Appendix 6.9.7

INPUT LISTINGS OF ES-3100 CALCULATION MODELS FOR SELECT CASES

This appendix contains selected input listing for calculations identified Tables 6.1a-e and Sects. 6.4, 6.5, and 6.6 of this document, and Sect. 6.7 on air transport. These listings are a few taken from Y/LF-718.

ES-3100 Input file - Results table crosswalk

Case	Description	Input File	Results Table
cvercyt11_21_1	3 cyl, 0.0 in np, 21000 gU (21000 g ^{235}U, 9082.6 g H_2O, h/x=11.29)	6-307	6-170
cvercyt11_36_2	3 cyl, 1.4 in np, 36000 gU (36000 g ^{235}U, 7673.1 g H_2O, h/x=5.56)	6-308	6-170
cvcrsqt11_36_1	3 bar, 0.0 in np, 36000 gU (36000 g ^{235}U, 8286.7 g H_2O, h/x=6.01)	6-310	6-177
cvercyct11_17_1	3 cyl, 0.0 in np, 17000 gU (17000 g ^{235}U, 9294.9 g H_2O, h/x=14.27)	6-312	6-183
cvercyct11_32_2	3 cyl, 1.4 in np, 32000 gU (32000 g ^{235}U, 7885.3 g H_2O, h/x= 6.43)	6-314	6-184
cvcr5est11_1_1	0.0 in np, 18286.5 gU (18286.5 g ^{235}U, 9226.6 g H_2O, h/x=13.75)	6-316	6-188
cvcr6e4st11_1	1.4 in np, 36573.0 gU (36573.0 g ^{235}U, 7642.7 g H_2O, h/x= 5.45)	6-319	6-188
cvcr70st11_2	0.0 in np, 25601.1 gU (25601.1 g ^{235}U, 8838.5 g H_2O, h/x= 9.01)	6-321	6-189
cvr3sqa_26_1_8_15	0.0 in np, 25893.7 gU (25893.7 g ^{235}U, 8822.9 g H_2O, h/x= 8.89)	6-324	N/A[a]
cvr3lha_26_1_8_15	0.0 in np, 25893.7 gU (25893.7 g ^{235}U, 8822.9 g H_2O, h/x= 8.89)	6-326	6-199
cvr3cha_26_1_8_15	0.0 in np, 25893.7 gU (25893.7 g ^{235}U, 8822.9 g H_2O, h/x= 8.89)	6-329	N/A[a]
cvcroxt11_1_24_1	0.0 in np, disp. 24000 gUO_2 (21124.9 g ^{235}U, 6533.9 g H_2O, h/x= 9.90)	6-331	6-219
cvcrsk3cc_9_15_17	0.0 in np, 21300g SOC (19865.3g UOx, 15672.8 g ^{235}U, 921.0 g C, h/x=12.82)	6-333	6-234
cvcrunhct11_9_1	0.0 in np, disp. 9000 gUNHc (4238.7 g ^{235}U, 6980.8 g H_2O, h/x=54.99)	6-335	6-223
cvcrtriga_1_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-336	6-250
ncsrcyt11_21_1_15	3 cyl, 0.0 in np, 21000 gU (21000 g ^{235}U, 9082.6 g H_2O, h/x=11.29)	6-338	6-174
nciacyct11_25_2_3	3 cyl, 1.4 in np, 25000 gU (25000 g ^{235}U, 8256.8 g H_2O, h/x= 8.62)	6-343	6-176
hciacyct12_25_2_3	3 cyl, 1.4 in np, 25000 gU (25000 g ^{235}U, 8256.8 g H_2O, h/x= 8.62)	6-347	6-176
ncia70st11_2_8_3	1.4 in np, 25601.1 gU (25601.1 g ^{235}U, 8224.9 g H_2O, h/x= 8.39)	6-351	6-195
ncia5est11_1_2_5_3	1.4 in np, 36665.6 gU (29332.5 g ^{235}U, 7642.7 g H_2O, h/x= 6.80)	6-355	6-194
nciabmt11_4_1_5_3	0.0 in np, 3708.5 gU (2966.8 g ^{235}U, 10000.7 g H_2O, h/x=87.98)	6-362	6-207
hctf5bmt12_25_2_8_3	1.4 in np, 24968.9 gU (24968.9 g ^{235}U, 8258.4 g H_2O, h/x= 8.63)	6-367	6-217
nciaoxt11_1_24_1_3	0.0 in np, disp. 24000 gUO_2 (21124.9 g ^{235}U, 6533.9 g H_2O, h/x= 9.90)	6-382	6-221
nciask_9_15	0.0 in np, 21300g SOC (19865.3g UOx, 15672.8 g ^{235}U, 921.0 g C, h/x=12.82)	6-386	6-246
ncsrunhct11_9_1_15	0.0 in np, disp. 9000 gUNHc (4238.7 g ^{235}U, 6980.8 g H_2O, h/x=54.99)	6-380	6-225
icsrunhct12_24_1_15	0.0 in np, disp. 24000.0 gUNHc (11303.1 g ^{235}U, 4874.9 g H_2O, h/x=30.14)	6-394	6-231

ES-3100 Input file - Results table crosswalk

Case	Description	Input File	Results Table
ncsrtriga_1_15_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-398	6-256
nciatriga_1_15_3	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-403	6-258
atdmr_7_8	7000 gU, 7000 g ^{235}U, 513.0 gCH_2, h/x=2.46, Rc=6.05465cm	6-407	6-268
atdmsr_7_8_11	7000 gU, 7000 g ^{235}U, 513.0 gCH_2, h/x=2.46, Rc=6.05465cm, 661331. gSS, Rs=13.0264cm	6-408	6-268
atdmkr_7_8_11	7000 gU, 7000 g ^{235}U, 513.0 gCH_2, h/x=2.46, Rc=6.05465cm, 128034.0gKao,Rk=31.0814cm	6-408	6-272
atdzr	10400.0 gUZrHx (921.0 g ^{235}U, 500.0 gCH_2, h/x=43.37), Rc=7.46774cm	6-410	6-276
athzpkr_11	10400.0 gUZrHx (921.g ^{235}U, 500.0 gCH_2, 76819 gH_2O, h/x=2220), Rc=39.15407cm	6-411	6-277
athzpwskr_9_11	10400 gUZrHx, 921.0 g ^{235}U, 500.0 gCH_2, 74614 gH_2O, h/x=2157, Rc=26.33372cm, Rs=36.35905cm	6-412	6-278
athmpkr_8_8_11	4000 gUZrHx, 4000 g ^{235}U, 513. gCH_2, 76819 gH_2O, h/x=505.5, Rc=39.10344cm	6-413	6-288
athmpwskr_2_8_11	1000gUZrHx, 1000. g ^{235}U, 513. gCH_2, 74614 gH_2O, h/x=1964, Rc=26.20298cm, Rs=36.29068cm	6-414	6-293
athm2pwskr_3_1_3	3500 gUZrHx, 700. g ^{235}U, 513. gCH_2, 14922 gH_2O, h/x=116.2, Rc=15.53077cm, Rs=32.25271cm	6-416	6-297
athmpkmr_2_5_1_11	17.5kgU,(1000. g ^{235}U, 513. gCH_2, 76819 gH_2O, h/x=404.45, Rc=39.10606cm, Rs=39.14036cm	6-418	6-300
cvcrtriga_1_1	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 0.0 gH_2O hx= 0.00)	6-419	6-250
cvcrtriga_1_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 gH_2O hx= 0.00)	6-422	6-250
cvcrtriga_2_15	1.4 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8384.6 g H_2O, h/x=237.62)	6-426	6-250
cvcrtriga_70_1_1	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 0.0 g H_2O, h/x=0.0)	6-429	6-250
cvcrtriga_70_1_15	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8998.2 g H_2O, h/x=575.64)	6-432	6-251
cvcrtriga_70_2_15	1.4 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8384.6 g H_2O, h/x=536.39)	6-435	6-251
ncsrtriga_1_15_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-439	6-256
ncsrtriga70_1_15_15	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8998.2 g H_2O, h/x=575.64)	6-443	6-260
ncsrt55d2_1_15_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-448	6-264
hcsrtriga_1_15_15	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-452	6-256
hcsrtriga70_1_15_15	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8998.2 g H_2O, h/x=575.64)	6-456	6-260
nciatriga_1_15_3	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-461	6-258
nciatriga70_1_15_3	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8998.2 g H_2O, h/x=575.64)	6-465	6-261
hciatriga_1_15_3	0.0 in np, 10400.0 gUZrHx (921.0 g ^{235}U, 8998.2 g H_2O, h/x=255.01)	6-470	6-258

ES-3100 Input file - Results table crosswalk

Case	Description	Input File	Results Table
hciatriga70_1_15_3	0.0 in np, 6847.1 gUZrHx (408.0 g ^{235}U, 8998.2 g H_2O, h/x=575.64)	6-474	6-261
ncrsT70_131_1_15_15	0.0in np, 5666.6 gUZrHx(337.7 g^{235}U, 9204.9 gH_2O hx=711.53), fr=1.0e+00	6-479	6-263
nciaT70_131_1_15_3	0.0in np, 5666.6 gUZrHx(337.7 g^{235}U, 9204.9 gH_2O hx=711.53), fr=1.0e-04	6-483	6-264
athopwskr20_3	12245.0 g U_3O_8-Al (716.0 g ^{235}U, 500.0 g CH_2, 14922.0 g H_2O, h/x=567.4, Rc=16.54607 cm, Rs=32.50193 cm	6-488	6-283
athopwskr70_2	1995.7 g U_3O_8-Al (408.0 g ^{235}U, 500.0 g CH_2, 7461.5 g H_2O, h/x=518.4, Rc=12.70245 cm, Rs=31.69964 cm	6-490	6-284
athopwskr93_2	1505.0 g U_3O_8-Al (408.0 g ^{235}U, 500.0 g CH_2, 7461.5 g H_2O, h/x=518.4, Rc=12.63331 cm, Rs=31.68860 cm	6-492	6-284
athupwskr93_2	920.5 g UO_2 Mg-Al (408.0 g ^{235}U, 500.0 g CH_2, 7461.5 g H_2O, g htox=518.4, Rc=12.5359 cm, Rs=31.67313 cm	6-494	6-286
athupwskr20_2	7523.6 g UO Mg-Al (716.0 g ^{235}U, 500.0 g CH_2, 7461.5 g H_2O, g htox=295.4, Rc=13.32851 cm, Rs=31.80486 cm	6-496	6-286
athupwskr09_2	15231.0 g UO_2 Mg-Al (716.8 g ^{235}U, 500.0 g CH_2, 7461.5 g H_2O, g htox=295.0, Rc=14.14894 cm, Rs=31.95726 cm	6-498	6-285

