NPRE 247 CP3

Anshuman Chaube

Due 12/4/17

1 Fuel enrichment(weight %) in given Serpent input

For the given atomic concentration of 5 % for ^{235}U, the enrichement was found to be **4.358 % w/w**.

2 Cladding Composition

Z	Element	Mass Fraction	Atom %
40	Zr	0.9823	98.3649
50	Sn	0.0145	1.1158
26	Fe	0.0021	0.3435
24	Cr	0.0010	0.1757
72	Hf	0.0001	$5.12x10^{-4}$

3 Optimum fuel to moderator ratio

The optimum fuel to moderator ratio was found to be **3.25910**, corresponding to a k (K_IMP) value of 1.16768 and moderator density 1.11 g/mL.
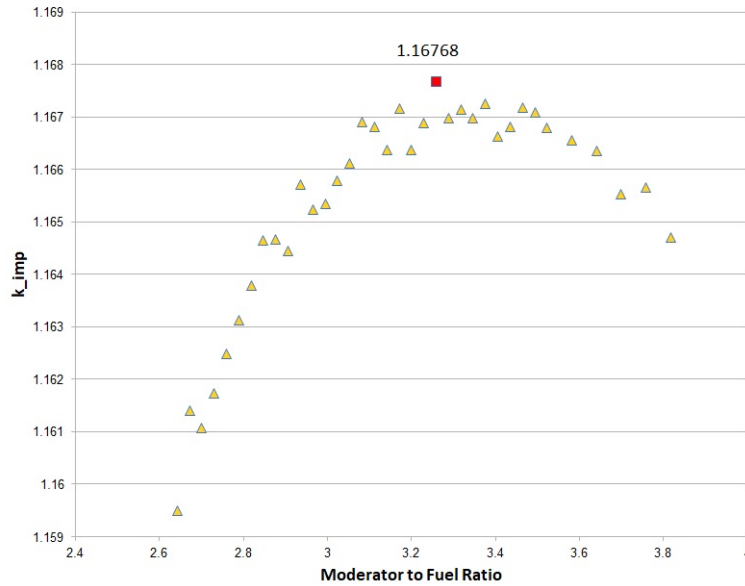
4 Plot

Figure 1: K_IMP from Serpent output plotted against Moderator to Fuel ratio, for moderator density ranging from 0.9 to 1.3 g/mL.

5 Serpent Input File corresponding to optimum moderator to fuel ratio

```
% --- Pin-cell burnup calculation ----------------------------
set title "Pin-cell burnup calculation"

% --- Pin definition:
pin 1
fuel 0.469550
void 0.479100
clad 0.546400
water

% --- Geometry:
surf 1 sqc 0.0 0.0 0.721350
cell 1 0 fill 1 -1
cell 2 0 outside 1

% --- Fuel (composition in atom fraction):
mat fuel   -10.21
92235.09c    0.005000
92238.09c    0.328333
 8016.09c    0.666667

% --- Zircalloy cladding (composition in mass fraction)
mat clad   -6.560
40000.06c  -0.9823
50000.06c  -0.0145
26000.06c  -0.0021
24000.06c  -0.0010
72000.06c  -0.0001

% --- Water (composition in atom fraction):
mat water  -1.1100 moder lwtr 1001
1001.06c    0.666667
8016.06c    0.333333

% --- Thermal scattering data for light water:
therm lwtr lwe7.10t

% --- Periodic boundary condition:
set bc 3

% --- Group constant generation:
% universe = 0 (homogenization over all space)
% 2-group structure (group boundary at 0.625 eV)
set gcu 0
set nfg 2 0.625E-6

% --- Geometry and mesh plots:
plot 3 1000 1000
mesh 3 1000 1000

% --- Cross section library file path:
set acelib "/home/serpent/xs/endfb7/sss_endfb7.xsdata"
set declib "/home/serpent/xs/endfb7/sss_endfb7.dec"
set nfylib "/home/serpent/xs/endfb7/sss_endfb7.nfy"

% --- Reduce energy grid size:
set egrid 5E-5 1E-10 15.0

% --- Depletion steps:
% Cycle 1
set powdens 25.00E-3

% --- Neutron population and criticality cycles:
set pop 10000  200  20
```