## **Supplemental Online Material**

## Analysis of VIP-BWR reactor core physics experiments on UO<sub>2</sub> and MOX mockup fuel assemblies with CASMO5

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This Supplemental Online Material consists of 9 pages and includes 9 figures.

X-axis

	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
1	7																				
1	6					0.54															
1	5			~																	
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1	1																				
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	9																				
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	7			_											1.15						
	6													1.26		1.11					
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	4 1.0	2 0.80			0.87			0.72		0.81		1.15		1.22	1.08	1.20					
	3			~												1.10	1.18	1.21	1.10		
	2			~										1.36		1.08	1.08	1.09		1.15	
xis	1													1.54	1.31		1.21	1.24		1.36	1.59
-a	00			-																	
· -	1			-	1.13							1.44		1.42	1.17	1.10	1.11	1.12	1.12	1.23	1.54
-	2			~								1.31			0.87	0.20	0.88	0.85	0.20	0.93	
-	3											1.22		1.00	0.19	0.79	0.95	0.95	0.80		
-	4	0.79	0.97	~	0.83	0.72		0.70		0.79	0.91	1.07		1.01	0.83	0.94					
-	5			~								1.04		1.00	0.82	0.92					
-	6											1.06		1.01	0.19	0.76					
-	7			~								1.13		1.09	0.84						
-	8			]	1.01							1.31		1.31							
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-1	4			-				0.52													
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-1	6			~	0.50	0.53															
-1	7				0.70																

**Figure S1**. Relative fission rate distribution in the left half of the all-UO<sub>2</sub> core. They were defined by normalizing the relative fission rates reported in the Reference [10] so that the averages of the fission rates of all the measured fuel rods were 1.0.  $\mathbf{x}$ .  $\mathbf{x}\mathbf{x}$  : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods and others: UO<sub>2</sub> fuel rods.

													X-axis									
	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
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6								L							1.23		1.02					
5								ļ								1.04						
4	1.06	0.77	0.81			0.98			0.78		0.88		1.20		1.18		1.14			1.11		1.07
3																1.03		1.10		0.99		
2															1.31		1.00	0.99	0.98		1.02	
. <u>s</u> 1															1.54	1.24		1.09	1.07		1.18	1.43
6 <sup>6</sup>					_																	
≻ <sub>-1</sub>						1.28							1.54		1.36	1.03	0.86	1.22	1.06	1.12	1.36	1.23
-2													1.26		1.01	1.07	0.18	0.91	0.17	0.88	0.18	1.33
-3								1					1.12		0.82	0.18	0.96	1.14	1.10	0.94		
-4		0.76	0.78	1.06		0.96	0.81		0.76		0.82	0.88	1.07		1.09	0.86	1.11			1.14		
-5													1.04		0.98	0.16	1.07					
-6								l					1.07		1.02	0.82	0.91			0.95		
-7													1.16		1.22	0.17	0.71			0.72	1.08	
-8						1 16							1 35		1.09							1 35
0				1	1	1.10	3	8	1		1		1.55		1.07			1	1	8		1.55
-9					1	<b></b>						****	1 20	l	1							
-10						*******						0.05	1.39									
-11											0.75	0.95										
-12											0.75											
-13								<u> </u>	0.00													
-14									0.60													
-15					4			ļ				ļ										
-16							0.62															
-17						0.82																

**Figure S2**. Relative fission rate distribution in the left half of the I-MOX core. They were defined by normalizing the relative fission rates reported in the Reference [11] so that the averages of the fission rates of all the measured fuel rods were 1.0.  $\mathbf{x}.\mathbf{xx}$  : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods,  $\mathbf{x}.\mathbf{xx}$  : MOX fuel rods and others: UO<sub>2</sub> fuel rods.

