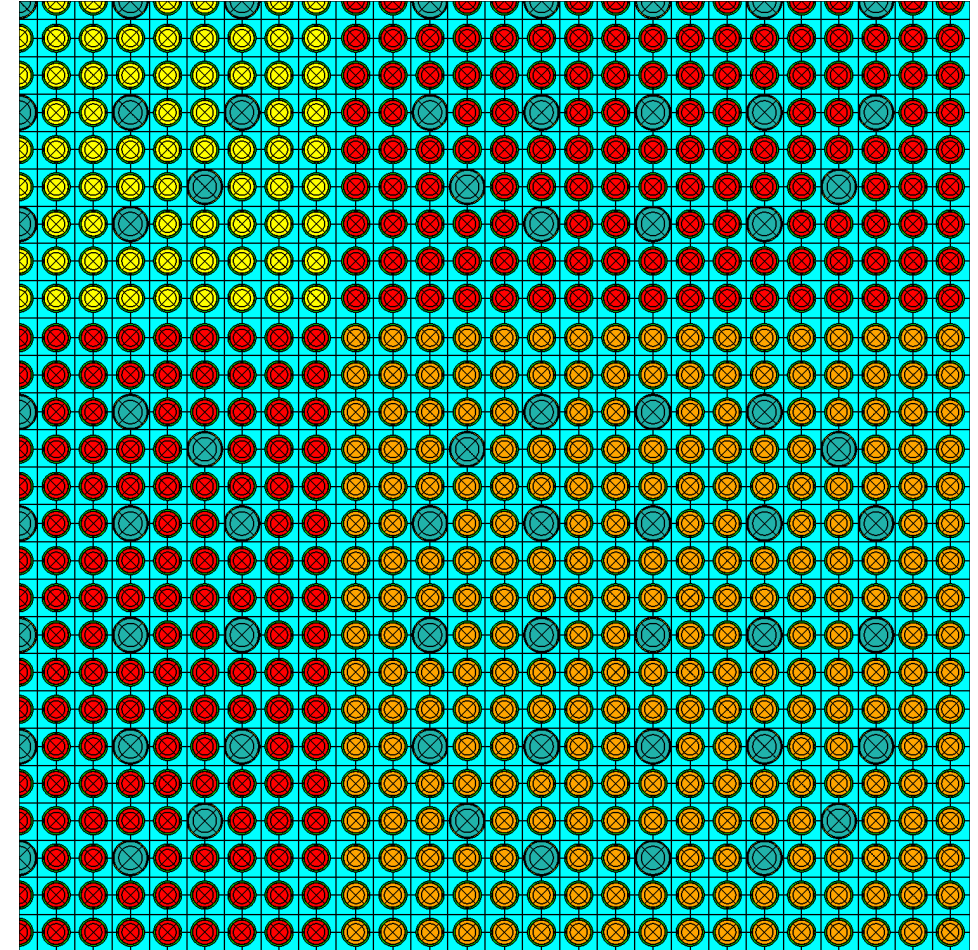


PWR 2D multi-lattice fuel shuffle model in Polaris

- Matthew Jessee, Senior R&D Staff, RNSD, Power Reactor Modeling Group (with an assist from Travis Zipperer PNNL)
- Polaris only supports two geometry types
 - ASSM – single 2D assembly
 - REFL – single 2D assembly with adjacent multi-slab reflector
- PWR 2D multi-lattice can be simulated in ASSM mode as a single mega lattice, and displacement maps can be used to adjust pin locations to account for interassembly gaps
- This model displays Polaris's ...
 - displacement map capability (**dxmap dymap**)
 - **history** and **insert** cards to show insert and removal of fresh fuel assemblies and shuffle of previous cycle assemblies
- 5 18-month cycles to build in equilibrium cycle with 3% enriched fuel
- Cycle 6 is a transition fuel cycle with 8% enriched fuel
- 51-step depletion case runs in 9 hours in SCALE 6.3



