

4/14/99

MACS code

done

Core

(1) check NUREG/CR; the MACS checks the spent fuel pool

4/15/99 (2) reduce the number of plumes to one

4/16/99 (3) change the core inventory (CCI)

4/16/99 (4) change the release fractions

4/15/99 (5) eliminate the second source term (leakage core)

~~to eliminate the second source term response scenario (leakage core)~~

later (1) modify the plume rise heating rate (w) ?

" (8) add rest of core (Sr, Y, Zr, Nb, Mo, Tc, I, Xe, Cs, Ba, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Po, At, Rn, Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Po, At, Rn, Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr)

" (7) correct the release fractions for: Sr, Y-91, Co-58, Co-60

Nb-95, Zr-95

" (10) add nuclides for: Rh-106, Sb-125, Te-125m, I-129,

Ba-137m, Rb-144, Sn-151, Eu-154,

Eu-156

" (11) modify the plume duration

(12) get updated version of code (Lynx problem)

4/16/99 (13) correct power to Susquehanna's power

VI

Write the report

look at which nuclides eliminate to explain dose results.

4/14/99

I. Started with sample problem A

Files: in1a.inp (atmos)

in2a.inp (early)

in3a-n.inp (chronic)

METSUR.inp

SURSET.inp

acout_n.out

Results

early fatalities (mean)

cancer fatalities (mean)

(population dose - SR (mean))

→ L-EDENBODY TOT LIF

(L. term (50 years))

(4/15/99) 3

II. Compared out the second source term

Files: atmos1.inp (atmos)
early1.inp (early)
chron1-n.inp (chron)
1-n.out (out put)

III. reduced the number of planes to 1

Files: atmos3.inp } TRIAL A
early1.inp
chron1-n.inp
3-n.out

Trial A: Changed NUMREL to 1

Trial B: Deleted RDELFR002 card

Trial C: Deleted second value on the following cards:

Files: atmos3b.inp } TRIAL B
early1.inp
chron1-n.inp
3b-n.out

Trial A:

Released inventory, all planes \leftarrow use this to check

I-131 1.55×10^{18}

core inv = 3.206×10^{18}

$\times .68 = 2.18 \times 10^{18}$

$\times .715 = 1.56 \times 10^{18} \checkmark$

Te-132 (3.2 d half-life) 5.61×10^{17}

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

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

IV change the release fractions

Files: atmos 4. inp

early 1. inp

chnc 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	✓

I. Along the core inventory

Core

- 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.

In Core Kly 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 lost here

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 isotypes:

K_r-85_m, K_r-87, K_r-88, S_r-91, S_r-92, Y-92, Y-93,
 Z_r-97, R_u-105, R_H-105, S_b-129, T_e-131_m,
 I-133, I-134, I-135, X_e-135,
 R_c-139, L_a-141, L_a-142, C_e-143

Case IV B Put in 30-day inventories for 40 isotypes
 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	File
IV A	adnos 5c.inp, 5a-n.out
IV B	adnos 5b.inp, 5b-n.out
IV C	adnos 5c.inp, 5c-n.out
IV D	adnos 5d.inp, 5d-n.out
all	{ early 1.inp { early 1-n.inp