X-axis

	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
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16						0.58														ļ	
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12										0.78											
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8														1.61	1.00						
7					******									1.20	1.22	1 10					
6														1.30	1.10	1.18					
) 1	1 1 4	0.87			0.02			0.77		0.87		1.21		1 2 1	1.10	1.26					
4	1.14	0.87			0.95			0.77		0.87		1.21		1.51	1 1 4	1.20	1.24	1 22	1 1 1		
2					*****									1 38	1.14	1.09	1.24	1.22	1.11	1 10	
1														1.56	1 29	1.09	1.09	1.09		1.10	1 44
1			00	1						1		1		1.54	1.27		1.10	1.10		1.23	1.77
-1			1	1								1 42		1.68	1 33	1 18	1 14	1 14	1 17	1.32	1 70
-2								1				1.12		1.30	0.85	0.18	0.92	0.17	0.95	0.19	1.70
-3												1.04		1.09	0.17	0.99	0.17	1.16	1.01		
-4		0.84	1.02		0.91	0.77		0.72		0.78	0.86	1.00		1.03	0.85	0.17					
-5												0.96		1.01	0.16	1.11					
-6												0.99		1.01	0.86	0.96					
-7												1.05		1.15	0.17						
-8					1.07							1.28		1.48							
-9				-								-									
-10												1.32									
-11											0.91										
-12										0.71											
-13														****						Ļ	
-14								0.56												ļ	
-15																				ļ	
-16						0.57														ļ]	
-17					0.76																

**Figure S3**. Relative fission rate distribution in the left half of the all-MOX core. They were defined by normalizing the relative fission rates reported in the Reference [12] so that the averages of the fission rates of all the measured fuel rods were 1.0.  $\mathbf{x}$ .  $\mathbf{x}$  : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods,  $\mathbf{x}$ .  $\mathbf{x}$ 

Y -axis



Figure S4. Measured results of axial buckling in the horizontal axis of the distance of the fuel rod from the core center for the all- $UO_2$  core [10].



**Figure S5**. Measured results of axial buckling in the horizontal axis of the distance of the fuel rod from the core center for the I-MOX core [11].



**Figure S6**. Measured results of axial buckling in the horizontal axis of the distance of the fuel rod from the core center for the all-MOX core [12].

0.952							
	-1.635						
-0.365		-1.052					
	-1.195						
1.719	1.712	1.392					
		0.421	2.690	0.913	0.606		
-1.861		1.043	1.862	1.743		0.906	
-0.600	1.225		2.048	0.543		-0.089	-1.179

1.28	2.63	-1.25	0.06	0.18	-0.74	1.13	-1.05
	-1.20	-2.42	-2.24	1.04	-1.48	-2.96	
2.92	-0.69	-4.82	0.88	1.53	-4.22		
1.48	-2.35	-0.67					
0.94	-1.82	0.77					
-2.87	-3.65	-4.38					
-0.57	-4.81						
-1.05							

Two fuel assemblies

0.488					*		
	-2.086						
-0.822		-1.506					
	-1.648						
1.252	1.245	0.927					
		-0.039	2.219	0.450	0.144		
-2.311		0.580	1.394	1.276		0.443	
-1.056	0.761		1.580	0.082		-0.548	-1.632

## Reference fuel assembly

1.06	2.41	-1.46	-0.16	-0.04	-0.95	0.91	-1.26
	-1.41	-2.63	-2.46	0.82	-1.69	-3.17	
2.70	-0.91	-5.03	0.66	1.31	-4.43		
1.27	-2.56	-0.89					
0.73	-2.03	0.55					
-3.08	-3.86	-4.59					
-0.79	-5.01						
-1.27							

All-UO<sub>2</sub> fuel assembly

**Figure S7**. Comparison of the calculated core radial fission rate distribution of CASMO5 with the measurements in (C/E - 1.0)% in the two assembly, test assembly, and reference assembly regions for the all-UO<sub>2</sub> core. **x**.**xx** : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods, and the others: UO<sub>2</sub> fuel rods.

