OECD/NEA Expert Group on Source Convergence Analysis

Benchmark Problem No. 1

Overview

The model comprises a notional 24x3 LWR fuel storage rack with fuel elements stored in alternate locations. The fuel elements are ~5.0% enriched-by-weight fuel elements located within fully water-flooded boronated-steel storage racks surrounded by a close-fitting full concrete reflection on three sides, water on the remaining side and water on the top and bottom. The fuel elements are formed from a 15x15 lattice of Zr-clad UO_2. The attached figure describes the problem geometry.

Material Data

The material compositions are as follows (in atoms/barn.cm):

Fuel		Concrete	
U238	2.20198E-02	H	5.5437E-03
O	4.65961E-02	C	6.9793E-03
U235	1.17376E-03	SI	7.7106E-03
		CA	8.9591E-03
		O	4.3383E-02
Water		Boronated Steel	
H	6.6706E-02	FE	8.26377E-02
O	3.3353E-02	B10	1.18182E-02
Zirconium			
ZR	4.2910E-02		

Output

Calculations should be performed using 500 scored generations. The fuel elements are numbered as in a conventional matrix, so that the lowest left-hand fuel element in the figure below is in position (1,1) and the top right-hand fuel element is in position (23,3).

Four sets of calculations are required using each of the following starting source distributions:

- Uniform over the 36 fuel elements
- All starting source points in location (1,1)
- All starting source points in location (23,3)
- All starting source points in location (12,2)

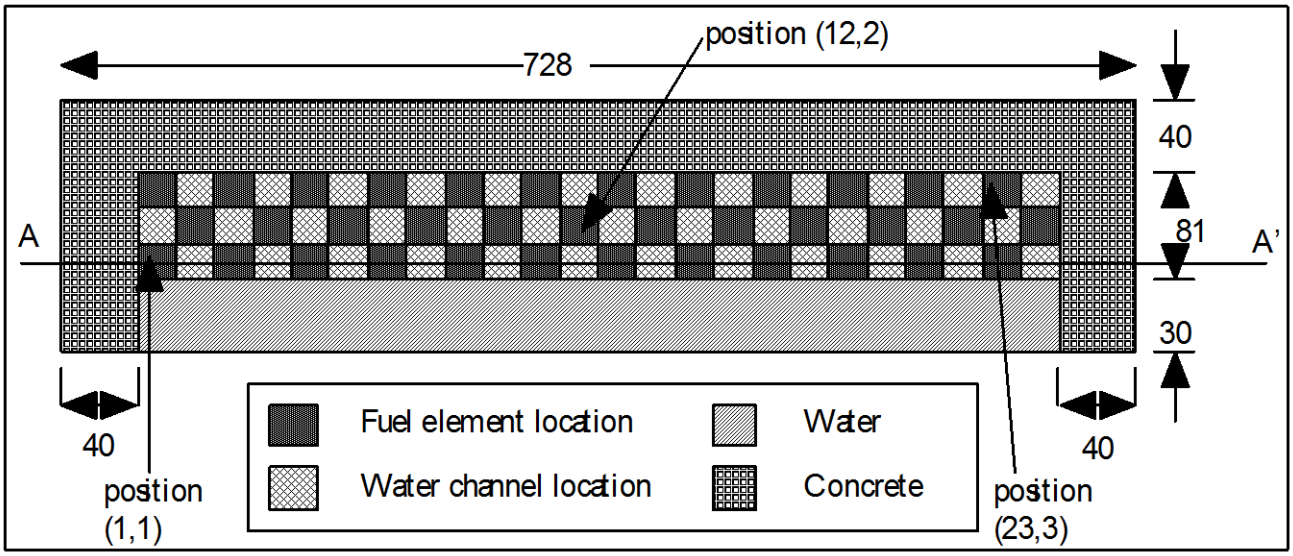
For each starting source distribution, three different numbers of skipped generations should be employed: 20, 40 and 100. In addition, for each source/skipped generations combination, three difference numbers of starting source points per iteration will be used: 1000, 2000, 5000.

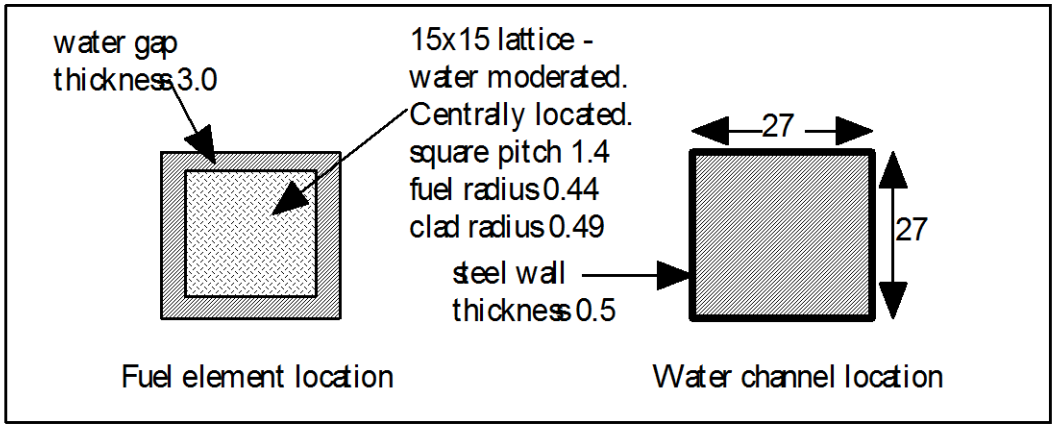
Thirty-six calculations are therefore required as follows:

