



Ain Shams University
Faculty of Science
Physics Department

Characteristics of Minor Actinides in Advanced Light Water Reactors

A thesis submitted as a partial fulfillment of the requirements of the Master
of Science for the degree of

MASTER OF SCIENCE

In the field of

NUCLEAR PHYSICS

By

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N o u r a H a s s a n H a f e z

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A p p r o v e d b y

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APPENDIX: MCNPX INPUT FILE - R1-UO₂

Minerve Core - UO₂ Fuel - R1-UO₂

C	*****	Cell Cards	*****
C	*****	Outside Region [Outside Tank	*****
1	0	1	imp:n=0
C	*****	Tank	*****
2	1	-1.0 -1 #3 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 & 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 (3:-4)(5:-6)(7:-8) & (190:-191)(193:-191) 194 195 196 197 (232:-206:68) 192 198 199 200 & 240 241 #612 46 47 48 49 #502 #602 #800 #900	imp:n=1
C	*****	Supporting Table	*****
3	2	6.4515625-2 -2 3	imp:n=1
	*****	Chimney	*****
4	4	5.686348-2 -3 4	imp:n=1
5	4	5.686348-2 -5 6	imp:n=1
6	4	5.686348-2 -7 8 #501 #504 #507 #503 #505 #506	imp:n=1
C	*****	Caisson of Large Graphite Block	*****
7	3	9.0962535-1 -9	imp:n=1
8	3	9.0962535-1 -10	imp:n=1
9	3	9.0962535-1 -11	imp:n=1
10	3	9.0962535-1 -12	imp:n=1
C	*****	Caisson of Driver Zone	*****
11	3	9.0962535-1 -13	imp:n=1
12	3	9.0962535-1 -14	imp:n=1
13	3	9.0962535-1 -15	imp:n=1
14	3	9.0962535-1 -16	imp:n=1
C	*****	Grid Plate of Medium & small Graphite Blocks	*****
15	5	6.0278649-2 -17	imp:n=1
16	5	6.0278649-2 -19	imp:n=1
17	5	6.0278649-2 -20	imp:n=1
18	5	6.0278649-2 -18	imp:n=1
19	5	6.0278649-2 -21	imp:n=1
20	5	6.0278649-2 -22	imp:n=1
C	*****	Large Graphite Blocks	*****
21	4	5.686348-2 -23 24 #800	imp:n=1

APPENDIX: MCNPX INPUT FILE

24	6	-1.7	-26	#800	imp:n=1
25	4	5.686348-2	-27	28 #900	imp:n=1
26	6	-1.7	-28	#900	imp:n=1
27	4	5.686348-2	-29	30 #900	imp:n=1
28	6	-1.7	-30	#900	imp:n=1
C	*****	Medium Graphite Blocks			*****
29	4	5.686348-2	-31	32	imp:n=1
30	6	-1.7	-32		imp:n=1
31	4	5.686348-2	-33	34	imp:n=1
32	6	-1.7	-34		imp:n=1
33	4	5.686348-2	-35	36	imp:n=1
34	6	-1.7	-36		imp:n=1
35	4	5.686348-2	-37	38	imp:n=1
36	6	-1.7	-38		imp:n=1
C	*****	Small Graphite Blocks			*****
37	4	5.686348-2	-39	40	imp:n=1
38	6	-1.7	-40		imp:n=1
39	4	5.686348-2	-41	42	imp:n=1
40	6	-1.7	-42		imp:n=1
C	*****	Graphite Element - North Region			*****
41	5	6.027864-2	-51 50 -53 52 -55 54	#42 #43 #44	u=11 imp:n=1
42	1	-1	-58 54 -57 59		u=11 imp:n=1
43	4	5.686348-2	-58 57 -55 59		u=11 imp:n=1
44	0	-59			u=11 imp:n=1
45	4	5.686348-2	-72 71 -85 82 -56 55 59		u=11 imp:n=1
46	6	-1.7	-61 60 -63 62 -78 56		u=11 imp:n=1
47	4	5.686348-2	-72 71 -85 82 -139 56	#46	u=11 imp:n=1
48	1	-1	#41 #42 #43 #44 #45 #46 #47		u=11 imp:n=1
C	*****	18-Plates- 90% U235 Fuel Element - North Region			
50	5	6.0278649-2	50 -51 52 -53 54 -55 #52 #53		u=12 imp:n=1
51	1	-1	-58 54 -57		u=12 imp:n=1
52	1	-1	-64 57 -65		u=12 imp:n=1
53	4	5.686348-2	-58 64 57 -55 #52		u=12 imp:n=1
54	4	5.686348-2	71 -72 82 -85 55 -65 #52		u=12 imp:n=1
55	12	5.985-2	-67		u=13 imp:n=1
56	7	-2.698	75 -76 80 -81 65 -79 67		u=13 imp:n=1
57	4	5.686348-2	(-72 70 73 -74 65 -79)(-80:76:81 65 -79)		u=13 imp:n=1