A. GODFREY , "VERA Core Physics Benchmark Progression Problem Specifications," CASL-U-2012-0131- 004, CASL (2014)

Lattice fuel shuffle model in Polaris

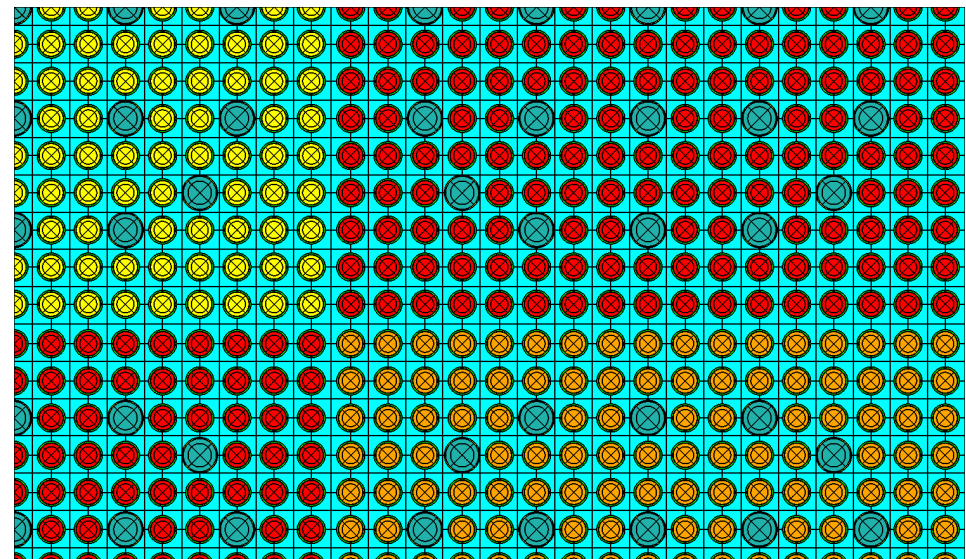
D Staff, RNSD, Power Reactor

Insert from Trewin Ziegler (DNNI)

```
colorset3x3.se.inp
Processors: document SCALE 6.3.pre-b16 Run View Edit
36 state ALL : temp=600
37 FUEL : temp=900
38 COOL : boron=1200 dens=0.6
39 CYCLE2_MAP : in=no
40 CYCLE3_MAP : in=no
41 CYCLE4_MAP : in=no
42 CYCLE5_MAP : in=no
43 CYCLE6_MAP : in=no
44
45 read history
46 % CYCLE 1
47 power 40
48 state COOL : boron=1000 955 885 770 540 310 20
49 bui 40 1000 1500 5000 10000 15000 21300 : MWD/MTIHM
50 power 0
51 dt 14
52
53 % CYCLE 2
54 power 40
55 state COOL : boron=1000 955 885 770 540 310 20
56 CYCLE2_MAP : in=yes
57 bui 40 1000 1500 5000 10000 15000 21300 : MWD/MTIHM
58 power 0
59 dt 14
60
61 % CYCLE 3
62 power 40
63 state COOL : boron=1000 955 885 770 540 310 20
64 CYCLE2_MAP : in=no
65 CYCLE3_MAP : in=yes
66 bui 40 1000 1500 5000 10000 15000 21300 : MWD/MTIHM
67 power 0
68 dt 14
69
70 % CYCLE 4
71 power 40
72 state COOL : boron=1000 955 885 770 540 310 20
73 CYCLE3_MAP : in=no
74 CYCLE4_MAP : in=yes
75 bui 40 1000 1500 5000 10000 15000 21300 : MWD/MTIHM
76 power 0
77 dt 14
78
79 % CYCLE 5
80 power 40
81 state COOL : boron=1000 955 885 770 540 310 20
82 CYCLE4_MAP : in=no
83 CYCLE5_MAP : in=yes
84 bui 40 1000 1500 5000 10000 15000 21300 : MWD/MTIHM
85 power 0
86 dt 14
87
88 % CYCLE 6
89 power 40
90 state COOL : boron=1300 1255 1190 1080 855 630 405 180 20
91 CYCLE5_MAP : in=no
92 CYCLE6_MAP : in=yes
93 bui 40 1000 2500 5000 10000 15000 20000 25000 28600 : MWD/MTIHM
94 power 0
95 dt 14
96
97 end history
```

```
245 insert CYCLE6_MAP
246 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
247 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
248 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
249 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
250 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
251 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
252 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
253 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
254 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6
255
256 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
257 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
258 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
259 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
260 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
261 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
262 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
263 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
264 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
265 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
266 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
267 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
268 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
269 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
270 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
271 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
272 6 6 6 6 6 6 6 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5
```

```
274 % pin pitch is 1.26
275 % assm pitch is 21.5
276 % use 21.5 / 17 = 1.2647 as pin-pitch for lattice and adjust location with dmaps
277 geom w3x3 : ASSM 51 1.2647 sym=SE
278
279 dxmap
280 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
281 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
282 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
283 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
284 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
285 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
286 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
287 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
288 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
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290 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
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295 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
296 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
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302 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
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304 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
305 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376 0.0376 0.0329 0.0282 0.0235 0.0188 0.0141 0.0094 0.0047 0.0000 -0.0047 -0.0094 -0.0141 -0.0188 -0.0235 -0.0282 -0.0329 -0.0376
```



added to