

MCCS codes

Date

Core

- 4/15/99 ① check NUREG/CR; the MCCS code for spent fuel pool III
- 4/16/99 ② reduce the number of plumes to one I
- 4/16/99 ③ change the core inventory (CI) IV
- 4/16/99 ④ change the release fractions IV
- 4/15/99 ⑤ eliminate the second source term (summer core) II
- ~~to eliminate the second source response scenario (summer core)~~
- later ⑥ modify the plume rise heating rate (W) ?
- " ⑧ add rest of core (SR) in vessel) in the core inventory
- " ⑦ correct the release fractions for: Sr, Y-91, Co-58, G-60
Wb-95, Zr-95
- " ⑩ add nuclides for: Rh-106, Sb-125, Te-125m, I-129,
Ba-137m, Rb-144, Sa-151, Eu-154,
Eu-156
- " ⑪ modify the plume duration
- ⑫ get updated version of code (Lynn's problem)
- 4/16/99 ⑬ correct power to Susquehanna's power

VI

Write the report

look at which nuclides contribute to explain those results.

U
2

I. Started with sample problem A

Files: in1a.inp (atmos)

in2a.inp (early)

in3a-n.inp (chronic)

METSUR.inp

SURSET.inp

ROUT.N.OUT

Results

early fatalities (mean)

cancer fatalities (mean)

(population dose - SR (mean))

→ L-EDENBODY TOTLIF

L. lifetime (50 years)

(4/15/99) 3

II. Connected out the second source term

Files: atmos1.inp (atmos)
early1.inp (early)
chronc1-n.inp (chronc)
lan-out (out put)

III. reduced the number of planes to 1

Files: atmos3.inp } TRIAL A
early1.inp }
chronc1-n.inp }
3-n.out }

Trial A: Changed NUMPL to 1

Trial B: Deleted RDRLEFR002 card

Trial C: Deleted second value on the following cards:

Files: atmos3b.inp } TRIAL B
early1.inp }
chronc1-n.inp }
3b-n.out }

Trid A:

Released inventory, all planes ← use this to check

I-131 1.55×10^{18}

$$\begin{aligned}
 \text{core inv} &= 3.206 \times 10^{18} \\
 &\times .68 &&= 2.18 \times 10^{18} \\
 &\times .715 &&= 1.56 \times 10^{18} \quad \checkmark
 \end{aligned}$$

Te-132 (3.2 d half-life) 5.61×10^{17}

$$4.658 \times 10^{18} \times .17 \times .715 = 5.66 \times 10^{17} \quad \Delta = 12 \quad \checkmark$$

$$4.658 \times 10^{18} \times .14 \times .715 = 4.66 \times 10^{17} \quad \Delta = 122$$

5

IV change the release fractions

Files: atmos 4. inp

early 1. inp

china 1-n. inp

4-n. out

4/16/99

Millstone 1
11 batches of spent fuel

Group	Release fraction (NUREG/CR-4982)	
Xe/Kr	1.00	/
I	1.00	/
Cs	1.00	/
Te	2.E-02	/
Sr	2.E-03	/
Ru	2.E-05	/
La	1.E-06	/
Ce	1.E-06	/
Ba	2.E-03	/

V Change the core inventory

Finna

- 121 assemblies in core
- typically discharge ≈ 25 assemblies in a refueling
- 1520 MWt

~~Inventories in Table 4.4 only include a final discharge of 24 assemblies. There are still 97 "partially used" assemblies in the reactor vessel.~~

For Glenn Kelly on 4/15/99,

- 1520 power to 3441 MWt for Susquehanna
- Use Millstone 1 radio-nucleic inventories