APPENDIX: MCNPX INPUT FILE

58	4	5.686348-2	(71 -69 73 -74 65 -79)(-80:-75:81 65 -79)u=13	imp:n=1
59	1	-1	#55 #56 #57 #58 u=13	imp:n=1
60	0	-72 71 -74 73 -79 65	Fill=13 lat=1 u=14	imp:n=1
62	0	-72 71 73 -77 -79 65	Fill=14 u=12	imp:n=1
63	1	-1	#50 #51 #52 #53 #54 #62 u=12	imp:n=1
C	*****	18-Plates- 93% U235 Fuel Element - North *****		
64	like	50	but u=15	imp:n=1
65	like	51	but u=15	imp:n=1
66	like	52	but u=15	imp:n=1
67	like	53	but u=15	imp:n=1
68	like	54	but u=15	imp:n=1
69	like	55	but mat=13 rho=5.770-2 u=16	imp:n=1
70	like	56	but u=16	imp:n=1
71	like	57	but u=16	imp:n=1
72	like	58	but u=16	imp:n=1
73	1	-1	#69 #70 #71 #72 u=16	imp:n=1
74	0	-72 71 -74 73 -79 65	Fill=16 Lat=1 u=17	imp:n=1
76	0	-72 71 73 -77 -79 65	Fill=17 u=15	imp:n=1
77	1	-1	#64 #65 #66 #67 #68 #76 u=15	imp:n=1
C	*****	9-Plates Fuel Element - North Region *****		
78	like	50	but u=18	imp:n=1
79	like	51	but u=18	imp:n=1
80	like	52	but u=18	imp:n=1
81	like	53	but u=18	imp:n=1
82	like	54	but u=18	imp:n=1
83	like	60	But Trcl (0 -0.0184 0) u=19	imp:n=1
90	0	-72 71 -84 82 -79 65	Fill=19 u=18	imp:n=1
91	6	-1.7	-86 u=18	imp:n=1
92	4	5.686348-2	69 -70 87 -99 65 -79 #91 u=18	imp:n=1
93	4	5.686348-2	71 -69 84 -85 -79 65 u=18	imp:n=1
94	4	5.686348-2	70 -72 84 -85 -79 65 u=18	imp:n=1
95	1	-1.0	#78 #79 #80 #81 #82 #90 #91 #92 #93 #94 u=18	imp:n=1
C	*****	Control Rod - Inserted - North Region *****		
101	like	50	but u=22	imp:n=1
102	like	51	but u=22	imp:n=1
103	like	52	but u=22	imp:n=1
104	like	53	but u=22	imp:n=1
105	like	54	but u=22	imp:n=1