[a] Input files included in appendix for comparison with bounding model but not recorded in results tables.

```
=csas25    parm=size=3000000
cvcrcyt11 3cyl,0.0in thk np,21000.0gU(21000.0g235, 9082.6gH2O hx= 11.29),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1116.36286, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.80, CV void volume 9098.99908'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrcyt11 3cyl,0.0in thk np,21000.0gU(21000.0g235, 9082.6gH2O,hx= 11.29),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 7.675 in.]'
 cylinder  1  1    4.114800     6.99579   0.0     com='cylindrical content'
 cylinder  3  1    6.426200    6.99629  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    6.99629  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    6.99629  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 7.675 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'20.99097            stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   56.09803   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   56.09803   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   56.09803   0.0     com='drum chine outer radius'
```

```
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrcyt11 3cyl,1.4in thk np,36000.0gU(36000.0g235, 7673.1gH2O hx=  5.56),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1913.76490, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.47, CV void volume 7686.91692'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
```

```
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrcytl1 3cyl,1.4in thk np,36000.0gU(36000.0g235, 7673.1gH2O,hx=  5.56),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 9.642 in.]'
 cylinder  1  1    4.114800   11.99278   0.0     com='cylindrical content'
 cylinder  3  1    6.426200   11.99328  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   11.99328  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   11.99328  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=11.042 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'43.09395             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   33.99505   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   33.99505   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   33.99505   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
```

```
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrsqt11 3bar,0.0in thk np,36000.0gU(36000.0g235, 8286.7gH2O hx=  6.01),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1913.76490, SPACER volume .   0.00000'
'HEU wrapped dry content can hx=0.47, CV void volume 8301.59704'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
```

```
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrsqt11 3bar,0.0in thk np,36000.0gU(36000.0g235, 8286.7gH2O,hx=  6.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev=12.337 in.]'
 cuboid    1  1  4p2.909600    18.83826   0.0     com='block content'
 cylinder  3  1    6.426200   18.83876  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   18.83876  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   18.83876  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=12.337 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'56.51838             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   20.57062   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   20.57062   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   20.57062   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
```

```
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrcyct11 3cyl,0.0in thk np,17000.1gU(17000.1g235, 9294.9gH2O hx= 14.27),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume = 903.72763, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.99, CV void volume 9311.63431'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000              end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
```

```
                                8016   88.8087    3  1.0      293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                             8  1.0      293  end
'steel: cv flange lower use 3.36 lb'
ss304                                             9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                            10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0      293  end
end comp
cvcrcyct11 3cyl,0.0in thk np,17000.1gU(17000.1g235, 9294.9gH2O,hx= 14.27),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 6.216 in.]'
 cylinder  1  1    5.397500     3.29140   0.0     com='cylindrical content'
 cylinder  3  1    6.426200    3.29190  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    3.29190  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.29190  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 6.216 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
' 9.87781             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   67.21119   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   67.21119   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   67.21119   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
```

```
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrcyct11 3cyl,1.4in thk np,32000.1gU(32000.1g235, 7885.3gH2O hx=  6.43),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1701.12968, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.52, CV void volume 7899.55215'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000              end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
```

```
                                8016   88.8087   21  1.0     293  end
end comp
cvcrcyct11 3cyl,1.4in thk np,32000.1gU(32000.1g235, 7885.3gH2O,hx=  6.43),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 7.360 in.]'
 cylinder  1  1    5.397500     6.19557   0.0     com='cylindrical content'
 cylinder  3  1    6.426200    6.19607  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    6.19607  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    6.19607  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 8.760 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'25.70230             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   51.38670   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   51.38670   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   51.38670   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
```

```
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvc5est11,0.0in np,18286.5gU(18286.5g235, 9226.6gH2O hx= 13.17),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume = 972.11199, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.92, CV void volume 9243.24995'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvc5est11,0.0in np,18286.5gU(18286.5g235, 9226.6gH2O,hx= 13.17),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
```

```
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'1st content can (collapsed) [Elev= 6.983 in.]'
'Reference CRC 29 Ed. pg 105'
'side of pentagon denoted spent'
'radius of inscribed circle in pentagon denoted icrpent'
'radius of circumscribed circle outside pentagon denoted ccrpent'
'ccrpent equals 0.85065 times spent'
'icrpent equals 0.68819 times spent'
'side of pentagon equals diameter of a cylinder fit into cc'
'radius of cc equals ccrpent plus radius of cylinder fit into cc'
'radius of ccrpent equal diamater of slug'
' 3.96875 radius of circumscribed circle'
' 2.33277 half of side of pentagon'
' 3.21078 radius of inscribed circle'
' 3.77452 x axis location of 2nd cyl in cc'
' 1.22642 y axis location of 2nd cyl in cc'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1020    0.0       3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1020    3.77452   1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1020    2.33277  -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1020   -2.33277  -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1020   -3.77452   1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1005
'np277_4 spacer [Elev= 6.983 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1006
'2nd content can (collapsed) [Elev= 9.046 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1021    0.0       3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1021    3.77452   1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1021    2.33277  -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1021   -2.33277  -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1021   -3.77452   1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.046 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'3rd content can (collapsed) [Elev= 9.046 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1022    0.0       3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1022    3.77452   1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1022    2.33277  -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1022   -2.33277  -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1022   -3.77452   1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1009
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'15.71985              stack height (content spacers)      CALCULATED
 cylinder  3  1    6.426200   61.36915   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   61.36915   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   61.36915   0.0     com='drum chine outer radius'
unit 1010
```

```
'cv at 1st step in liner [Elev=11.169 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=11.259 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=11.759 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=12.909 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=13.309 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=13.369 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=16.589 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=18.339 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=18.589 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=19.339 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
unit 1020
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
unit 1021
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
unit 1022
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
global
unit 1023
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1025
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1023               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end
```

```
=csas25    parm=size=3000000
cvcr6e4st11,1.4in np,36573.0gU(36573.0g235, 7642.7gH2O hx=  5.45),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1944.22398, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.46, CV void volume 7656.45784'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcr6e4st11,1.4in np,36573.0gU(36573.0g235, 7642.7gH2O,hx=  5.45),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'1st content can (collapsed) [Elev= 9.045 in.]'
'Reference CRC 29 Ed. pg 105'
'side of pentagon denoted spent'
'radius of inscribed circle in pentagon denoted icrpent'
'radius of circumscribed circle outside pentagon denoted ccrpent'
'ccrpent equals 0.85065 times spent'
'icrpent equals 0.68819 times spent'
'side of pentagon equals diameter of a cylinder fit into cc'
'radius of cc equals ccrpent plus radius of cylinder fit into cc'
'radius of ccrpent equal diamater of slug'
' 3.96925 radius of circumscribed circle'
' 2.33307 half of side of pentagon'
' 3.21119 radius of inscribed circle'
' 3.77499 x axis location of 2nd cyl in cc'
' 1.22658 y axis location of 2nd cyl in cc'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1020    0.0       3.96925 0.0        com='cyl (0,ccrpent)'
```

```
 hole  1020    3.77499   1.22658 0.0        com='cy2 (xtwo,ytwo)'
 hole  1020    2.33307  -3.21119 0.0        com='cy3 (hspent,-icrpent)'
 hole  1020   -2.33307  -3.21119 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1020   -3.77499   1.22658 0.0        com='cy5 (-xtwo,ytwo)'
 hole  1020    0.0       0.0    0.0       com='cy6 (0,0)'
 hole  1020    2.80704   0.0 5.23875      com='cy7'
 hole  1020   -2.80704   0.0 5.23875      com='cy8'
 hole  1020    0.0     2.80704 5.23875      com='cy9'
 hole  1020    0.0    -2.80704 5.23875      com='cy10'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   10.47800  -0.0005  com='drum chine outer radius'
unit 1005
'np277_4 spacer [Elev=10.446 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1006
'2nd content can (collapsed) [Elev=14.571 in.]'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1021    0.0       3.96925 0.0        com='cy1 (0,ccrpent)'
 hole  1021    3.77499   1.22658 0.0        com='cy2 (xtwo,ytwo)'
 hole  1021    2.33307  -3.21119 0.0        com='cy3 (hspent,-icrpent)'
 hole  1021   -2.33307  -3.21119 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1021   -3.77499   1.22658 0.0        com='cy5 (-xtwo,ytwo)'
 hole  1021    0.0       0.0    0.0       com='cy6 (0,0)'
 hole  1021    2.80704   0.0 5.23875      com='cy7'
 hole  1021   -2.80704   0.0 5.23875      com='cy8'
 hole  1021    0.0     2.80704 5.23875      com='cy9'
 hole  1021    0.0    -2.80704 5.23875      com='cy10'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   10.47800  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=15.971 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'3rd content can (collapsed) [Elev=14.571 in.]'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1022    0.0       3.96925 0.0        com='cy1 (0,ccrpent)'
 hole  1022    3.77499   1.22658 0.0        com='cy2 (xtwo,ytwo)'
 hole  1022    2.33307  -3.21119 0.0        com='cy3 (hspent,-icrpent)'
 hole  1022   -2.33307  -3.21119 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1022   -3.77499   1.22658 0.0        com='cy5 (-xtwo,ytwo)'
 hole  1022    0.0       0.0    0.0       com='cy6 (0,0)'
 hole  1022    2.80704   0.0 5.23875      com='cy7'
 hole  1022   -2.80704   0.0 5.23875      com='cy8'
 hole  1022    0.0     2.80704 5.23875      com='cy9'
 hole  1022    0.0    -2.80704 5.23875      com='cy10'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   10.47800  -0.0005  com='drum chine outer radius'
unit 1009
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.54810          stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.54090   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.54090   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.54090   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=20.156 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=20.246 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=20.746 in.]'
```

```
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=21.896 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=22.296 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=22.356 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=25.576 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=27.326 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=27.576 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=28.326 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
unit 1020
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
unit 1021
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
unit 1022
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
global
unit 1023
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1025
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1023               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcr70st11,0.0in np,25601.1gU(25601.1g235, 8838.5gH2O hx=  9.01),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1360.95679, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.66, CV void volume 8854.40516'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000              end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
```

```
                                  5011    81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0     6012     1.9189
                                  7014     0.0141
                                  8016    43.4251
                                 11023     0.1174
                                 12000     0.3378
                                 13027    39.0479
                                 14000     2.4672
                                 16000     0.3083
                                 20000    11.8336
                                 26000     0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0     1001    11.1913
                                  8016    88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0     1001    11.1913
                                8016    88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                             8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                             9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                            10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0     1001    11.1913
                                8016    88.8087   21  1.0     293  end
end comp
cvcr70st11,0.0in np,25601.1gU(25601.1g235, 8838.5gH2O,hx=  9.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'1st content can (collapsed) [Elev= 6.983 in.]'
'3.437212   plus-y location cylinders'
'-3.437212  minus-y location cylinders'
'1.984375   plus-x location cylinders'
'-1.984375  minus-x location cylinders'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1020   -3.968750   0.0       0.0     com='cy1 (2cymx,0)'
 hole  1020   -1.984375   3.437212  0.0     com='cy2 (cymx,cypy)'
 hole  1020    1.984375   3.437212  0.0     com='cy3 (cypx,cypy)'
 hole  1020    3.968750   0.0       0.0     com='cy4 (2cypx,0)'
 hole  1020    1.984375  -3.437212  0.0     com='cy5 (cypx,cymx)'
 hole  1020   -1.984375  -3.437212  0.0     com='cy6 (cymx,cymy)'
 hole  1020    0.0        0.0       0.0     com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1005
'np277_4 spacer [Elev= 6.983 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1006
'2nd content can (collapsed) [Elev= 9.046 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1021   -3.968750   0.0       0.0     com='cy1 (2cymx,0)'
 hole  1021   -1.984375   3.437212  0.0     com='cy2 (cymx,cypy)'
 hole  1021    1.984375   3.437212  0.0     com='cy3 (cypx,cypy)'
 hole  1021    3.968750   0.0       0.0     com='cy4 (2cypx,0)'
 hole  1021    1.984375  -3.437212  0.0     com='cy5 (cypx,cymx)'
```

```
 hole  1021   -1.984375  -3.437212  0.0      com='cy6 (cymx,cymy)'
 hole  1021    0.0        0.0       0.0      com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.046 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'3rd content can (collapsed) [Elev= 9.046 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1022   -3.968750   0.0       0.0      com='cy1 (2cymx,0)'
 hole  1022   -1.984375   3.437212  0.0      com='cy2 (cymx,cypy)'
 hole  1022    1.984375   3.437212  0.0      com='cy3 (cypx,cypy)'
 hole  1022    3.968750   0.0       0.0      com='cy4 (2cypx,0)'
 hole  1022    1.984375  -3.437212  0.0      com='cy5 (cypx,cymx)'
 hole  1022   -1.984375  -3.437212  0.0      com='cy6 (cymx,cymy)'
 hole  1022    0.0        0.0       0.0      com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200    5.23925  -0.0005  com='drum chine outer radius'
unit 1009
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'15.71985             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   61.36915   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   61.36915   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   61.36915   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=11.169 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=11.259 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=11.759 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=12.909 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=13.309 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=13.369 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=16.589 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=18.339 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=18.589 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=19.339 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
unit 1020
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
unit 1021
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
```

```
unit 1022
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0       com='cyl'
global
unit 1023
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1025
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1023              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvr 3x3sqa,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O hx=  8.89),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1376.51338, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.65, CV void volume 8838.84856'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000              end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07072e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4264
                                11023    0.1174
                                12000    0.3378
                                13027   39.0470
                                14000    2.4671
                                16000    0.3083
                                20000   11.8333
                                26000    0.5297    2  1.0000  293  end
arbmnph2o 3.84144e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'void space internal to containmment vessel -- including content cans'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvr 3x3sqa,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O,hx=  8.89),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
```

```
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'cubical content, stacked per cc'
'    9.08802     3.57796 lattice width-depth'
'    2.54000     1.00000 cube dimension'
'    1.27000     0.50000 cube half-dimension'
'   16.38706     1.00000 volume of HEU cube in unit cell'
'  308.25850             HEU mass one cube'
'   28                   number of HEU cubes per can'
' 8631.23808             HEU mass of cubes in cc'
'    3           3       number of cubes in -x direction'
'    3           3       number of cubes in -y direction'
'    9           9       number of HEU cubes in a layer'
'    4    VARIABLE       number of HEU layers in z-axis'
'    1    VARIABLE       number of HEU cubes in top layer modulus(Z%N)'
'    8    VARIABLE       number of HEU voids in top layer'
'    ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill'
'    0.48924     0.19261 gap dimension                        CALCULATED
'    3.02924     1.19261 unit cell dimension                  CALCULATED
'    1.51462     0.59631 unit cell half-dimension             CALCULATED
'   27.79719     1.69629 volume of unit cell                  CALCULATED
'   11.41013     0.69629 volume of water gap in unit cell     CALCULATED
 cuboid    1  1  6p1.26990                       com='content cube'
 cuboid    3  1  6p1.51452                       com='unit cell'
unit 1005
'cubical void, filler for layers'
 cuboid    3  1  6p1.51452                       com='unit cell'
unit 1006
'content (collapsed) [Elev= 9.691 in.]'
' 4.54386     1.78892 half width-depth lattice             CALCULATED'
'12.11696             height lattice                       CALCULATED'
 array 1          2r-4.54386      0.0
 cuboid    3  1  4p4.54386     12.1169   0.0     com='content-array'
 cylinder  3  1    6.426200   12.11746  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   12.11746  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.11746  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.691 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'36.35448             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   40.73452   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   40.73452   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   40.73452   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
```

```
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
 array 3   2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvr 3x3lha,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O hx=  8.89),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1376.51338, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.65, CV void volume 8838.84856'
uranium  1 den=18.81109 0.45852 293      92235  100.00
                                    92238   0.000                end
arbmh20i   0.54051  2 0 0 0    1001   11.1913
                               8016   88.8087    1  1       293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07072e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4264
                                11023    0.1174
                                12000    0.3378
                                13027   39.0470
                                14000    2.4671
                                16000    0.3083
```

```
                                20000   11.8333
                                26000    0.5297    2  1.0000  293  end
arbmnph2o 3.84144e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'void space internal to containmment vessel -- including content cans'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvr 3x3lha,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O,hx=  8.89),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200   0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'cubical content, stacked per cc'
'    9.08802     3.57796 lattice width-depth'
'    2.54000     1.00000 cube dimension'
'    1.27000     0.50000 cube half-dimension'
'   16.38706     1.00000 volume of HEU cube in unit cell'
'  308.25850             HEU mass one cube'
'   28                   number of HEU cubes per can'
' 8631.23808             HEU mass of cubes in cc'
'    3           3       number of cubes in -x direction'
'    3           3       number of cubes in -y direction'
'    9           9       number of HEU cubes in a layer'
'    4    VARIABLE       number of HEU layers in z-axis'
'    1    VARIABLE       number of HEU cubes in top layer modulus(Z%N)'
'    8    VARIABLE       number of HEU voids in top layer'
'    ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill'
'    0.48924     0.19261 gap dimension                        CALCULATED
'    3.02924     1.19261 unit cell dimension                  CALCULATED
'    1.51462     0.59631 unit cell half-dimension             CALCULATED
'   27.79719     1.69629 volume of unit cell                  CALCULATED
'   11.41013     0.69629 volume of water gap in unit cell     CALCULATED
' 1000.69893             lattice volume in cc                 CALCULATED
'  541.86113             moderator volume in lattice in cc    CALCULATED
'  458.83779             HEU volume in lattice in cc          CALCULATED
'    0.45852             volume fraction of HEU in lattice'   CALCULATED
'    0.54051             bulk dens of water in lattice in cc  CALCULATED
 cuboid    1  1  6p1.51452                        com='unit cell'
unit 1005
'cubical void, filler for layers'
 cuboid    1  1  6p1.51452                        com='unit cell'
unit 1006
'content (collapsed) [Elev= 9.691 in.]'
' 4.54386     1.78892 half width-depth lattice             CALCULATED'
'12.11696             height lattice                       CALCULATED'
'array 1         2r-4.54386      0.0'
 cuboid    1  1  4p4.54386     12.1169   0.0     com='homog. content-array'
 cylinder  3  1    6.426200   12.11746  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   12.11746  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.11746  -0.0005  com='drum chine outer radius'
unit 1007
```

```
'np277_4 spacer [Elev= 9.691 in.]'
 cylinder  2  1    5.24510     0.00010   0.0      com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001   com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001   com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001   com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'36.35448            stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   40.73452   0.0      com='cv well cavity'
 cylinder  8  1    6.680200   40.73452   0.0      com='cv below 1st step'
 cuboid    21 1 4p24.587200   40.73452   0.0      com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0      com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0      com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0      com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
 array 3   2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0     com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48    com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
```

```
end start
end data
end


=csas25    parm=size=3000000
cvr 3x3cha,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O hx=  8.89),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1376.51338, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.65, CV void volume 8838.84856'
uranium  1 den=18.81109 0.13475 293      92235  100.00
                                       92238   0.000                end
arbmh20i   0.86369  2 0 0 0    1001   11.1913
                               8016   88.8087    1  1       293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0   5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07072e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4264
                                11023    0.1174
                                12000    0.3378
                                13027   39.0470
                                14000    2.4671
                                16000    0.3083
                                20000   11.8333
                                26000    0.5297    2  1.0000  293  end
arbmnph2o 3.84144e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'void space internal to containmment vessel -- including content cans'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvr 3x3cha,0.0in thk np,25893.7gU(25893.7g235, 8822.9gH2O,hx=  8.89),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200   0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200  11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200   0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200   0.63500   0.0     com='drum chine outer radius'
unit 1004
'cubical content, stacked per cc'
'    9.08802     3.57796 lattice width-depth'
'    2.54000     1.00000 cube dimension'
'    1.27000     0.50000 cube half-dimension'
'   16.38706     1.00000 volume of HEU cube in unit cell'
'  308.25850             HEU mass one cube'
'   28                   number of HEU cubes per can'
' 8631.23808             HEU mass of cubes in cc'
'    3           3       number of cubes in -x direction'
'    3           3       number of cubes in -y direction'
'    9           9       number of HEU cubes in a layer'
```

```
'    4    VARIABLE       number of HEU layers in z-axis'
'    1    VARIABLE       number of HEU cubes in top layer modulus(Z%N)'
'    8    VARIABLE       number of HEU voids in top layer'
'    ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill'
'    0.48924     0.19261 gap dimension                        CALCULATED
'    3.02924     1.19261 unit cell dimension                  CALCULATED
'    1.51462     0.59631 unit cell half-dimension             CALCULATED
'   27.79719     1.69629 volume of unit cell                  CALCULATED
'   11.41013     0.69629 volume of water gap in unit cell     CALCULATED
' 1000.69893             lattice volume in cc                 CALCULATED
'  541.86113             moderator volume in lattice in cc    CALCULATED
'  458.83779             HEU volume in lattice in cc          CALCULATED
'    0.13475             volume fraction of HEU in CV         CALCULATED
'    0.86369             bulk dens of water in CV             CALCULATED
 cuboid    1  1  6p1.51452                        com='unit cell'
unit 1005
'cubical void, filler for layers'
 cuboid    1  1  6p1.51452                        com='unit cell'
unit 1006
'content (collapsed) [Elev= 9.691 in.]'
' 4.54386     1.78892 half width-depth lattice             CALCULATED'
'12.11696             height lattice                       CALCULATED'
'array 1         2r-4.54386      0.0'
 cuboid    1  1  4p4.54386     12.1169   0.0     com='homog. content-array'
 cylinder  1  1    6.426200   12.11746  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   12.11746  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.11746  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.691 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  1  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'36.35448             stack height (content spacers)       CALCULATED
 cylinder  1  1    6.426200   40.73452   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   40.73452   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   40.73452   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  1  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  1  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  1  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
```

```
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
 array 3   2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=1 nux=3 nuy=3 nuz=4   fill 28r1004  8r1005      end fill
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcroxt11,0.0in np,disp.24000.0gUO2 (21124.9g235, 6533.9gH2O hx=  9.90),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =3669.72477, SPACER volume    0.00000'
'HEU oxide, bulk density of oxide in cans=  6.54000 g/cm3'
'wrapped dry content can hx=0.79, CV void volume 6545.63717'
'oxide= 24000.0 g, sat. moisture in HEU oxide=1477.3 g, oxide htox= 1.83'
arbmuox    6.54000   2 0 0 0  92235   88.0203
                              8016   11.9797    1  1.0000  293  end
arbmastm  4.0256e-01  2 0 0 0   1001   11.1913
                              8016   88.8087    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  9.9820e-01  2 0 0 0   1001   11.1913
                              8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                          8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                          9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                         10  0.94348 293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
```

```
                                8016   88.8087   21  1.0     293  end
end comp
cvcroxtl1,0.0in np,disp.24000.0gUO2 (21124.9g235, 6533.9gH2O,hx=  9.90),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.270 in.]'
 cylinder  3  1    6.426200   77.72400  28.92123 com='cavity abv HEU'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200   77.72400   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
```

```
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrsk3cc,0.0,21300.0g soc(19865.3uox,15672.8u235,  921.0c),hx= 12.82,fr=1.0e+00
238groupndf5 infhommedium
'  cm3: Skull oxide content 6974.5, SPACER    0.0, CV void 3240.9; CV htox=12.82'
'g/cm3: Skull oxide content  3.05400'
'U3O8   (19865.33gUOX,16816.3gU,15672.8g235U, 3801.4g.sat.H2O, HX=  7.43)'
'Carbon (  921.00gC,   58764.1mgC/g235U)'
'Poly   (  513.00gCH2)'
'Other  (    0.67gUnident (assumed H2O)'
''
'Increm (  921.0gC,15672.8g235U,   58764.1mgC/g235U)'
'GREP1:21300.00 19865.33 3.8014e+03    7.43 16816.35 15672.84   921.00  58764.1
'GREP2: 3235.07   513.00      12.82    0.67  1.0e+00
''
arbmuox    2.84830    3 0 0 0  92235   78.8954
                               92238    5.7563
                                8016   15.3483    1  1.0000  293  end
arbmc     1.3205e-01  1 0 0 0   6012  100.0000    1  1.0000  293  end
arbmastm  5.4505e-01  2 0 0 0   1001   11.1913
                                8016   88.8087    1  1.0000  293  end
arbmpoly   0.07355    2 0 0 0   1001   14.3798
                                6012   85.6202    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  9.9820e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrsk3cc,0.0,21300.0g soc(19865.3uox,15672.8u235,  921.0c),hx= 12.82 fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
```

```
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.270 in.]'
 cylinder  3  1    6.426200   77.72400  54.39413 com='cavity abv HEU'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200   77.72400   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
```

```
end start
end data
end


=csas25    parm=size=3000000
cvcrunhct11 0.0innp,disp. 9000.0gUNHc( 4238.7g235, 6980.8gH2O hx= 54.99),fr=1.0e+00
238groupndf5 infhommedium
'U(enr)O2(NO3)2+6H2O [2.81 g/cc for U(nat)], gU/L= 414.9296'
'UNH crystals in cans  2.79329 g/cm3. wrapped dry content can hx=3.96'
arbmunh    2.79329  5 0 0 0   92235   47.0962
                              92238    0.0000
                               1001    2.4232
                               7014    5.6116
                               8016   44.8690    1  0.31541 293  end
arbmh2oc  6.8336e-01  2 0 0 0  1001   11.1913
                               8016   88.8087    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  6.8336e-01  2 0 0 0   1001   11.1913
                                8016   88.8087     3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrunhct11 0.0innp,disp. 9000.0gUNHc( 4238.7g235, 6980.8gH2O,hx= 54.99),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun      all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.270 in.]'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200   77.72400   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
```

```
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
```

```
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'reflective water'
arbmh2Or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235,  8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
```

```
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3,0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrcytl1 3cyl,0.0in thk np,21000.0gU(21000.0g235, 9082.6gH2O hx= 11.29),fr=1.0e+00
238groupndf5 infhommedium
'HEU volume =1116.36286, SPACER volume    0.00000'
'HEU wrapped dry content can hx=0.80, CV void volume 9098.99908'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000               end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
```

```
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
```

```
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460  13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465  13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185  13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831  13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039  13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878  14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087  15  1       293  end
'steel: liner'
ss304                                          16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                          17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                          18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                          18  1.25705 293  end
'steel: drum steel for single units'
ss304                                          19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                          19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087  20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087  21  1.0     293  end
end comp
ncsrcytl1 3cyl,0.0in thk np,21000.0gU(21000.0g235, 9082.6gH2O,hx= 11.29),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun     all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 7.675 in.]'
```

```
 cylinder  1  1    4.114800     6.99579   0.0      com='cylindrical content'
 cylinder  3  1    6.426200    6.99629  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    6.99629  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    6.99629  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    6.99629  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    6.99629  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    6.99629  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500    6.99629  -0.0005  com='kaolite'
 cylinder  19 1   23.329900    6.99629  -0.0005  com='drum'
 cuboid    21 1 4p24.587200    6.99629  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 7.675 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'20.99097              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   56.09803   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   56.09803   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   56.09803   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   56.09803   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   56.09803   0.0     com='np277_4'
 cylinder  16 1   11.074400   56.09803   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   56.09803   0.0     com='kaolite'
 cylinder  19 1   23.329900   56.09803   0.0     com='drum'
 cuboid    21 1 4p24.587200   56.09803   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0     com='kaolite'
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 cylinder  19 1   23.329900    2.92100   0.0      com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0      com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0      com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0      com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0      com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0      com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0      com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0      com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0     com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
```

```
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciacyct11 3cyl,1.4in thk np,25000.2gU(25000.2g235, 8256.8gH2O hx=  8.62),fr=1.0e-04
238groupndf5 infhommedium
'HEU volume =1329.01404, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.67, CV void volume 8271.66778'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
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```
                                 8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                                 8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                                 8016   88.8087   21  1.0     293  end
end comp
nciacyct11 3cyl,1.4in thk np,25000.2gU(25000.2g235, 8256.8gH2O,hx=  8.62),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                      end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
```