Millstone 1: • 580 assemblies in core

- 167 assemblies was last batch

discharged

- 2011 MWt

Sheet1

4/16/99

Millstone 1
11 batches of spent fuel

Nuclide	Inventory in Spent Fuel Pool					
	30 days after last batch put in pool (Ci)	90 days after last batch put in pool (Ci)	1 year after last batch put in pool (Ci)	30 days after last batch put in pool (Bq)	90 days after last batch put in pool (Bq)	1 year after last batch put in pool (Bq)
Co-58	2.29E+04	1.26E+04	8.54E+02	8.47E+14	4.66E+14	3.16E+13
Co-60	3.72E+05	3.15E+05	2.85E+05	1.38E+16	1.17E+16	1.05E+16
Kr-85	1.41E+06	1.39E+06	1.33E+06	5.22E+16	5.14E+16	4.92E+16
Kr-85m						
Kr-87						
Kr-88						
Rb-86	1.01E+04	1.05E+03	3.84E-02	3.74E+14	3.89E+13	1.42E+09
Sr-89	8.39E+06	3.63E+06	8.33E+04	3.10E+17	1.34E+17	3.08E+15
Sr-90	1.42E+07	1.42E+07	1.39E+07	5.25E+17	5.25E+17	5.14E+17
Sr-91						
Sr-92						
Y-90	1.43E+07	1.42E+07	1.39E+07	5.29E+17	5.25E+17	5.14E+17
Y-91	1.18E+07	5.75E+06	2.21E+05	4.37E+17	2.13E+17	8.18E+15
Y-92						
Y-93						
Zr-95	1.94E+07	1.00E+07	5.10E+05	7.18E+17	3.70E+17	1.89E+16
Zr-97						
Nb-95	2.54E+07	1.70E+07	1.11E+06	9.40E+17	6.29E+17	4.11E+16
Mo-99	1.49E+04	3.12E-03	0	5.51E+14	1.15E+08	0.00E+00
Tc-99m	1.43E+04	3.01E-03	0	5.29E+14	1.11E+08	0.00E+00
Ru-103	1.53E+07	5.21E+06	4.07E+04	5.66E+17	1.93E+17	1.51E+15
Ru-105						
Ru-106	1.72E+07	1.53E+07	9.13E+06	6.36E+17	5.66E+17	3.38E+17
Rh-105						
Sb-127	1.19E+06	1.39E-01	0	4.40E+16	5.14E+09	0.00E+00
Sb-129						
Te-127	2.21E+05	1.45E+05	2.52E+04	8.18E+15	5.37E+15	9.32E+14
Te-127m	2.18E+05	1.48E+05	2.57E+04	8.07E+15	5.48E+15	9.51E+14
Te-129	2.74E+05	7.79E+04	2.68E+02	1.01E+16	2.88E+15	9.92E+12
Te-129m	4.21E+05	1.20E+05	4.12E+02	1.56E+16	4.44E+15	1.52E+13
Te-131m						
Te-132	3.74E+04	8.64E-02	0	1.38E+15	3.20E+09	0.00E+00
I-131	1.22E+06	6.35E+03	0	4.51E+16	2.35E+14	0.00E+00
I-132	3.85E+04	8.90E-02	0	1.42E+15	3.29E+09	0.00E+00
I-133						
I-134						
I-135						
Xe-133	7.29E+05	2.30E+02	0	2.70E+16	8.51E+12	0.00E+00
Xe-135						
Cs-134	7.90E+06	7.47E+06	5.80E+06	2.92E+17	2.76E+17	2.15E+17
Cs-136	2.05E+05	8.13E+03	3.91E-03	7.59E+15	3.01E+14	1.45E+08
Cs-137	2.02E+07	2.01E+07	1.97E+07	7.47E+17	7.44E+17	7.29E+17