APPENDIX: MCNPX INPUT FILE

111	4	5.686348-2	75 -76 80 -81 65 -88	u=24	imp:n=1
112	like	57	but	u=24	imp:n=1
113	like	58	but	u=24	imp:n=1
114	1	-1	#111 #112 #113	u=24	imp:n=1
115	17	9.3538149-2	-89	u=25	imp:n=1
116	16	-13.31	-90	u=25	imp:n=1
117	8	8.547655-2	-91 90	u=25	imp:n=1
118	like	57	but	u=25	imp:n=1
119	like	58	but	u=25	imp:n=1
120	1	-1	#115 #116 #117 #118 #119	u=25	imp:n=1
121	0	-72 71 -74 73 -79 65	Fill = 0:0 0:17 0:0		&
		16 16 24 25 24 16 7r 24 25 24 16 16	Lat=1	u=26	imp:n=1
123	0	-72 71 73 -77 -79 65	Fill=26	u=22	imp:n=1
124	16	-13.31	-92	u=27	imp:n=1
125	8	8.547655-2	-93 92	u=27	imp:n=1
126	1	-1.0	#124 #125	u=27	imp:n=1
127	0		-94 Fill=27	u=22	imp:n=1
128	like	127	but Trcl (0 4.8664 0)	u=22	imp:n=1
129	1	-1.0	#101 #102 #103 #104 #105 #123 #127 #128		&
				u=22	imp:n=1

C	*****	Control Rod - Withdrawn - North Region				*****
130	like	50	but		u=28	imp:n=1
131	like	51	but		u=28	imp:n=1
132	like	52	but		u=28	imp:n=1
133	like	53	but		u=28	imp:n=1
134	like	54	but		u=28	imp:n=1
135	17	9.3538149-2	-95		u=29	imp:n=1
136	16	-13.31	-96		u=29	imp:n=1
137	8	8.547655-2	-97 96		u=29	imp:n=1
138	like	57	but		u=29	imp:n=1
139	like	58	but		u=29	imp:n=1
140	1	-1	#135 #136 #137 #138 #139	u=29	imp:n=1	
141	0		-72 71 -74 73 -79 65	Fill = 0:0 0:17 0:0		&
		16 16 24 29 24 16 7r 24 29 24 16 16		Lat=1	u=31	imp:n=1
143	0		-72 71 73 -77 -79 65	Fill=31	u=28	imp:n=1
144	16	-13.31	-98		u=32	imp:n=1
145	8	8.547655-2	-93 98		u=32	imp:n=1

APPENDIX: MCNPX INPUT FILE

146	1	-1.0	#144 #145	u=32	imp:n=1
147	0		-94	Fill=32 u=28	imp:n=1
148	like	147	but Trcl (0 4.8664 0)	u=28	imp:n=1
149	1	-1.0	#130 #131 #132 #133 #134 #143 #147 #148 &	u=28	imp:n=1
C	*****	Detector Element - North Region			*****
150	like	41	but	u=33	imp:n=1
151	like	42	but	u=33	imp:n=1
152	like	43	but	u=33	imp:n=1
153	like	44	but	u=33	imp:n=1
154	like	45	but	u=33	imp:n=1
155	4	5.686348-2	71 -72 82 -85 56 -102 #156 #157	u=33	imp:n=1
156	6	-1.7	60 -61 62 -63 56 -101 #157	u=33	imp:n=1
157	0		(60 -61 62 -63 101 -103) : -104 : -105	u=33	imp:n=1
158	1	-1.0	#150 #151 #152 #153 #154 #155 #156 #157	u=33	imp:n=1
C	*****	Thermal Column Element			*****
159	like	41	but	u=34	imp:n=1
160	like	42	but	u=34	imp:n=1
161	like	43	but	u=34	imp:n=1
162	like	44	but	u=34	imp:n=1
163	like	45	but	u=34	imp:n=1
164	4	5.686348-2	71 -72 82 -85 56 -68 #165 #166 #167 &		
			#168 #169 #170 #171	u=34	imp:n=1
165	6	-1.7	60 -61 62 -63 56 -68 #166 #167 &		
			#168 #169 #170 #171	u=34	imp:n=1
166	30	-0.9106	-106 107 #167 #168	u=34	imp:n=1
167	0		-107 108	u=34	imp:n=1
168	0		-108	u=34	imp:n=1
169	like	166	but Trcl (3.478 -3.308 0)	u=34	imp:n=1
170	like	167	but Trcl (3.478 -3.308 0)	u=34	imp:n=1
171	like	168	but Trcl (3.478 -3.308 0)	u=34	imp:n=1
172	1	-1.0	#159 #160 #161 #162 #163 #164 #165 &		
			#166 #167 #168 #169 #170 #171	u=34	imp:n=1
C	*****	12 Plates Fuel Element North Region			*****
173	like	50	but	u=35	imp:n=1
174	like	51	but	u=35	imp:n=1
175	like	52	but	u=35	imp:n=1
176	like	53	but	u=35	imp:n=1