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unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 6.832 in.]'
 cylinder  1  1    5.397500     4.84031   0.0     com='cylindrical content'
 cylinder  3  1    6.426200    4.84081  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    4.84081  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    4.84081  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    4.84081  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    4.84081  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    4.84081  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075    4.84081  -0.0005  com='kaolite'
 cylinder  19 1   21.722275    4.84081  -0.0005  com='drum'
 cuboid    20 1 4p22.866096    4.84081  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 8.232 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'21.63653              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   55.45247   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   55.45247   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   55.45247   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   55.45247   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   55.45247   0.0     com='np277_4'
 cylinder  16 1   11.074400   55.45247   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   55.45247   0.0     com='kaolite'
 cylinder  19 1   21.722275   55.45247   0.0     com='drum'
 cuboid    20 1 4p22.866096   55.45247   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
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 cylinder  12 1   21.555075    0.22860   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0      com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0      com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0      com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0      com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0      com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0      com='drum lid'
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 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0    com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
hciacyct12 3cyl,1.4in thk np,25000.2gU(25000.2g235, 8256.8gH2O hx=  8.62),fr=1.0e-04
238groupndf5 infhommedium
'HEU wrapped dry content can hx=0.67, CV void volume 8271.66778'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000               end
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0   5010   18.1479
                                5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0   6012    1.9188
                                7014    0.0141
                                8016   43.4254
                               11023    0.1174
                               12000    0.3378
                               13027   39.0477
                               14000    2.4671
                               16000    0.3083
                               20000   11.8335
                               26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0   1001   11.1913
                                8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0   1001   11.1913
                              8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                           8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                           9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                          10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0   5010   18.1479
                                5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0   6012    1.9188
                                7014    0.0141
```

