.0	3.7	0.9	3.9
PU240	0.6	0.1	0.6	0.0	0.1	0.8
O16	0.0	0.0	0.0	0.5	0.0	0.5
PU241	0.1	0.2	0.0	0.0	0.0	0.2
CR50	0.0	0.0	0.0	0.0	0.0	0.1
Total	4.6	3.2	3.0	4.0	6.5	10.0

U238 Uncertainty on Sodium Void

Uncertainty (%)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.0	0.0	0.0	0.0	0.0
1.00E+07	0.0	0.0	0.1	0.0	0.6
6.07E+06	0.0	0.1	0.2	0.1	1.5
3.68E+06	0.0	0.1	0.4	0.2	2.8
2.23E+06	0.1	0.0	0.2	0.2	2.1
1.35E+06	0.1	0.0	0.1	0.3	1.4
8.21E+05	0.3	0.0	0.0	0.3	0.2
4.98E+05	0.1	0.0	0.0	0.1	0.2
3.02E+05	0.1	0.0	0.0	0.2	0.1
1.83E+05	0.1	0.0	0.0	0.1	0.2
1.11E+05	0.0	0.0	0.0	0.1	0.4
6.74E+04	0.0	0.0	0.0	0.1	0.2
4.09E+04	0.0	0.0	0.0	-0.1	0.0
2.48E+04	0.8	0.0	0.0	0.1	0.0
1.50E+04	1.4	0.0	0.0	0.0	0.0
9.12E+03	1.2	0.0	0.0	0.0	0.0
5.53E+03	-0.3	0.0	0.0	0.0	0.0
3.35E+03	-1.4	0.0	0.0	0.0	0.0
2.03E+03	2.0	0.0	0.0	0.0	0.0
1.23E+03	2.1	0.0	0.0	0.0	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	22.3	0.6	1.4	7.4	31.6
2	21.2	0.7	1.4	12.3	30.3
3	19.9	0.6	1.3	13.1	20.1
4	5.9	0.6	1.3	15.1	19.4
5	6.1	0.6	1.3	18.8	20.6
6	3.1	1.8	1.1	9.5	16.9
7	1.7	4.9	2.0	2.6	5.6
8	1.5	5.1	2.0	2.2	4.3
9	1.5	6.8	2.0	1.8	4.1
10	1.7	5.2	2.0	1.9	6.0
11	1.7	5.1	2.0	2.8	19.2
12	1.7	5.1	2.0	3.4	17.9
13	1.6	5.2	2.0	4.3	0.0
14	3.2	100.0	2.0	2.3	0.0
15	3.9	98.8	2.0	0.9	0.0
16	3.3	100.0	2.0	0.8	0.0
17	2.8	14.5	2.0	0.7	0.0
18	2.9	66.8	2.0	0.8	0.0
19	2.9	68.0	2.0	0.8	0.0
20	2.8	6.9	2.0	1.0	0.0

Na23 Uncertainty on Sodium Void

Uncertainty (%)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.6	0.0	0.0	0.0	0.2
1.00E+07	1.2	0.0	0.0	0.1	0.8
6.07E+06	0.6	0.0	0.0	-0.2	1.1
3.68E+06	0.2	0.0	0.0	0.3	2.1
2.23E+06	0.3	0.0	0.0	0.6	2.0
1.35E+06	0.3	0.0	0.0	0.2	2.0
8.21E+05	0.1	0.0	0.0	0.1	3.1
4.98E+05	0.1	0.0	0.0	0.9	0.1
3.02E+05	0.2	0.0	0.0	0.6	0.0
1.83E+05	0.2	0.0	0.0	0.8	0.0
1.11E+05	0.0	0.0	0.0	0.8	0.0
6.74E+04	0.1	0.0	0.0	0.4	0.0
4.09E+04	0.2	0.0	0.0	0.2	0.0
2.48E+04	0.0	0.0	0.0	-0.6	0.0
1.50E+04	0.0	0.0	0.0	-0.6	0.0
9.12E+03	0.0	0.0	0.0	-0.4	0.0
5.53E+03	0.1	0.0	0.0	-0.2	0.0
3.35E+03	0.2	0.0	0.0	0.3	0.0
2.03E+03	0.1	0.0	0.0	0.2	0.0
1.23E+03	0.1	0.0	0.0	0.2	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	61.0	0.0	0.0	8.3	5.5
2	57.8	0.0	0.0	9.6	5.6
3	59.2	0.0	0.0	10.4	6.3
4	61.0	0.0	0.0	10.0	6.9
5	65.9	0.0	0.0	9.3	8.3
6	48.0	0.0	0.0	6.4	14.9
7	33.4	0.0	0.0	3.0	17.5
8	23.6	0.0	0.0	5.2	9.9
9	19.9	0.0	0.0	3.9	0.0
10	18.8	0.0	0.0	5.6	0.0
11	15.2	0.0	0.0	5.6	0.0
12	20.9	0.0	0.0	3.9	0.0
13	15.8	0.0	0.0	5.5	0.0
14	8.1	0.0	0.0	5.4	0.0
15	4.2	0.0	0.0	5.1	0.0
16	2.2	0.0	0.0	4.4	0.0
17	2.9	0.0	0.0	3.2	0.0
18	4.6	0.0	0.0	1.6	0.0
19	2.0	0.0	0.0	5.1	0.0
20	1.8	0.0	0.0	6.3	0.0