APPENDIX: MCNPX INPUT FILE

177	like	54	but		u=35	imp:n=1
178	like	60	But	Trcl (0 -0.0184 0)	u=36	imp:n=1
185	0	-72 71 -701 82 -79 65		Fill=36	u=35	imp:n=1
186	6	-1.7	-702		u=35	imp:n=1
187	4	5.686348-2	-703 702		u=35	imp:n=1
188	4	5.686348-2	71 -69 701 -85 -79 65		u=35	imp:n=1
189	4	5.686348-2	70 -72 701 -85 -79 65		u=35	imp:n=1
190	1	-1.0	#173 #174 #175 #176 #177 #185 #186	&		
			#187 #188 #189		u=35	imp:n=1
C	*****	12 Plates Fuel Element Rotated by 180			*****	
191	like	50	but		u=38	imp:n=1
192	like	51	but		u=38	imp:n=1
193	like	52	but		u=38	imp:n=1
194	like	53	but		u=38	imp:n=1
195	like	54	but		u=38	imp:n=1
196	like	60	but	Trcl (0 2.6728 0)	u=39	imp:n=1
197	0	-72 71 -85 115 -79 65		Fill=39	u=38	imp:n=1
207	6	-1.7	-117		u=38	imp:n=1
208	4	5.686348-2	69 -70 -113 116 65 -79 #207		u=38	imp:n=1
209	4	5.686348-2	71 -69 82 -115 -79 65		u=38	imp:n=1
210	4	5.686348-2	70 -72 82 -115 -79 65		u=38	imp:n=1
211	1	-1.0	#191 #192 #193 #194 #195 #197 #207	&		
			#208 #209 #210		u=38	imp:n=1
C	*****	9-Plate fuel element rotated by 180 Element			*****	
212	like	50	but		u=42	imp:n=1
213	like	51	but		u=42	imp:n=1
214	like	52	but		u=42	imp:n=1
215	like	53	but		u=42	imp:n=1
216	like	54	but		u=42	imp:n=1
217	like	60	But	Trcl (0 4 0)	u=43	imp:n=1
224	0		-72 71 -85 118 -79 65	Fill=43	u=42	imp:n=1
225	6	-1.7	-120		u=42	imp:n=1
226	4	5.686348-2	69 -70 109 -110 65 -79 120		u=42	imp:n=1
227	4	5.686348-2	71 -69 82 -118 -79 65		u=42	imp:n=1
228	4	5.686348-2	70 -72 82 -118 -79 65		u=42	imp:n=1
229	1	-1.0	#212 #213 #214 #215 #216 #224 #225	&		
			#226 #227 #228		u=42	imp:n=1