```
                                  8016   43.4254
                                 11023    0.1174
                                 12000    0.3378
                                 13027   39.0477
                                 14000    2.4671
                                 16000    0.3083
                                 20000   11.8335
                                 26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                 8016   88.8087   12  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                 8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                 8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                             18  1.23239 293  end
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'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                          19  1.08401 293  end
'void space external to drum'
'array density is assumed not reduced by hac'
arbmwed    0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                              8016   88.8087   21  1.0     293  end
end comp
hciacyct12 3cyl,1.4in thk np,25000.2gU(25000.2g235, 8256.8gH2O,hx=  8.62),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                   end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   21.838092    0.26670   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p21.838092    0.26670   0.0     com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510   0.0     com='drum'
 cuboid    20 1 4p21.838092   11.59510   0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.685692    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1006
'content (collapsed) [Elev= 6.826 in.]'
 cylinder  1  1    5.397500     4.84031   0.0     com='cylindrical content'
 cylinder  3  1    6.426200    4.84081  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    4.84081  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    4.84081  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    4.84081  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    4.84081  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    4.84081  -0.0005  com='kaolite liner'
 cylinder  12 1   21.685692    4.84081  -0.0005  com='kaolite'
 cylinder  19 1   21.838092    4.84081  -0.0005  com='drum'
 cuboid    20 1 4p21.838092    4.84081  -0.0005  com='drum(chine)outer radius'
unit 1007
'np277_4 spacer [Elev= 8.226 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.685692    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.838092    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p21.838092    3.55620  -0.0001  com='drum(chine)outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'21.63653             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   55.45247   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   55.45247   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   55.45247   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   55.45247   0.0     com='np277_4 liner'
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 cylinder  11 1   10.922000   55.45247   0.0     com='np277_4'
 cylinder  16 1   11.074400   55.45247   0.0     com='kaolite liner'
 cylinder  12 1   21.685692   55.45247   0.0     com='kaolite'
 cylinder  19 1   21.838092   55.45247   0.0     com='drum'
 cuboid    20 1 4p21.838092   55.45247   0.0     com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.685692    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.22860   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.22860   0.0     com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.685692    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.838092    1.27000   0.0     com='drum'
 cuboid    20 1 4p21.838092    1.27000   0.0     com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.685692    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.838092    2.92100   0.0     com='drum'
 cuboid    20 1 4p21.838092    2.92100   0.0     com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.685692    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.838092    1.01600   0.0     com='drum'
 cuboid    20 1 4p21.838092    1.01600   0.0     com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.685692    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.838092    8.17880   0.0     com='drum'
 cuboid    20 1 4p21.838092    8.17880   0.0     com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
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 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.685692    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.838092    4.44500   0.0     com='drum'
 cuboid    20 1 4p21.838092    4.44500   0.0     com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.685692    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  20 1   21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1   21.622192    1.90500   0.0     com='drum lid'
 cylinder  20 1   21.685692    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.838092    1.90500   0.0     com='drum'
 cuboid    20 1 4p21.838092    1.90500   0.0     com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0    com='bare package'
'cuboid    21  1 4p52.318092   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncia70st11,1.4in np,25601.1gU(25601.1g235, 8224.9gH2O hx=  8.39),fr=1.0e-04
238groupndf5 infhommedium
'HEU volume =1360.95679, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.66, CV void volume 8239.72504'
uranium  1 den=18.81109 1.0 293      92235  100.00
                                     92238   0.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
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arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                          8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                          9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                         10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
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arbmna2o   0.33241  2 0 0 0   11023   74.1961
                              8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                              1001    8.1573
                              8016   21.5782
                             14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                           16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                           17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                           18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                           18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                           19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                           19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                              8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                              8016   88.8087   21  1.0     293  end
end comp
ncia70st11,1.4in np,25601.1gU(25601.1g235, 8224.9gH2O,hx=  8.39),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                    end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'1st content can (collapsed) [Elev= 6.989 in.]'
'3.437212   plus-y location cylinders'
'-3.437212  minus-y location cylinders'
'1.984375   plus-x location cylinders'
'-1.984375  minus-x location cylinders'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1020   -3.968750   0.0        0.0      com='cy1 (2cymx,0)'
 hole  1020   -1.984375   3.437212   0.0      com='cy2 (cymx,cypy)'
 hole  1020    1.984375   3.437212   0.0      com='cy3 (cypx,cypy)'
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 hole  1020    3.968750   0.0        0.0      com='cy4 (2cypx,0)'
 hole  1020    1.984375  -3.437212  0.0      com='cy5 (cypx,cymx)'
 hole  1020   -1.984375  -3.437212  0.0      com='cy6 (cymx,cymy)'
 hole  1020    0.0        0.0        0.0      com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    5.23925  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    5.23925  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    5.23925  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    5.23925  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075    5.23925  -0.0005  com='kaolite'
 cylinder  19 1   21.722275    5.23925  -0.0005  com='drum'
 cuboid    20 1 4p22.866096    5.23925  -0.0005  com='drum chine outer radius'
unit 1005
'np277_4 spacer [Elev= 8.389 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    3.55620  -0.0001  com='drum chine outer radius'
unit 1006
'2nd content can (collapsed) [Elev=10.452 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1021   -3.968750   0.0        0.0      com='cy1 (2cymx,0)'
 hole  1021   -1.984375   3.437212   0.0      com='cy2 (cymx,cypy)'
 hole  1021    1.984375   3.437212   0.0      com='cy3 (cypx,cypy)'
 hole  1021    3.968750   0.0        0.0      com='cy4 (2cypx,0)'
 hole  1021    1.984375  -3.437212   0.0      com='cy5 (cypx,cymx)'
 hole  1021   -1.984375  -3.437212   0.0      com='cy6 (cymx,cymy)'
 hole  1021    0.0        0.0        0.0      com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    5.23925  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    5.23925  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    5.23925  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    5.23925  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075    5.23925  -0.0005  com='kaolite'
 cylinder  19 1   21.722275    5.23925  -0.0005  com='drum'
 cuboid    20 1 4p22.866096    5.23925  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=11.852 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'3rd content can (collapsed) [Elev=10.452 in.]'
 cylinder  3  1    6.426200    5.23925  -0.0005  com='cv well cavity'
 hole  1022   -3.968750   0.0        0.0      com='cy1 (2cymx,0)'
 hole  1022   -1.984375   3.437212   0.0      com='cy2 (cymx,cypy)'
 hole  1022    1.984375   3.437212   0.0      com='cy3 (cypx,cypy)'
 hole  1022    3.968750   0.0        0.0      com='cy4 (2cypx,0)'
 hole  1022    1.984375  -3.437212   0.0      com='cy5 (cypx,cymx)'
 hole  1022   -1.984375  -3.437212   0.0      com='cy6 (cymx,cymy)'
 hole  1022    0.0        0.0        0.0      com='cy7 (0,0)'
 cylinder  8  1    6.680200    5.23925  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    5.23925  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    5.23925  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000    5.23925  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    5.23925  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075    5.23925  -0.0005  com='kaolite'
 cylinder  19 1   21.722275    5.23925  -0.0005  com='drum'
```

```
 cuboid    20 1 4p22.866096    5.23925  -0.0005  com='drum chine outer radius'
unit 1009
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'22.83185              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   54.25715   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   54.25715   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   54.25715   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   54.25715   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   54.25715   0.0     com='np277_4'
 cylinder  16 1   11.074400   54.25715   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   54.25715   0.0     com='kaolite'
 cylinder  19 1   21.722275   54.25715   0.0     com='drum'
 cuboid    20 1 4p22.866096   54.25715   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=13.975 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=14.065 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=14.565 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=15.715 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=16.115 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=16.175 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=19.395 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
```

