

## OECD/NEA Source Convergence Benchmark 4: Array of interacting spheres

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### Overview

In this benchmark a lattice of  $5 \times 5 \times 1$  separated highly enriched uranium metal spheres is considered. The separating material being the air. The center-to-center distance between spheres is 80 cm. All the spheres have the same composition (see Table 1). The radius of the central sphere is 10 cm while the radius of the other spheres is 8.71 cm. Figure 1 describes the overall geometry. The benchmark is an adaptation from Kadotani et al. (Proc. ICNC'91, Oxford, 1991)

## Specifications

Material data

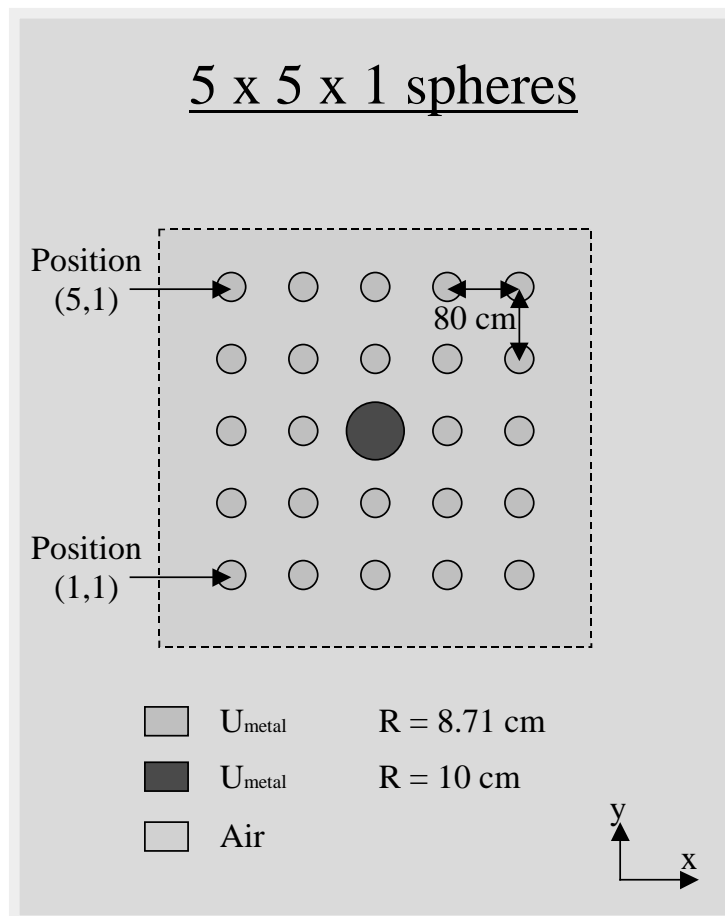
The fuel and air compositions are given in the following Table (in atoms/barn.cm):

High enriched uranium metal	
U235	4.549E-02
U238	2.560E-03
Air	
N	4.3250E-5
O	1.0810E-5

Table 1

Geometry data

The following figure describes the problem geometry. The spheres are numbered as in a conventional matrix, so that the lowest left-hand sphere in the figure below is in position (1,1) and the top right-hand sphere is in position (5,5).



### Required calculations

Calculations are to be performed using the following parameters:

125 neutrons per generation

1000 active generations.

The source distribution of the **125** starting neutrons is the following:

- **101** neutrons in the centre of the **sphere (1,1)**,
- **1** neutron in the centre of the **other 24 spheres**.

Three different numbers of skipped generations should be employed: **0**, **200** and **400**.

For each number of skipped generations, **100** replicas will be run, using different random numbers sequences.

**300** calculations are therefore required as follows:

Case	Random numbers sequence	Skipped Generations
1	#1	0
2	#1	200
3	#1	400
4	#2	0
5	#2	200
6	#2	400
...	...	...
298	#100	0
299	#100	200
300	#100	400

## Required output

The following information is required. The proposed submission format is intended to make the analysis phase easier. MS Excel spreadsheets may be used to enter the data. However, when a simple text file is used, numerical data separator should be "," without blanks and the word NODATA is to be inserted if a field is empty.

( "

Line	Required information
1:	Date
2:	Institution
3:	Contact Person
4:	e-mail address
5:	Voice phone number
6:	FAX Phone Number
7:	Problem name, e.g., "Benchmark 1: Checkerboard storage"
8:	Case name, e.g., 1
9:	Code name
10:	Code type, e.g., Monte Carlo, SN
11:	Cross section library source, e.g., JEF-2.2
12:	Starting source
13:	nskip = number of generations skipped before beginning tallies or before convergence:
14:	nngen = number of generations tallied
15:	nhist = number of histories per generation
16:	ngensh = number of generations per superhistory
17:	final k-eff estimate
18:	final k-eff estimate uncertainty (one standard deviation)
19:	k-eff estimate for first supergeneration
20:	individual k-eff estimate for second supergeneration
18+nngen:	individual k-eff estimate for last supergeneration

Cumulative fission fractions " ff(i,g)" in fissionable region "i" in generation g, is also an important output. As all computer codes do not have the capability of printing this information for any generation, participants may choose between the following alternatives.

- 1) Fission fractions are given as average over all generations
- 2) Fission fractions are given as average over all active generations
- 3) Fission fractions are given at different generation sequences