Sheet1

Ba-139						
Ba-140	5.19E+06	1.90E+05	6.41E-02	1.92E+17	7.03E+15	2.37E+09
La-140	5.97E+06	2.19E+05	7.37E-02	2.21E+17	8.10E+15	2.73E+09
La-141						
La-142						
Ce-141	1.32E+07	3.61E+06	1.03E+04	4.88E+17	1.34E+17	3.81E+14
Ce-143						
Ce-144	2.64E+07	2.27E+07	1.16E+07	9.77E+17	8.40E+17	4.29E+17
Pr-143	5.44E+06	2.41E+05	1.90E-01	2.01E+17	8.92E+15	7.03E+09
Nd-147	1.54E+06	3.36E+04	1.10E-03	5.70E+16	1.24E+15	4.07E+07
Np-239	5.59E+04	2.88E+03	2.88E+03	2.07E+15	1.07E+14	1.07E+14
Pu-238	4.51E+05	4.53E+05	4.54E+05	1.67E+16	1.68E+16	1.68E+16
Pu-239	8.89E+04	8.89E+04	8.89E+04	3.29E+15	3.29E+15	3.29E+15
Pu-240	1.30E+05	1.30E+05	1.30E+05	4.81E+15	4.81E+15	4.81E+15
Pu-241	2.29E+07	2.27E+07	2.19E+07	8.47E+17	8.40E+17	8.10E+17
Am-241	2.88E+05	2.94E+05	3.21E+05	1.07E+16	1.09E+16	1.19E+16
Cm-242	1.45E+06	1.12E+06	3.50E+05	5.37E+16	4.14E+16	1.30E+16
Cm-244	2.27E+05	2.25E+05	2.19E+05	8.40E+15	8.33E+15	8.10E+15