```
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0     com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=21.145 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=21.395 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=22.151 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
unit 1020
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0      com='cyl'
unit 1021
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0      com='cyl'
unit 1022
'HEU cylinder content, 3.96875cm diameter by  5.23875cm height'
 cylinder  1  1    1.983875  5.23875   0.0      com='cyl'
global
unit 1023
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0    com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1025
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1023               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncia5est11,1.4in np,36665.6gU(29332.5g235, 7642.7gH2O hx=  6.80),fr=1.0e-04
238groupndf5 infhommedium
'HEU volume =1944.22398, SPACER volume  614.68012'
'HEU wrapped dry content can hx=0.57, CV void volume 7656.45784'
uranium  1 den=18.85873 1.0 293      92235  80.000
```

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                                    92238  20.000                end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1:527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
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' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  0.0287  293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067   293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012   293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307   293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131   293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru    1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed     1.16026  2 0 0 0    1001   11.1913
                                8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   21  1.0     293  end
end comp
ncia5est11,1.4in np,36665.6gU(29332.5g235, 7642.7gH2O,hx=  6.80),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                      end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
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 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'1st content can (collapsed) [Elev= 9.051 in.]'
'Reference CRC 29 Ed. pg 105'
'side of pentagon denoted spent'
'radius of inscribed circle in pentagon denoted icrpent'
'radius of circumscribed circle outside pentagon denoted ccrpent'
'ccrpent equals 0.85065 times spent'
'icrpent equals 0.68819 times spent'
'side of pentagon equals diameter of a cylinder fit into cc'
'radius of cc equals ccrpent plus radius of cylinder fit into cc'
'radius of ccrpent equal diamater of slug'
' 3.96875 radius of circumscribed circle'
' 2.33277 half of side of pentagon'
' 3.21078 radius of inscribed circle'
' 3.77452 x axis location of 2nd cyl in cc'
' 1.22642 y axis location of 2nd cyl in cc'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1020    0.0        3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1020    3.77452    1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1020    2.33277   -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1020   -2.33277   -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1020   -3.77452    1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   10.47800  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   10.47800  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   10.47800  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   10.47800  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   10.47800  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   10.47800  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   10.47800  -0.0005  com='drum chine outer radius'
unit 1005
'np277_4 spacer [Elev=10.451 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    3.55620  -0.0001  com='drum chine outer radius'
unit 1006
'2nd content can (collapsed) [Elev=14.577 in.]'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1021    0.0        3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1021    3.77452    1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1021    2.33277   -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1021   -2.33277   -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1021   -3.77452    1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   10.47800  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   10.47800  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   10.47800  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   10.47800  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   10.47800  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   10.47800  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   10.47800  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=15.977 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    3.55620  -0.0001  com='void btw cv-np liner'
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 cylinder  16 1    8.077200    3.55620  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    3.55620  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    3.55620  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    3.55620  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    3.55620  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'3rd content can (collapsed) [Elev=14.577 in.]'
 cylinder  3  1    6.426200   10.47800  -0.0005  com='cv well cavity'
 hole  1022    0.0       3.96875 0.0        com='cy1 (0,ccrpent)'
 hole  1022    3.77452   1.22642 0.0        com='cy2 (xtwo,ytwo)'
 hole  1022    2.33277  -3.21078 0.0        com='cy3 (hspent,-icrpent)'
 hole  1022   -2.33277  -3.21078 0.0        com='cy4 (-hspent,-icrpent)'
 hole  1022   -3.77452   1.22642 0.0        com='cy5 (-xtwo,ytwo)'
 cylinder  8  1    6.680200   10.47800  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   10.47800  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   10.47800  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   10.47800  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   10.47800  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   10.47800  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   10.47800  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   10.47800  -0.0005  com='drum chine outer radius'
unit 1009
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'38.54810              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.54090   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.54090   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.54090   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.54090   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.54090   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.54090   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   38.54090   0.0     com='kaolite'
 cylinder  19 1   21.722275   38.54090   0.0     com='drum'
 cuboid    20 1 4p22.866096   38.54090   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=20.162 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=20.252 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=20.752 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=21.902 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
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 cylinder  19 1   21.722275    2.92100   0.0      com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=22.302 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=22.362 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=25.582 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0      com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=27.332 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0      com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0      com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=27.582 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=28.338 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0      com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0      com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0      com='drum chine outer radius'
unit 1020
'HEU cylinder content, 3.96875cm diameter by 10.47750cm height'
 cylinder  1  1    1.983875  10.4775'  0.0       com='cyl'
unit 1021
'HEU cylinder content, 3.96875cm diameter by 10.47750cm height'
 cylinder  1  1    1.983875  10.4775   0.0       com='cyl'
unit 1022
'HEU cylinder content, 3.96875cm diameter by 10.47750cm height'
 cylinder  1  1    1.983875  10.4775   0.0       com='cyl'
global
unit 1023
'es3100 drum [Elev=43.512 in.]'
array 3          2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0     com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48    com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0     com='interstital array space'
'global
'unit 1025
'array 4   3r0.0
```

```
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1023               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciabmt11,0.0in thk np, 3708.5gU( 2966.8g235,10000.7gH2O hx= 87.98),fr=1.0e-04
238groupndf5 infhommedium
'HEU volume = 196.64477, SPACER volume    0.00000'
'HEU wrapped dry content can hx=5.65, CV void volume 10018.7171'
uranium  1 den=18.85873 0.01925 293      92235  80.000
                                       92238  20.000              end
arbmh20i  0.97898  2 0 0 0    1001   11.1913
                              8016   88.8087    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                           8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                           9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                          10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
```

```
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok    0.63931  2 0 0 0    1001   11.1913
                                8016   88.8087   12  0.0287  293  end
arbmal2o3   0.42622  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096   293  end
arbmsio2    0.42622  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367   293  end
arbmfe2o3   0.42622  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067   293  end
arbmtio2    0.42622  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012   293  end
arbmcao     0.42622  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307   293  end
arbmmgo     0.42622  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131   293  end
arbmna2o    0.42622  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  0.0287  293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067   293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012   293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307   293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131   293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru    1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed     1.16026  2 0 0 0    1001   11.1913
                                8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
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'                                 8016   88.8087   21  1.0      293  end
end comp
nciabmt11,0.0in thk np, 3708.5gU( 2966.8g235,10000.7gH2O,hx= 87.98),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                    end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'cubical content, stacked per cc'
'    9.08802     3.57796 lattice width-depth'
'    2.54000     1.00000 cube dimension'
'    1.27000     0.50000 cube half-dimension'
'   16.38706     1.00000 volume of HEU cube in unit cell'
'  309.03922             HEU mass one cube'
'    4                   number of HEU cubes per can'
' 1236.15687             HEU mass of cubes in cc'
'    3           3       number of cubes in -x direction'
'    3           3       number of cubes in -y direction'
'    9           9       number of HEU cubes in a layer'
'    1    VARIABLE       number of HEU layers in z-axis'
'    4    VARIABLE       number of HEU cubes in top layer modulus(Z%N)'
'    5    VARIABLE       number of HEU voids in top layer'
'    ara=1 nux=3 nuy=3 nuz=1   fill  4r1004  5r1005      end fill'
'    0.48924     0.19261 gap dimension                       CALCULATED
'    3.02924     1.19261 unit cell dimension                 CALCULATED
'    1.51462     0.59631 unit cell half-dimension            CALCULATED
'   27.79719     1.69629 volume of unit cell                 CALCULATED
'   11.41013     0.69629 volume of water gap in unit cell    CALCULATED
'  250.17473             lattice volume in cc                CALCULATED
'  184.62648             moderator volume in lattice in cc   CALCULATED
'   65.54826             HEU volume in lattice in cc         CALCULATED
'    0.01925             volume fraction of HEU in CV        CALCULATED
'    0.97898             bulk dens of water in CV            CALCULATED
 cuboid    1  1  6p1.51452                       com='unit cell'
unit 1005
'cubical void, filler for layers'
 cuboid    1  1  6p1.51452                       com='unit cell'
unit 1006
'content (collapsed) [Elev= 6.119 in.]'
' 4.54386     1.78892 half width-depth lattice             CALCULATED'
' 3.02924             height lattice                       CALCULATED'
'array 1         2r-4.54386      0.0'
 cuboid    1  1  4p4.54386     3.02924   0.0     com='homog. content-array'
 cylinder  1  1    6.426200    3.02974  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200    3.02974  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800    3.02974  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200    3.02974  -0.0005  com='np277_4 liner'
```

```
 cylinder  11 1   10.922000    3.02974  -0.0005  com='np277_4'
 cylinder  16 1   11.074400    3.02974  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075    3.02974  -0.0005  com='kaolite'
 cylinder  19 1   21.722275    3.02974  -0.0005  com='drum'
 cuboid    20 1 4p22.866096    3.02974  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 6.119 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  1  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
' 9.09132              stack height (content spacers)       CALCULATED
 cylinder  1  1    6.426200   67.99768   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   67.99768   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   67.99768   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   67.99768   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   67.99768   0.0     com='np277_4'
 cylinder  16 1   11.074400   67.99768   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   67.99768   0.0     com='kaolite'
 cylinder  19 1   21.722275   67.99768   0.0     com='drum'
 cuboid    20 1 4p22.866096   67.99768   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  1  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  1  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  1  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
```

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 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0      com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0      com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0      com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0      com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0      com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0     com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48    com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=1 nux=3 nuy=3 nuz=1   fill  4r1004  5r1005      end fill
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019       end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
```

```
end start
end data
end


=csas25    parm=size=4000000
hctf5bmt12,1.4in thk np,24968.9gU(24968.9g235, 8258.4gH2O hx=  8.63),fr=1.0e-04
238groupndf5 infhommedium
'HEU wrapped dry content can hx=0.67, CV void volume 8273.32964'
uranium  1 den=18.81109 0.13826 293      92235  100.00
                                       92238   0.000              end
arbmh20i   0.86019  2 0 0 0    1001   11.1913
                               8016   88.8087    1  1.0000  293  end
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                          8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                          9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                         10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
```