-1.69							-2.88
	-2.01						
-1.42		-1.33					
	-1.32						
0.25		-2.08			-1.75		-1.38
	-2.46		-0.43		-2.64		
-2.07		-1.93	-1.69	-1.97		-2.89	
-3.39	-1.06		-1.87	-1.61		-1.78	-3.15
-1.68	-0.93	-1.75	-2.26	3.81	2.44	1.35	-3.35
-1.68 0.52	-0.93 3.01	-1.75 -3.39	-2.26 1.08	3.81 -1.73	2.44 3.20	1.35 -2.16	-3.35 3.60
-1.68 0.52 -0.92	-0.93 3.01 -2.63	-1.75 -3.39 2.35	-2.26 1.08 2.18	3.81 -1.73 3.74	2.44 3.20 1.68	1.35 -2.16	-3.35 3.60
-1.68 0.52 -0.92 3.66	-0.93 3.01 -2.63 3.47	-1.75 -3.39 2.35 3.23	-2.26 1.08 2.18	3.81 -1.73 3.74	2.44 3.20 1.68 -0.58	1.35 -2.16	-3.35 3.60
-1.68 0.52 -0.92 3.66 5.51	-0.93 3.01 -2.63 3.47 -0.95	-1.75 -3.39 2.35 3.23 3.15	-2.26 1.08 2.18	3.81 -1.73 3.74	2.44 3.20 1.68 -0.58	1.35 -2.16	-3.35 3.60
-1.68 0.52 -0.92 3.66 5.51 5.07	-0.93 3.01 -2.63 3.47 -0.95 2.81	-1.75 -3.39 2.35 3.23 3.15 0.15	-2.26 1.08 2.18	3.81 -1.73 3.74	2.44 3.20 1.68 -0.58 3.21	<u>1.35</u> -2.16	-3.35 3.60
-1.68 0.52 -0.92 3.66 5.51 5.07 4.41	-0.93 3.01 -2.63 3.47 -0.95 2.81 -1.93	-1.75 -3.39 2.35 3.23 3.15 0.15	-2.26 1.08 2.18	3.81 -1.73 3.74	2.44 3.20 1.68 -0.58 3.21	1.35 -2.16 2.56	-3.35 3.60

Two fuel assemblies

0.21							-1.01
	-0.12						
0.49		0.58					
	0.59						
2.19		-0.19			0.15		0.52
	-0.57		1.50		-0.76		
-0.18		-0.04	0.21	-0.08		-1.02	
-1.53	0.84		0.03	0.29		0.11	-1.28

Reference fuel assembly

-3.14	-2.39	-3.21	-3.70	2.27	0.92	-0.16	-4.78
-0.97	1.48	-4.82	-0.42	-3.19	1.67	-3.61	2.06
-2.39	-4.08	0.83	0.67	2.20	0.18		
2.12	1.94	1.70			-2.05		
3.95	-2.42	1.62					
3.52	1.28	-1.33			1.68		
2.86	-3.39					1.04	
-1.47							-2.49

I-MOX fuel assembly

**Figure S8**. Comparison of the calculated core radial fission rate distribution of CASMO5 with the measurements in (C/E - 1.0)% in the two assembly, test assembly and reference assembly regions for the I-MOX core. **x**.**xx** : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods, **x**.**xx** : MOX fuel rods, and the others: UO<sub>2</sub> fuel rods.

-1.86							
	-2.99						
-4.10		-3.50					
	-2.33						
-2.01		-1.08					
	-2.59		-1.30	-0.34	-2.08		
-3.11		-1.61	-1.47	-2.00		-1.36	
-3.87	-2.90		-1.80	-2.04		-2.70	-2.97

2.74	2.32	2.93	1.86	1.87	3.17	2.18	1.99
1.32	1.50	-2.90	1.15	-3.12	1.10	-2.79	
3.50	-2.36	0.66	-2.03	2.34	1.22		
3.16	2.81	-3.24					
3.07	-2.92	3.45					
6.11	1.41	0.72					
2.75	-3.02						
3.10							

Two fuel assemblies

0.47	7						
	-0.69						
-1.8	3	-1.21					
	-0.02						
0.31		1.26					
	-0.28		1.04	2.02	0.24		
-0.8	1	0.73	0.87	0.32		0.98	
-1.5	9 -0.60		0.53	0.28		-0.39	-0.67

Reference fuel assembly

0.59	0.18	0.78	-0.27	-0.26	1.01	0.05	-0.13
-0.79	-0.61	-4.93	-0.96	-5.14	-1.01	-4.82	
1.34	-4.39	-1.44	-4.08	0.21	-0.89		
1.01	0.67	-5.26					
0.92	-4.94	1.30					
3.90	-0.71	-1.38					
0.60	-5.05						
0.95							

All-MOX fuel assembly

**Figure S9**. Comparison of the calculated core radial fission rate distribution of CASMO5 with the measurements in (C/E - 1.0)% in the two assembly, test assembly and reference assembly regions for the all-MOX core. **x**.xx : Gd<sub>2</sub>O<sub>3</sub>-UO<sub>2</sub> fuel rods, **x**.xx : MOX fuel rods, and the others: UO<sub>2</sub> fuel rods.