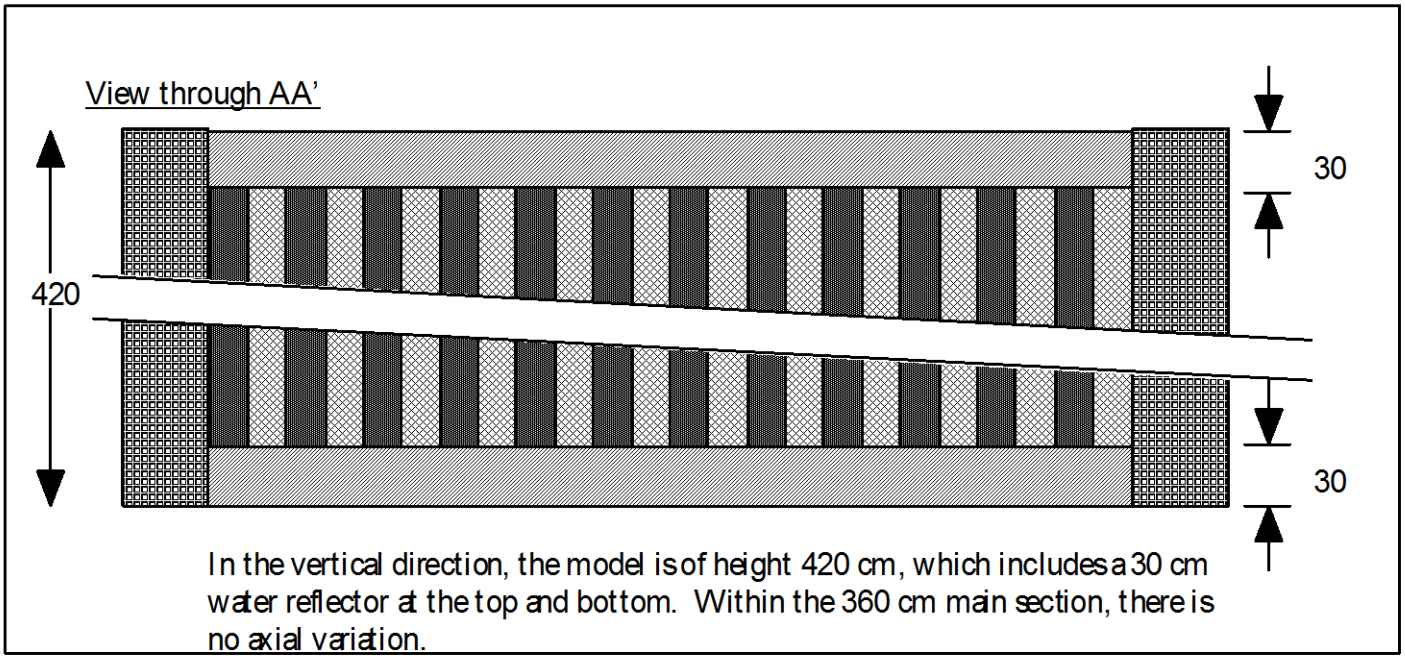
Case	Starting Source	Skipped Generations	Starting source points
1	Uniform	20	1000
2	Uniform	40	1000
3	Uniform	100	1000
4	Location (1,1)	20	1000
5	Location (1,1)	40	1000
6	Location (1,1)	100	1000
7	Location (23,3)	20	1000
8	Location (23,3)	40	1000
9	Location (23,3)	100	1000
10	Location (12,2)	20	1000
11	Location (12,2)	40	1000
12	Location (12,2)	100	1000
13	Uniform	20	2000
14	Uniform	40	2000
15	Uniform	100	2000
16	Location (1,1)	20	2000
17	Location (1,1)	40	2000
18	Location (1,1)	100	2000
19	Location (23,3)	20	2000
20	Location (23,3)	40	2000
21	Location (23,3)	100	2000
22	Location (12,2)	20	2000
23	Location (12,2)	40	2000
24	Location (12,2)	100	2000
25	Uniform	20	5000
26	Uniform	40	5000
27	Uniform	100	5000
28	Location (1,1)	20	5000
29	Location (1,1)	40	5000
30	Location (1,1)	100	5000
31	Location (23,3)	20	5000
32	Location (23,3)	40	5000
33	Location (23,3)	100	5000
34	Location (12,2)	20	5000
35	Location (12,2)	40	5000
36	Location (12,2)	100	5000

Cumulative k-effective values should be produced for each case after every twenty generations (including during the skipped generations). In addition, the fraction of fission events in each of the thirty-six fuel elements at the end of the calculation should be reported. Results to be returned by completing the attached spreadsheet. Copies of any code advisory or warning messages relating to convergence that arise with any of the cases should be provided in an accompanying text file.

All dimensions in cm







In the vertical direction, the model is of height 420 cm, which includes a 30 cm water reflector at the top and bottom. Within the 360 cm main section, there is no axial variation.