```
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516 for HAC'
ss304                                            18  1.23239 293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645 for HAC'
ss304                                            19  1.08401 293  end
'void space external to drum'
arbmwed    0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   20  0.0001  293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
more data dab=400 end
hctf5bmt12,1.4in thk np,24968.9gU(24968.9g235, 8258.4gH2O,hx=  8.63),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 nb8=400 end parameters
read boun       all=specular                     end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'zhemicyl-y  19 1   21.838092    0.26620   0.00050 com='extend radius not used'
 zhemicyl-y  19 1   21.838092    0.26620   0.00050 com='drum bottom flat cover'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
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 zhemicyl-y  15 1    3.175000   11.59460  11.16330 com='void in pad-1'
 zhemicyl-y  14 1    7.924800   11.59460  11.16330 com='pad-1'
 zhemicyl-y  16 1    8.077200   11.59460  11.16330 com='np277_4 liner'
 zhemicyl-y  11 1   10.922000   11.59460  11.16330 com='np277_4'
 zhemicyl-y  16 1   11.074400   11.59460  10.85850 com='kaolite liner bottom'
 zhemicyl-y  12 1   21.685692   11.59460   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092   11.59460   0.00050 com='drum'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 zhemicyl-y  8  1    6.680200    0.63450   0.00050 com='cv bottom'
 zhemicyl-y  15 1    7.924800    0.63450   0.00050 com='void btw cv-np liner'
 zhemicyl-y  16 1    8.077200    0.63450   0.00050 com='np277_4 liner'
 zhemicyl-y  11 1   10.922000    0.63450   0.00050 com='np277_4'
 zhemicyl-y  16 1   11.074400    0.63450   0.00050 com='kaolite liner'
 zhemicyl-y  12 1   21.685692    0.63450   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    0.63450   0.00050 com='drum'
unit 1004
'cubical content, stacked per cc'
'    9.08802     3.57796 lattice width-depth'
'    2.54000     1.00000 cube dimension'
'    1.27000     0.50000 cube half-dimension'
'   16.38706     1.00000 volume of HEU cube in unit cell'
'  308.25850             HEU mass one cube'
'   27                   number of HEU cubes per can'
' 8322.97957             HEU mass of cubes in cc'
'    3           3       number of cubes in -x direction'
'    3           3       number of cubes in -y direction'
'    9           9       number of HEU cubes in a layer'
'    4    VARIABLE       number of HEU layers in z-axis'
'    0    VARIABLE       number of HEU cubes in top layer modulus(Z%N)'
'    9    VARIABLE       number of HEU voids in top layer'
'    ara=1 nux=3 nuy=3 nuz=4   fill 27r1004  9r1005      end fill'
'    0.48924     0.19261 gap dimension                       CALCULATED
'    3.02924     1.19261 unit cell dimension                 CALCULATED
'    1.51462     0.59631 unit cell half-dimension            CALCULATED
'   27.79719     1.69629 volume of unit cell                 CALCULATED
'   11.41013     0.69629 volume of water gap in unit cell    CALCULATED
' 1000.69893             lattice volume in cc                CALCULATED
'  558.24820             moderator volume in lattice in cc   CALCULATED
'  442.45073             HEU volume in lattice in cc         CALCULATED
'    0.13826             volume fraction of HEU in CV        CALCULATED
'    0.86019             bulk dens of water in CV            CALCULATED
 cuboid    1  1  6p1.51452                      com='unit cell'
unit 1005
'cubical void, filler for layers'
 cuboid    1  1  6p1.51452                      com='unit cell'
unit 1006
'content (collapsed) [Elev= 9.691 in.]'
' 4.54386     1.78892 half width-depth lattice            CALCULATED'
'12.11696             height lattice                      CALCULATED'
'array 1         2r-4.54386      0.0'
 cuboid  1  1  2p4.54386 0.0 -4.54386 12.1169 0.0005 com='homog. content-array'
 zhemicyl-y  1  1    6.426200   12.11696   0.00050 com='cv well cavity'
 zhemicyl-y  8  1    6.680200   12.11696   0.00050 com='cv below 1st step'
 zhemicyl-y  15 1    7.924800   12.11696   0.00050 com='void btw cv-np liner'
 zhemicyl-y  16 1    8.077200   12.11696   0.00050 com='np277_4 liner'
 zhemicyl-y  11 1   10.922000   12.11696   0.00050 com='np277_4'
 zhemicyl-y  16 1   11.074400   12.11696   0.00050 com='kaolite liner'
 zhemicyl-y  12 1   21.685692   12.11696   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092   12.11696   0.00050 com='drum'
unit 1007
'np277_4 spacer [Elev=11.091 in.]'
 zhemicyl-y  2  1    5.24510     3.55660   0.00050 com='np spacer'
 zhemicyl-y  1  1    6.426200    3.55660   0.00050 com='cv well cavity'
 zhemicyl-y  8  1    6.680200    3.55660   0.00050 com='cv below 1st step'
 zhemicyl-y  15 1    7.924800    3.55660   0.00050 com='void btw cv-np liner'
 zhemicyl-y  16 1    8.077200    3.55660   0.00050 com='np277_4 liner'
 zhemicyl-y  11 1   10.922000    3.55660   0.00050 com='np277_4'
 zhemicyl-y  16 1   11.074400    3.55660   0.00050 com='kaolite liner'
 zhemicyl-y  12 1   21.685692    3.55660   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    3.55660   0.00050 com='drum'
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unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'43.46828              stack height (content spacers)       CALCULATED
 zhemicyl-y  1  1    6.426200   33.62022   0.00050 com='cv well cavity'
 zhemicyl-y  8  1    6.680200   33.62022   0.00050 com='cv below 1st step'
 zhemicyl-y  15 1    7.924800   33.62022   0.00050 com='void btw cv-np liner'
 zhemicyl-y  16 1    8.077200   33.62022   0.00050 com='np277_4 liner'
 zhemicyl-y  11 1   10.922000   33.62022   0.00050 com='np277_4'
 zhemicyl-y  16 1   11.074400   33.62022   0.00050 com='kaolite liner'
 zhemicyl-y  12 1   21.685692   33.62022   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092   33.62022   0.00050 com='drum'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 zhemicyl-y  1  1    6.426200    0.15190   0.00050 com='cv well cavity'
 zhemicyl-y  8  1    6.680200    0.15190   0.00050 com='cv at 1st step'
 zhemicyl-y  15 1    7.924800    0.15190   0.00050 com='void btw cv and liner'
 zhemicyl-y  16 1   11.074400    0.15190   0.00050 com='liner 1st step'
 zhemicyl-y  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    0.15190   0.00050 com='drum'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 zhemicyl-y  1  1    6.426200    0.22810   0.00050 com='cv well cavity'
 zhemicyl-y  8  1    6.680200    0.22810   0.00050 com='cv gap btw step-flng'
 zhemicyl-y  15 1   10.922000    0.22810   0.00050 com='void btw cv and liner'
 zhemicyl-y  16 1   11.074400    0.22810   0.00050 com='liner wall'
 zhemicyl-y  12 1   21.685692    0.22810   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    0.22810   0.00050 com='drum'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 zhemicyl-y  1  1    6.426200    1.26950   0.00050 com='cavity'
 zhemicyl-y  9  1    9.525000    1.26950   0.00050 com='flange to top of well'
 zhemicyl-y  15 1    9.525000    1.26950   0.00050 com='void btw cv and pad-2'
 zhemicyl-y  14 1   10.033000    1.26950   0.00050 com='pad-2'
 zhemicyl-y  15 1   10.922000    1.26950   0.00050 com='void btw cv and liner'
 zhemicyl-y  16 1   11.074400    1.26950   0.00050 com='liner wall'
 zhemicyl-y  12 1   21.685692    1.26950   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    1.26950   0.00050 com='drum'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 zhemicyl-y  10 1    9.525000    2.92050   0.00050 com='flange above cv well'
 zhemicyl-y  15 1    9.525000    2.92050   0.00050 com='void btw cv and pad-2'
 zhemicyl-y  14 1   10.033000    2.92050   0.00050 com='pad-2'
 zhemicyl-y  15 1   10.922000    2.92050   0.00050 com='void btw pad2-liner'
 zhemicyl-y  16 1   11.074400    2.92050   0.00050 com='liner wall'
 zhemicyl-y  12 1   21.685692    2.92050   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    2.92050   0.00050 com='drum'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 zhemicyl-y  14 1   10.033000    0.76150   0.00050 com='pad-2'
 zhemicyl-y  15 1   10.922000    1.01550   0.00050 com='void btw pad2-liner'
 zhemicyl-y  16 1   11.074400    1.01550   0.00050 com='liner wall'
 zhemicyl-y  12 1   21.685692    1.01550   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    1.01550   0.00050 com='drum'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 zhemicyl-y  15 1   10.922000    0.15190   0.00050 com='void abv pad2'
 zhemicyl-y  16 1   18.757900    0.15190   0.00050 com='liner 2nd step'
 zhemicyl-y  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    0.15190   0.00050 com='drum'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 zhemicyl-y  13 1   18.097500    8.17830   0.49276 com='plug kaolite'
 zhemicyl-y  17 1   18.249900    8.17830   0.34036 com='sides of plug case'
 zhemicyl-y  15 1   18.605500    8.17830   0.00050 com='void: plug to liner'
 zhemicyl-y  16 1   18.757900    8.17830   0.00050 com='liner wall'
 zhemicyl-y  12 1   21.685692    8.17830   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    8.17830   0.00050 com='drum'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 zhemicyl-y  13 1   18.097500    4.44450   0.00050 com='plug kaolite'
 zhemicyl-y  17 1   18.249900    4.44450   0.00050 com='sides of plug case'
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 zhemicyl-y  15 1   18.605500    4.44450   0.00050 com='void: plug to liner'
 zhemicyl-y  16 1   18.757900    4.44450   0.00050 com='liner wall'
 zhemicyl-y  18 1   19.392900    4.44450   0.00050 com='lower angle iron'
 zhemicyl-y  12 1   21.685692    4.44450   0.00050 com='kaolite'
 zhemicyl-y  19 1   21.838092    4.44450   0.00050 com='drum'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 zhemicyl-y  13 1   18.097500    0.11126   0.00050 com='plug kaolite'
 zhemicyl-y  17 1   18.249900    0.26366   0.00050 com='sides of plug case'
 zhemicyl-y  15 1   18.605500    0.63450   0.00050 com='void: plug to liner'
 zhemicyl-y  16 1   18.757900    0.63450   0.00050 com='liner wall'
 zhemicyl-y  18 1   21.685692    0.63450   0.00050 com='bend section of ai'
 zhemicyl-y  19 1   21.838092    0.63450   0.00050 com='drum'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 zhemicyl-y  20 1   21.469792    1.90450   0.15240 com='void above lid'
 zhemicyl-y  19 1   21.622192    1.90450   0.00050 com='drum lid'
 zhemicyl-y  20 1   21.685692    1.90450   0.00050 com='void btw lid-drumwall'
 zhemicyl-y  19 1   21.838092    1.90450   0.00050 com='drum'
unit 2001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'zhemicyl+y  19 1   21.838092    0.26620   0.00050 com='extended radius not used'
 zhemicyl+y  19 1   21.838092    0.26620   0.00050 com='drum bottom flat cover'
unit 2002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 zhemicyl+y  15 1    3.175000   11.59460  11.16330 com='void in pad-1'
 zhemicyl+y  14 1    7.924800   11.59460  11.16330 com='pad-1'
 zhemicyl+y  16 1    8.077200   11.59460  11.16330 com='np277_4 liner'
 zhemicyl+y  11 1   10.922000   11.59460  11.16330 com='np277_4'
 zhemicyl+y  16 1   11.074400   11.59460  10.85850 com='kaolite liner bottom'
 zhemicyl+y  12 1   21.685692   11.59460   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092   11.59460   0.00050 com='drum'
unit 2003
'cv bottom [Elev= 4.920 in.]'
 zhemicyl+y  8  1    6.680200    0.63450   0.00050 com='cv bottom'
 zhemicyl+y  15 1    7.924800    0.63450   0.00050 com='void btw cv-np liner'
 zhemicyl+y  16 1    8.077200    0.63450   0.00050 com='np277_4 liner'
 zhemicyl+y  11 1   10.922000    0.63450   0.00050 com='np277_4'
 zhemicyl+y  16 1   11.074400    0.63450   0.00050 com='kaolite liner'
 zhemicyl+y  12 1   21.685692    0.63450   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    0.63450   0.00050 com='drum'
unit 2006
'content (collapsed) [Elev= 9.691 in.]'
 zhemicyl+y  1  1    6.426200   12.11696   0.00050 com='cv well cavity'
 zhemicyl+y  8  1    6.680200   12.11696   0.00050 com='cv below 1st step'
 zhemicyl+y  15 1    7.924800   12.11696   0.00050 com='void btw cv-np liner'