Rh-106
Sb-125
Te-125m
I-129
Ba-137m
Pr-144
Sm-151
Eu-154
Eu-156

Nuclide	Inventory in Spent Fuel Pool					
	30 days after last batch put in pool	90 days after last batch put in pool	1 year after last batch put in pool	30 days after last batch put in pool	90 days after last batch put in pool	1 year after last batch put in pool
	(Ci)	(Ci)	(Ci)	(Bq)	(Bq)	(Bq)
Co-58	2.29E+04	1.26E+04	8.54E+02	8.47E+14	4.66E+14	3.16E+13
Co-60	3.72E+05	3.15E+05	2.85E+05	1.38E+16	1.17E+16	1.05E+16
Kr-85	1.41E+06	1.39E+06	1.33E+06	5.22E+16	5.14E+16	4.92E+16
Kr-85m						
Kr-87						
Kr-88						
Rb-86	1.01E+04	1.05E+03	3.84E-02	3.74E+14	3.89E+13	1.42E+09
Sr-89	8.39E+06	3.63E+06	8.33E+04	3.10E+17	1.34E+17	3.08E+15
Sr-90	1.42E+07	1.42E+07	1.39E+07	5.25E+17	5.25E+17	5.14E+17
Sr-91						
Sr-92						
Y-90	1.43E+07	1.42E+07	1.39E+07	5.29E+17	5.25E+17	5.14E+17
Y-91	1.18E+07	5.75E+06	2.21E+05	4.37E+17	2.13E+17	8.18E+15
Y-92						
Y-93						
Zr-95	1.94E+07	1.00E+07	5.10E+05	7.18E+17	3.70E+17	1.89E+16
Zr-97						
Nb-95	2.54E+07	1.70E+07	1.11E+06	9.40E+17	6.29E+17	4.11E+16
Mo-99	1.49E+04	3.12E-03	0	5.51E+14	1.15E+08	0.00E+00
Tc-99m	1.43E+04	3.01E-03	0	5.29E+14	1.11E+08	0.00E+00
Ru-103	1.53E+07	5.21E+06	4.07E+04	5.66E+17	1.93E+17	1.51E+15
Ru-105						
Ru-106	1.72E+07	1.53E+07	9.13E+06	6.36E+17	5.66E+17	3.38E+17
Rh-105						
Sb-127	1.19E+06	1.39E-01	0	4.40E+16	5.14E+09	0.00E+00
Sb-129						
Te-127	2.21E+05	1.45E+05	2.52E+04	8.18E+15	5.37E+15	9.32E+14
Te-127m	2.18E+05	1.48E+05	2.57E+04	8.07E+15	5.48E+15	9.51E+14
Te-129	2.74E+05	7.79E+04	2.68E+02	1.01E+16	2.88E+15	9.92E+12
Te-129m	4.21E+05	1.20E+05	4.12E+02	1.56E+16	4.44E+15	1.52E+13
Te-131m						
Te-132	3.74E+04	8.64E-02	0	1.38E+15	3.20E+09	0.00E+00
I-131	1.22E+06	6.35E+03	0	4.51E+16	2.35E+14	0.00E+00
I-132	3.85E+04	8.90E-02	0	1.42E+15	3.29E+09	0.00E+00
I-133						
I-134						
I-135						
Xe-133	7.29E+05	2.30E+02	0	2.70E+16	8.51E+12	0.00E+00
Xe-135						
Cs-134	7.90E+06	7.47E+06	5.80E+06	2.92E+17	2.76E+17	2.15E+17
Cs-136	2.05E+05	8.13E+03	3.91E-03	7.59E+15	3.01E+14	1.45E+08
Cs-137	2.02E+07	2.01E+07	1.97E+07	7.47E+17	7.44E+17	7.29E+17
Ba-139						
Ba-140	5.19E+06	1.90E+05	6.41E-02	1.92E+17	7.03E+15	2.37E+09
La-140	5.97E+06	2.19E+05	7.37E-02	2.21E+17	8.10E+15	2.73E+09
La-141						
La-142						
Ce-141	1.32E+07	3.61E+06	1.03E+04	4.88E+17	1.34E+17	3.81E+14
Ce-143						
Ce-144	2.64E+07	2.27E+07	1.16E+07	9.77E+17	8.40E+17	4.29E+17
Pr-143	5.44E+06	2.41E+05	1.90E-01	2.01E+17	8.92E+15	7.03E+09
Nd-147	1.54E+06	3.36E+04	1.10E-03	5.70E+16	1.24E+15	4.07E+07
Np-239	5.59E+04	2.88E+03	2.88E+03	2.07E+15	1.07E+14	1.07E+14
Pu-238	4.51E+05	4.53E+05	4.54E+05	1.67E+16	1.68E+16	1.68E+16
Pu-239	8.89E+04	8.89E+04	8.89E+04	3.29E+15	3.29E+15	3.29E+15
Pu-240	1.30E+05	1.30E+05	1.30E+05	4.81E+15	4.81E+15	4.81E+15
Pu-241	2.29E+07	2.27E+07	2.19E+07	8.47E+17	8.40E+17	8.10E+17
Am-241	2.88E+05	2.94E+05	3.21E+05	1.07E+16	1.09E+16	1.19E+16
Cm-242	1.45E+06	1.12E+06	3.50E+05	5.37E+16	4.14E+16	1.30E+16
Cm-244	2.27E+05	2.25E+05	2.19E+05	8.40E+15	8.33E+15	8.10E+15
Rh-106						
Sb-125						
Te-125m						
I-129						
Ba-137m						
Pr-144						
Sm-151						
Eu-154						
Eu-156						

Case IV A. zero out the inventories for 20 isotopes:

- Kr-85m, Kr-87, Kr-88, Sr-91, Sr-92, Y-92, Y-93,
- Zr-97, Ru-105, Rh-105, Sb-129, Te-131m,
- I-133, I-134, I-135, Xe-135,
- Ba-139, La-141, La-142, Ce-143

Case IV B Put in 30-day inventories for 40 isotopes
from Table 4.1 of NUREG/CR-4982.

Case IV C. Put in 90-day inventories

Case IV D Put in 1-year inventories

Case Files

- IV A arnos 5c.inp, 5a-n.out
 - IV B arnos 5b.inp, 5b-n.out
 - IV C arnos 5c.inp, 5c-n.out
 - IV D arnos 5d.inp, 5d-n.out
- all { early 1.inp
 { arnos 1-n.inp