Pu239 Uncertainty on Sodium Void

Uncertainty (%)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.0	0.0	0.0	0.0	0.0
1.00E+07	0.0	0.1	0.0	0.0	0.0
6.07E+06	0.0	0.1	0.0	0.0	0.1
3.68E+06	0.0	0.2	0.0	0.0	0.3
2.23E+06	0.0	0.1	0.0	0.0	0.2
1.35E+06	0.1	0.2	0.1	0.1	0.2
8.21E+05	0.3	0.7	0.2	0.2	0.5
4.98E+05	0.2	0.3	0.1	0.0	0.3
3.02E+05	0.2	0.3	0.1	0.1	0.1
1.83E+05	0.0	0.2	0.1	0.1	0.2
1.11E+05	-0.1	0.1	0.1	0.0	0.2
6.74E+04	-0.1	0.1	0.1	0.0	0.1
4.09E+04	0.2	-0.1	0.1	0.0	0.1
2.48E+04	-0.1	0.1	0.4	0.0	-0.1
1.50E+04	-0.3	0.2	0.7	0.0	-0.1
9.12E+03	-0.6	0.1	0.3	0.0	0.0
5.53E+03	0.3	0.1	0.2	0.0	0.0
3.35E+03	0.7	-0.7	1.1	0.0	0.0
2.03E+03	0.6	1.6	1.4	0.0	0.0
1.23E+03	0.6	1.7	1.6	0.0	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	36.3	0.8	0.4	5.6	24.1
2	39.9	0.9	0.2	8.7	27.6
3	42.0	0.8	0.2	10.8	25.6
4	34.2	0.9	0.2	9.4	19.5
5	26.6	0.9	0.2	10.7	19.0
6	20.5	0.8	0.2	11.7	27.0
7	15.5	0.8	0.2	9.2	32.6
8	12.1	0.9	0.2	6.4	32.7
9	11.3	0.8	0.3	5.2	36.2
10	9.6	1.0	0.7	4.5	43.7
11	10.8	0.9	0.5	3.6	50.0
12	11.4	0.8	0.7	2.6	45.1
13	8.9	0.9	0.6	2.1	31.9
14	7.2	0.9	1.2	2.1	30.1
15	7.8	1.2	2.0	2.3	26.7
16	16.5	0.8	0.9	3.7	17.1
17	16.5	0.8	1.0	4.3	0.0
18	10.7	0.7	1.4	3.3	0.0
19	1.5	1.2	1.0	0.5	0.0
20	1.5	1.3	1.2	0.7	0.0

Fe56 Uncertainty on Sodium Void

Uncertainty (%)

Ener. ev	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1.96E+07	0.0	0.0	0.0	0.0	0.0
1.00E+07	0.1	0.0	0.0	0.0	0.1
6.07E+06	0.0	0.0	0.0	0.1	0.1
3.68E+06	0.0	0.0	0.0	0.3	0.2
2.23E+06	0.0	0.0	0.0	0.5	0.5
1.35E+06	0.1	0.0	0.0	0.6	0.7
8.21E+05	0.7	0.0	0.0	2.8	0.0
4.98E+05	0.4	0.0	0.0	1.5	0.0
3.02E+05	0.2	0.0	0.0	1.7	0.0
1.83E+05	0.2	0.0	0.0	1.1	0.0
1.11E+05	0.1	0.0	0.0	0.7	0.0
6.74E+04	0.1	0.0	0.0	0.5	0.0
4.09E+04	-0.2	0.0	0.0	-0.2	0.0
2.48E+04	-0.1	0.0	0.0	0.3	0.0
1.50E+04	0.0	0.0	0.0	-0.2	0.0
9.12E+03	0.0	0.0	0.0	-0.1	0.0
5.53E+03	0.0	0.0	0.0	0.6	0.0
3.35E+03	0.1	0.0	0.0	-0.2	0.0
2.03E+03	-0.1	0.0	0.0	-0.9	0.0
1.23E+03	0.8	0.0	0.0	-0.9	0.0

Standard Deviat. %

Group	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}
1	61.5	0.0	0.0	5.4	7.6
2	23.8	0.0	0.0	5.9	4.3
3	18.2	0.0	0.0	4.8	4.3
4	21.2	0.0	0.0	6.1	4.5
5	16.6	0.0	0.0	8.8	12.0
6	18.9	0.0	0.0	6.0	11.0
7	25.2	0.0	0.0	12.5	0.0
8	25.2	0.0	0.0	14.1	0.0
9	13.5	0.0	0.0	13.3	0.0
10	10.7	0.0	0.0	12.4	0.0
11	7.0	0.0	0.0	11.5	0.0
12	7.6	0.0	0.0	16.5	0.0
13	10.3	0.0	0.0	10.1	0.0
14	12.4	0.0	0.0	7.7	0.0
15	12.4	0.0	0.0	7.7	0.0
16	12.4	0.0	0.0	7.7	0.0
17	12.4	0.0	0.0	7.7	0.0
18	12.4	0.0	0.0	7.7	0.0
19	9.4	0.0	0.0	7.7	0.0
20	4.8	0.0	0.0	7.7	0.0