 zhemicyl+y  16 1    8.077200   12.11696   0.00050 com='np277_4 liner'
 zhemicyl+y  11 1   10.922000   12.11696   0.00050 com='np277_4'
 zhemicyl+y  16 1   11.074400   12.11696   0.00050 com='kaolite liner'
 zhemicyl+y  12 1   21.685692   12.11696   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092   12.11696   0.00050 com='drum'
unit 2007
'np277_4 spacer [Elev=11.091 in.]'
 zhemicyl+y  2  1    5.24510     3.55660   0.00050 com='np spacer'
 zhemicyl+y  1  1    6.426200    3.55660   0.00050 com='cv well cavity'
 zhemicyl+y  8  1    6.680200    3.55660   0.00050 com='cv below 1st step'
 zhemicyl+y  15 1    7.924800    3.55660   0.00050 com='void btw cv-np liner'
 zhemicyl+y  16 1    8.077200    3.55660   0.00050 com='np277_4 liner'
 zhemicyl+y  11 1   10.922000    3.55660   0.00050 com='np277_4'
 zhemicyl+y  16 1   11.074400    3.55660   0.00050 com='kaolite liner'
 zhemicyl+y  12 1   21.685692    3.55660   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    3.55660   0.00050 com='drum'
unit 2008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
 zhemicyl+y  1  1    6.426200   33.62022   0.00050 com='cv well cavity'
 zhemicyl+y  8  1    6.680200   33.62022   0.00050 com='cv below 1st step'
 zhemicyl+y  15 1    7.924800   33.62022   0.00050 com='void btw cv-np liner'
 zhemicyl+y  16 1    8.077200   33.62022   0.00050 com='np277_4 liner'
 zhemicyl+y  11 1   10.922000   33.62022   0.00050 com='np277_4'
 zhemicyl+y  16 1   11.074400   33.62022   0.00050 com='kaolite liner'
 zhemicyl+y  12 1   21.685692   33.62022   0.00050 com='kaolite'
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 zhemicyl+y  19 1   21.838092   33.62022   0.00050 com='drum'
unit 2010
'cv at 1st step in liner [Elev=35.330 in.]'
 zhemicyl+y  1  1    6.426200    0.15190   0.00050 com='cv well cavity'
 zhemicyl+y  8  1    6.680200    0.15190   0.00050 com='cv at 1st step'
 zhemicyl+y  15 1    7.924800    0.15190   0.00050 com='void btw cv and liner'
 zhemicyl+y  16 1   11.074400    0.15190   0.00050 com='liner 1st step'
 zhemicyl+y  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    0.15190   0.00050 com='drum'
unit 2011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 zhemicyl+y  1  1    6.426200    0.22810   0.00050 com='cv well cavity'
 zhemicyl+y  8  1    6.680200    0.22810   0.00050 com='cv gap btw step-flng'
 zhemicyl+y  15 1   10.922000    0.22810   0.00050 com='void btw cv and liner'
 zhemicyl+y  16 1   11.074400    0.22810   0.00050 com='liner wall'
 zhemicyl+y  12 1   21.685692    0.22810   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    0.22810   0.00050 com='drum'
unit 2012
'cv flange to top of cv well [Elev=35.920 in.]'
 zhemicyl+y  1  1    6.426200    1.26950   0.00050 com='cavity'
 zhemicyl+y  9  1    9.525000    1.26950   0.00050 com='flange to top of well'
 zhemicyl+y  15 1    9.525000    1.26950   0.00050 com='void btw cv and pad-2'
 zhemicyl+y  14 1   10.033000    1.26950   0.00050 com='pad-2'
 zhemicyl+y  15 1   10.922000    1.26950   0.00050 com='void btw cv and liner'
 zhemicyl+y  16 1   11.074400    1.26950   0.00050 com='liner wall'
 zhemicyl+y  12 1   21.685692    1.26950   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    1.26950   0.00050 com='drum'
unit 2013
'cv flange above cv well [Elev=37.070 in.]'
 zhemicyl+y  10 1    9.525000    2.92050   0.00050 com='flange above cv well'
 zhemicyl+y  15 1    9.525000    2.92050   0.00050 com='void btw cv and pad-2'
 zhemicyl+y  14 1   10.033000    2.92050   0.00050 com='pad-2'
 zhemicyl+y  15 1   10.922000    2.92050   0.00050 com='void btw pad2-liner'
 zhemicyl+y  16 1   11.074400    2.92050   0.00050 com='liner wall'
 zhemicyl+y  12 1   21.685692    2.92050   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    2.92050   0.00050 com='drum'
unit 2014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 zhemicyl+y  14 1   10.033000    0.76150   0.00050 com='pad-2'
 zhemicyl+y  15 1   10.922000    1.01550   0.00050 com='void btw pad2-liner'
 zhemicyl+y  16 1   11.074400    1.01550   0.00050 com='liner wall'
 zhemicyl+y  12 1   21.685692    1.01550   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    1.01550   0.00050 com='drum'
unit 2015
'2nd step in liner [Elev=37.530 in.]'
 zhemicyl+y  15 1   10.922000    0.15190   0.00050 com='void abv pad2'
 zhemicyl+y  16 1   18.757900    0.15190   0.00050 com='liner 2nd step'
 zhemicyl+y  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    0.15190   0.00050 com='drum'
unit 2016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 zhemicyl+y  13 1   18.097500    8.17830   0.49276 com='plug kaolite'
 zhemicyl+y  17 1   18.249900    8.17830   0.34036 com='sides of plug case'
 zhemicyl+y  15 1   18.605500    8.17830   0.00050 com='void: plug to liner'
 zhemicyl+y  16 1   18.757900    8.17830   0.00050 com='liner wall'
 zhemicyl+y  12 1   21.685692    8.17830   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    8.17830   0.00050 com='drum'
unit 2017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 zhemicyl+y  13 1   18.097500    4.44450   0.00050 com='plug kaolite'
 zhemicyl+y  17 1   18.249900    4.44450   0.00050 com='sides of plug case'
 zhemicyl+y  15 1   18.605500    4.44450   0.00050 com='void: plug to liner'
 zhemicyl+y  16 1   18.757900    4.44450   0.00050 com='liner wall'
 zhemicyl+y  18 1   19.392900    4.44450   0.00050 com='lower angle iron'
 zhemicyl+y  12 1   21.685692    4.44450   0.00050 com='kaolite'
 zhemicyl+y  19 1   21.838092    4.44450   0.00050 com='drum'
unit 2018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 zhemicyl+y  13 1   18.097500    0.11126   0.00050 com='plug kaolite'
 zhemicyl+y  17 1   18.249900    0.26366   0.00050 com='sides of plug case'
 zhemicyl+y  15 1   18.605500    0.63450   0.00050 com='void: plug to liner'
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 zhemicyl+y  16 1   18.757900    0.63450   0.00050 com='liner wall'
 zhemicyl+y  18 1   21.685692    0.63450   0.00050 com='bend section of ai'
 zhemicyl+y  19 1   21.838092    0.63450   0.00050 com='drum'
unit 2019
'drum lid and lip [Elev=43.500 in.]'
 zhemicyl+y  20 1   21.469792    1.90450   0.15240 com='void above lid'
 zhemicyl+y  19 1   21.622192    1.90450   0.00050 com='drum lid'
 zhemicyl+y  20 1   21.685692    1.90450   0.00050 com='void btw lid-drumwall'
 zhemicyl+y  19 1   21.838092    1.90450   0.00050 com='drum'
unit 3001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'zhemicyl-x  19 1   21.838092    0.26620   0.00050 com='extended radius not used'
 zhemicyl-x  19 1   21.838092    0.26620   0.00050 com='drum bottom flat cover'
unit 3002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 zhemicyl-x  15 1    3.175000   11.59460  11.16330 com='void in pad-1'
 zhemicyl-x  14 1    7.924800   11.59460  11.16330 com='pad-1'
 zhemicyl-x  16 1    8.077200   11.59460  11.16330 com='np277_4 liner'
 zhemicyl-x  11 1   10.922000   11.59460  11.16330 com='np277_4'
 zhemicyl-x  16 1   11.074400   11.59460  10.85850 com='kaolite liner bottom'
 zhemicyl-x  12 1   21.685692   11.59460   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092   11.59460   0.00050 com='drum'
unit 3003
'cv bottom [Elev= 4.920 in.]'
 zhemicyl-x  8  1    6.680200    0.63450   0.00050 com='cv bottom'
 zhemicyl-x  15 1    7.924800    0.63450   0.00050 com='void btw cv-np liner'
 zhemicyl-x  16 1    8.077200    0.63450   0.00050 com='np277_4 liner'
 zhemicyl-x  11 1   10.922000    0.63450   0.00050 com='np277_4'
 zhemicyl-x  16 1   11.074400    0.63450   0.00050 com='kaolite liner'
 zhemicyl-x  12 1   21.685692    0.63450   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    0.63450   0.00050 com='drum'
unit 3006
'content (collapsed) [Elev= 9.691 in.]'
 zhemicyl-x  1  1    6.426200   12.11696   0.00050 com='cv well cavity'
 zhemicyl-x  8  1    6.680200   12.11696   0.00050 com='cv below 1st step'
 zhemicyl-x  15 1    7.924800   12.11696   0.00050 com='void btw cv-np liner'
 zhemicyl-x  16 1    8.077200   12.11696   0.00050 com='np277_4 liner'
 zhemicyl-x  11 1   10.922000   12.11696   0.00050 com='np277_4'
 zhemicyl-x  16 1   11.074400   12.11696   0.00050 com='kaolite liner'
 zhemicyl-x  12 1   21.685692   12.11696   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092   12.11696   0.00050 com='drum'
unit 3007
'np277_4 spacer [Elev=11.091 in.]'
 zhemicyl-x  2  1    5.24510     3.55660   0.00050 com='np spacer'
 zhemicyl-x  1  1    6.426200    3.55660   0.00050 com='cv well cavity'
 zhemicyl-x  8  1    6.680200    3.55660   0.00050 com='cv below 1st step'
 zhemicyl-x  15 1    7.924800    3.55660   0.00050 com='void btw cv-np liner'
 zhemicyl-x  16 1    8.077200    3.55660   0.00050 com='np277_4 liner'
 zhemicyl-x  11 1   10.922000    3.55660   0.00050 com='np277_4'
 zhemicyl-x  16 1   11.074400    3.55660   0.00050 com='kaolite liner'
 zhemicyl-x  12 1   21.685692    3.55660   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    3.55660   0.00050 com='drum'
unit 3008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
 zhemicyl-x  1  1    6.426200   33.62022   0.00050 com='cv well cavity'
 zhemicyl-x  8  1    6.680200   33.62022   0.00050 com='cv below 1st step'
 zhemicyl-x  15 1    7.924800   33.62022   0.00050 com='void btw cv-np liner'
 zhemicyl-x  16 1    8.077200   33.62022   0.00050 com='np277_4 liner'
 zhemicyl-x  11 1   10.922000   33.62022   0.00050 com='np277_4'
 zhemicyl-x  16 1   11.074400   33.62022   0.00050 com='kaolite liner'
 zhemicyl-x  12 1   21.685692   33.62022   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092   33.62022   0.00050 com='drum'
unit 3010
'cv at 1st step in liner [Elev=35.330 in.]'
 zhemicyl-x  1  1    6.426200    0.15190   0.00050 com='cv well cavity'
 zhemicyl-x  8  1    6.680200    0.15190   0.00050 com='cv at 1st step'
 zhemicyl-x  15 1    7.924800    0.15190   0.00050 com='void btw cv and liner'
 zhemicyl-x  16 1   11.074400    0.15190   0.00050 com='liner 1st step'
 zhemicyl-x  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    0.15190   0.00050 com='drum'
unit 3011
```

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'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 zhemicyl-x  1  1    6.426200    0.22810   0.00050 com='cv well cavity'
 zhemicyl-x  8  1    6.680200    0.22810   0.00050 com='cv gap btw step-flng'
 zhemicyl-x  15 1   10.922000    0.22810   0.00050 com='void btw cv and liner'
 zhemicyl-x  16 1   11.074400    0.22810   0.00050 com='liner wall'
 zhemicyl-x  12 1   21.685692    0.22810   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    0.22810   0.00050 com='drum'
unit 3012
'cv flange to top of cv well [Elev=35.920 in.]'
 zhemicyl-x  1  1    6.426200    1.26950   0.00050 com='cavity'
 zhemicyl-x  9  1    9.525000    1.26950   0.00050 com='flange to top of well'
 zhemicyl-x  15 1    9.525000    1.26950   0.00050 com='void btw cv and pad-2'
 zhemicyl-x  14 1   10.033000    1.26950   0.00050 com='pad-2'
 zhemicyl-x  15 1   10.922000    1.26950   0.00050 com='void btw cv and liner'
 zhemicyl-x  16 1   11.074400    1.26950   0.00050 com='liner wall'
 zhemicyl-x  12 1   21.685692    1.26950   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    1.26950   0.00050 com='drum'
unit 3013
'cv flange above cv well [Elev=37.070 in.]'
 zhemicyl-x  10 1    9.525000    2.92050   0.00050 com='flange above cv well'
 zhemicyl-x  15 1    9.525000    2.92050   0.00050 com='void btw cv and pad-2'
 zhemicyl-x  14 1   10.033000    2.92050   0.00050 com='pad-2'
 zhemicyl-x  15 1   10.922000    2.92050   0.00050 com='void btw pad2-liner'
 zhemicyl-x  16 1   11.074400    2.92050   0.00050 com='liner wall'
 zhemicyl-x  12 1   21.685692    2.92050   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    2.92050   0.00050 com='drum'
unit 3014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 zhemicyl-x  14 1   10.033000    0.76150   0.00050 com='pad-2'
 zhemicyl-x  15 1   10.922000    1.01550   0.00050 com='void btw pad2-liner'
 zhemicyl-x  16 1   11.074400    1.01550   0.00050 com='liner wall'
 zhemicyl-x  12 1   21.685692    1.01550   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    1.01550   0.00050 com='drum'
unit 3015
'2nd step in liner [Elev=37.530 in.]'