APPENDIX: MCNPX INPUT FILE

C	*****	Start-Up Source Element				*****
230	like	41	but		u=45	imp:n=1
231	like	42	but		u=45	imp:n=1
232	like	43	but		u=45	imp:n=1
233	like	44	but		u=45	imp:n=1
234	like	45	but		u=45	imp:n=1
235	4	5.686348-2	-122		u=45	imp:n=1
236	8	8.547655-2	-123 124		u=45	imp:n=1
237	4	5.686348-2	-125 126 #238		u=45	imp:n=1
238	0		-127		u=45	imp:n=1
239	0		(-124 127) : (-126 123) 127		u=45	imp:n=1
240	1	-1.0	#230 #231 #232 #233 #234 #235 #236	&		
			#237 #238 #239		u=45	imp:n=1
C	*****	East and West Regions				*****
241	5	6.0278649-2	54 -55 #242 #243 #244		u=46	imp:n=1
242	1	-1.0	-135 54 -57 136		u=46	imp:n=1
243	4	5.686348-2	-135 57 -55 136		u=46	imp:n=1
244	0		-136		u=46	imp:n=1
245	4	5.686348-2	-153 152 -155 154 55 -56 136		u=46	imp:n=1
246	6	-1.7	121 -130 128 -129 -78 56		u=46	imp:n=1
247	4	5.686348-2	-153 152 -155 154 56 -139 #246		u=46	imp:n=1
248	1	-1.0 #241	#242 #243 #244 #245 #246 #247		u=46	imp:n=1
C	*****	18 plate fuel element 90%Uo2 - East Region				*****
250	5	6.0278649-2	54 -55 #251 #252 #253		u=47	imp:n=1
251	1	-1.0	-135 54 -57		u=47	imp:n=1
252	1	-1.0	-140 57 -65		u=47	imp:n=1
253	4	5.686348-2	-135 140 57 -55 #252		u=47	imp:n=1
254	4	5.686348-2	152 -153 154 -155 55 -65 #252		u=47	imp:n=1
255	12	5.985-2	-142		u=48	imp:n=1
256	7	-2.698	143 -144 146 -145 65 -79 142		u=48	imp:n=1
257	4	5.686348-2	(149 -150 154 -148 65 -79)(144:-146:-143 65 -79)	&		
					u=48	imp:n=1
258	4	5.686348-2	(149 -150 -155 147 65 -79) (144:145:-143 65 -79)	&		
					u=48	imp:n=1
259	1	-1.0	#255 #256 #257 #258		u=48	imp:n=1
260	0	-150 149 -155 154 -79 65		Fill=48 Lat=1	u=49	imp:n=1
262	0		-151 149 -155 154 65 -79	Fill=49	u=47	imp:n=1
263	1	-1.0	#250 #251 #252 #253 #254 #262		u=47	imp:n=1
C	*****	18 Plate Fuel Element 93%Uo2				*****
264	like	250	but		u=51	imp:n=1
265	like	251	but		u=51	imp:n=1

APPENDIX: MCNPX INPUT FILE

266	like	252	but			u=51	imp:n=1
267	like	253	but			u=51	imp:n=1
268	like	254	but			u=51	imp:n=1
269	like	255	but	mat=13	rho=5.770-2	u=52	imp:n=1
270	like	256	but			u=52	imp:n=1
271	like	257	but			u=52	imp:n=1
272	like	258	but			u=52	imp:n=1
273	1	-1.0	#269 #270 #271 #272			u=52	imp:n=1
274	0	-150 149 -155 154 -79 65	Fill=52	Lat=1		u=53	imp:n=1
276	0	-151 149 -155 154 -79 65	Fill=53			u=51	imp:n=1
277	1	-1.0	#264 #265 #266 #267 #268 #276			u=51	imp:n=1
C	***** 12-Plates Fuel Element*****						
278	like	250	but			u=54	imp:n=1
279	like	251	but			u=54	imp:n=1
280	like	252	but			u=54	imp:n=1
281	like	253	but			u=54	imp:n=1
282	like	254	but			u=54	imp:n=1
283	like	260	but	Trcl (-0.0184 0 0)		u=55	imp:n=1
290	0	-157 152 -155 154 -79 65	Fill=55			u=54	imp:n=1
291	6	-1.7	-158			u=54	imp:n=1
292	4	5.68638-2	111 -112 148 -147 65 -79 158			u=54	imp:n=1
293	4	5.68638-2	157 -153 -155 147 -79 65			u=54	imp:n=1
294	4	5.686348-2	157 -153 154 -148 -79 65			u=54	imp:n=1
295	1	-1.0	#278 #279 #280 #281 #282 #290 #291			&	
			#292 #293 #294			u=54	imp:n=1
C	***** 12-Plates Fuel Element Rotated *****						
301	like	250	but			u=57	imp:n=1
302	like	251	but			u=57	imp:n=1
303	like	252	but			u=57	imp:n=1
304	like	253	but			u=57	imp:n=1
305	like	254	but			u=57	imp:n=1
311	like	260	but	Trcl (2.6728 0 0)		u=59	imp:n=1
313	0	-153 160 -155 154 -79 65	Fill=59			u=57	imp:n=1
314	6	-1.7	-178			u=57	imp:n=1
			179 -180 148 -147 65 -79				
315	4	5.686348-2	#314			u=57	imp:n=1
316	4	5.686348-2	152 -160 -155 147 -79 65			u=57	imp:n=1