 zhemicyl-x  15 1   10.922000    0.15190   0.00050 com='void abv pad2'
 zhemicyl-x  16 1   18.757900    0.15190   0.00050 com='liner 2nd step'
 zhemicyl-x  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    0.15190   0.00050 com='drum'
unit 3016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 zhemicyl-x  13 1   18.097500    8.17830   0.49276 com='plug kaolite'
 zhemicyl-x  17 1   18.249900    8.17830   0.34036 com='sides of plug case'
 zhemicyl-x  15 1   18.605500    8.17830   0.00050 com='void: plug to liner'
 zhemicyl-x  16 1   18.757900    8.17830   0.00050 com='liner wall'
 zhemicyl-x  12 1   21.685692    8.17830   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    8.17830   0.00050 com='drum'
unit 3017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 zhemicyl-x  13 1   18.097500    4.44450   0.00050 com='plug kaolite'
 zhemicyl-x  17 1   18.249900    4.44450   0.00050 com='sides of plug case'
 zhemicyl-x  15 1   18.605500    4.44450   0.00050 com='void: plug to liner'
 zhemicyl-x  16 1   18.757900    4.44450   0.00050 com='liner wall'
 zhemicyl-x  18 1   19.392900    4.44450   0.00050 com='lower angle iron'
 zhemicyl-x  12 1   21.685692    4.44450   0.00050 com='kaolite'
 zhemicyl-x  19 1   21.838092    4.44450   0.00050 com='drum'
unit 3018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 zhemicyl-x  13 1   18.097500    0.11126   0.00050 com='plug kaolite'
 zhemicyl-x  17 1   18.249900    0.26366   0.00050 com='sides of plug case'
 zhemicyl-x  15 1   18.605500    0.63450   0.00050 com='void: plug to liner'
 zhemicyl-x  16 1   18.757900    0.63450   0.00050 com='liner wall'
 zhemicyl-x  18 1   21.685692    0.63450   0.00050 com='bend section of ai'
 zhemicyl-x  19 1   21.838092    0.63450   0.00050 com='drum'
unit 3019
'drum lid and lip [Elev=43.500 in.]'
 zhemicyl-x  20 1   21.469792    1.90450   0.15240 com='void above lid'
 zhemicyl-x  19 1   21.622192    1.90450   0.00050 com='drum lid'
 zhemicyl-x  20 1   21.685692    1.90450   0.00050 com='void btw lid-drumwall'
 zhemicyl-x  19 1   21.838092    1.90450   0.00050 com='drum'
unit 4001
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'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'zhemicyl+x  19 1   21.838092    0.26620   0.00050 com='extended radius not used'
 zhemicyl+x  19 1   21.838092    0.26620   0.00050 com='drum bottom flat cover'
unit 4002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 zhemicyl+x  15 1    3.175000   11.59460  11.16330 com='void in pad-1'
 zhemicyl+x  14 1    7.924800   11.59460  11.16330 com='pad-1'
 zhemicyl+x  16 1    8.077200   11.59460  11.16330 com='np277_4 liner'
 zhemicyl+x  11 1   10.922000   11.59460  11.16330 com='np277_4'
 zhemicyl+x  16 1   11.074400   11.59460  10.85850 com='kaolite liner bottom'
 zhemicyl+x  12 1   21.685692   11.59460   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092   11.59460   0.00050 com='drum'
unit 4003
'cv bottom [Elev= 4.920 in.]'
 zhemicyl+x  8  1    6.680200    0.63450   0.00050 com='cv bottom'
 zhemicyl+x  15 1    7.924800    0.63450   0.00050 com='void btw cv-np liner'
 zhemicyl+x  16 1    8.077200    0.63450   0.00050 com='np277_4 liner'
 zhemicyl+x  11 1   10.922000    0.63450   0.00050 com='np277_4'
 zhemicyl+x  16 1   11.074400    0.63450   0.00050 com='kaolite liner'
 zhemicyl+x  12 1   21.685692    0.63450   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    0.63450   0.00050 com='drum'
unit 4006
'content (collapsed) [Elev= 9.691 in.]'
 zhemicyl+x  1  1    6.426200   12.11696   0.00050 com='cv well cavity'
 zhemicyl+x  8  1    6.680200   12.11696   0.00050 com='cv below 1st step'
 zhemicyl+x  15 1    7.924800   12.11696   0.00050 com='void btw cv-np liner'
 zhemicyl+x  16 1    8.077200   12.11696   0.00050 com='np277_4 liner'
 zhemicyl+x  11 1   10.922000   12.11696   0.00050 com='np277_4'
 zhemicyl+x  16 1   11.074400   12.11696   0.00050 com='kaolite liner'
 zhemicyl+x  12 1   21.685692   12.11696   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092   12.11696   0.00050 com='drum'
unit 4007
'np277_4 spacer [Elev=11.091 in.]'
 zhemicyl+x  2  1    5.24510     3.55660   0.00050 com='np spacer'
 zhemicyl+x  1  1    6.426200    3.55660   0.00050 com='cv well cavity'
 zhemicyl+x  8  1    6.680200    3.55660   0.00050 com='cv below 1st step'
 zhemicyl+x  15 1    7.924800    3.55660   0.00050 com='void btw cv-np liner'
 zhemicyl+x  16 1    8.077200    3.55660   0.00050 com='np277_4 liner'
 zhemicyl+x  11 1   10.922000    3.55660   0.00050 com='np277_4'
 zhemicyl+x  16 1   11.074400    3.55660   0.00050 com='kaolite liner'
 zhemicyl+x  12 1   21.685692    3.55660   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    3.55660   0.00050 com='drum'
unit 4008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
 zhemicyl+x  1  1    6.426200   33.62022   0.00050 com='cv well cavity'
 zhemicyl+x  8  1    6.680200   33.62022   0.00050 com='cv below 1st step'
 zhemicyl+x  15 1    7.924800   33.62022   0.00050 com='void btw cv-np liner'
 zhemicyl+x  16 1    8.077200   33.62022   0.00050 com='np277_4 liner'
 zhemicyl+x  11 1   10.922000   33.62022   0.00050 com='np277_4'
 zhemicyl+x  16 1   11.074400   33.62022   0.00050 com='kaolite liner'
 zhemicyl+x  12 1   21.685692   33.62022   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092   33.62022   0.00050 com='drum'
unit 4010
'cv at 1st step in liner [Elev=35.330 in.]'
 zhemicyl+x  1  1    6.426200    0.15190   0.00050 com='cv well cavity'
 zhemicyl+x  8  1    6.680200    0.15190   0.00050 com='cv at 1st step'
 zhemicyl+x  15 1    7.924800    0.15190   0.00050 com='void btw cv and liner'
 zhemicyl+x  16 1   11.074400    0.15190   0.00050 com='liner 1st step'
 zhemicyl+x  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    0.15190   0.00050 com='drum'
unit 4011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 zhemicyl+x  1  1    6.426200    0.22810   0.00050 com='cv well cavity'
 zhemicyl+x  8  1    6.680200    0.22810   0.00050 com='cv gap btw step-flng'
 zhemicyl+x  15 1   10.922000    0.22810   0.00050 com='void btw cv and liner'
 zhemicyl+x  16 1   11.074400    0.22810   0.00050 com='liner wall'
 zhemicyl+x  12 1   21.685692    0.22810   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    0.22810   0.00050 com='drum'
unit 4012
'cv flange to top of cv well [Elev=35.920 in.]'
 zhemicyl+x  1  1    6.426200    1.26950   0.00050 com='cavity'
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 zhemicyl+x  9  1    9.525000    1.26950   0.00050 com='flange to top of well'
 zhemicyl+x  15 1    9.525000    1.26950   0.00050 com='void btw cv and pad-2'
 zhemicyl+x  14 1   10.033000    1.26950   0.00050 com='pad-2'
 zhemicyl+x  15 1   10.922000    1.26950   0.00050 com='void btw cv and liner'
 zhemicyl+x  16 1   11.074400    1.26950   0.00050 com='liner wall'
 zhemicyl+x  12 1   21.685692    1.26950   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    1.26950   0.00050 com='drum'
unit 4013
'cv flange above cv well [Elev=37.070 in.]'
 zhemicyl+x  10 1    9.525000    2.92050   0.00050 com='flange above cv well'
 zhemicyl+x  15 1    9.525000    2.92050   0.00050 com='void btw cv and pad-2'
 zhemicyl+x  14 1   10.033000    2.92050   0.00050 com='pad-2'
 zhemicyl+x  15 1   10.922000    2.92050   0.00050 com='void btw pad2-liner'
 zhemicyl+x  16 1   11.074400    2.92050   0.00050 com='liner wall'
 zhemicyl+x  12 1   21.685692    2.92050   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    2.92050   0.00050 com='drum'
unit 4014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 zhemicyl+x  14 1   10.033000    0.76150   0.00050 com='pad-2'
 zhemicyl+x  15 1   10.922000    1.01550   0.00050 com='void btw pad2-liner'
 zhemicyl+x  16 1   11.074400    1.01550   0.00050 com='liner wall'
 zhemicyl+x  12 1   21.685692    1.01550   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    1.01550   0.00050 com='drum'
unit 4015
'2nd step in liner [Elev=37.530 in.]'
 zhemicyl+x  15 1   10.922000    0.15190   0.00050 com='void abv pad2'
 zhemicyl+x  16 1   18.757900    0.15190   0.00050 com='liner 2nd step'
 zhemicyl+x  12 1   21.685692    0.15190   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    0.15190   0.00050 com='drum'
unit 4016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 zhemicyl+x  13 1   18.097500    8.17830   0.49276 com='plug kaolite'
 zhemicyl+x  17 1   18.249900    8.17830   0.34036 com='sides of plug case'
 zhemicyl+x  15 1   18.605500    8.17830   0.00050 com='void: plug to liner'
 zhemicyl+x  16 1   18.757900    8.17830   0.00050 com='liner wall'
 zhemicyl+x  12 1   21.685692    8.17830   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    8.17830   0.00050 com='drum'
unit 4017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 zhemicyl+x  13 1   18.097500    4.44450   0.00050 com='plug kaolite'
 zhemicyl+x  17 1   18.249900    4.44450   0.00050 com='sides of plug case'
 zhemicyl+x  15 1   18.605500    4.44450   0.00050 com='void: plug to liner'
 zhemicyl+x  16 1   18.757900    4.44450   0.00050 com='liner wall'
 zhemicyl+x  18 1   19.392900    4.44450   0.00050 com='lower angle iron'
 zhemicyl+x  12 1   21.685692    4.44450   0.00050 com='kaolite'
 zhemicyl+x  19 1   21.838092    4.44450   0.00050 com='drum'
unit 4018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 zhemicyl+x  13 1   18.097500    0.11126   0.00050 com='plug kaolite'
 zhemicyl+x  17 1   18.249900    0.26366   0.00050 com='sides of plug case'
 zhemicyl+x  15 1   18.605500    0.63450   0.00050 com='void: plug to liner'
 zhemicyl+x  16 1   18.757900    0.63450   0.00050 com='liner wall'
 zhemicyl+x  18 1   21.685692    0.63450   0.00050 com='bend section of ai'
 zhemicyl+x  19 1   21.838092    0.63450   0.00050 com='drum'
unit 4019
'drum lid and lip [Elev=43.500 in.]'
 zhemicyl+x  20 1   21.469792    1.90450   0.15240 com='void above lid'
 zhemicyl+x  19 1   21.622192    1.90450   0.00050 com='drum lid'
 zhemicyl+x  20 1   21.685692    1.90450   0.00050 com='void btw lid-drumwall'
 zhemicyl+x  19 1   21.838092    1.90450   0.00050 com='drum'
unit 5001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    20 1 2p21.839092  2p37.826417   0.26670   0.0
 hole 1001 0.0   37.826417   0.0
 hole 2001 0.0  -37.826417   0.0
 hole 3001  21.839092   0.0   0.0
 hole 4001 -21.839092   0.0   0.0
unit 5002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    20 1 2p21.839092  2p37.826417  11.59510   0.0
 hole 1002 0.0   37.826417   0.0
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 hole 2002 0.0  -37.826417   0.0
 hole 3002  21.839092   0.0   0.0
 hole 4002 -21.839092   0.0   0.0
unit 5003
'cv bottom [Elev= 4.920 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   0.63500   0.0
 hole 1003 0.0   37.826417   0.0
 hole 2003 0.0  -37.826417   0.0
 hole 3003  21.839092   0.0   0.0
 hole 4003 -21.839092   0.0   0.0
unit 5006
'content (collapsed) [Elev= 9.691 in.]'
 cuboid    20 1 2p21.839092  2p37.826417  12.11746   0.0
 hole 1006 0.0   37.826417   0.0
 hole 2006 0.0  -37.826417   0.0
 hole 3006  21.839092   0.0   0.0
 hole 4006 -21.839092   0.0   0.0
unit 5007
'np277_4 spacer [Elev=11.091 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   3.55710   0.0
 hole 1007 0.0   37.826417   0.0
 hole 2007 0.0  -37.826417   0.0
 hole 3007  21.839092   0.0   0.0
 hole 4007 -21.839092   0.0   0.0
unit 5008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
 cuboid    20 1 2p21.839092  2p37.826417  33.62072   0.0
 hole 1008 0.0   37.826417   0.0
 hole 2008 0.0  -37.826417   0.0
 hole 3008  21.839092   0.0   0.0
 hole 4008 -21.839092   0.0   0.0
unit 5010
'cv at 1st step in liner [Elev=35.330 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   0.15240   0.0
 hole 1010 0.0   37.826417   0.0
 hole 2010 0.0  -37.826417   0.0
 hole 3010  21.839092   0.0   0.0
 hole 4010 -21.839092   0.0   0.0
unit 5011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   0.22860   0.0
 hole 1011 0.0   37.826417   0.0
 hole 2011 0.0  -37.826417   0.0
 hole 3011  21.839092   0.0   0.0
 hole 4011 -21.839092   0.0   0.0
unit 5012
'cv flange to top of cv well [Elev=35.920 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   1.27000   0.0
 hole 1012 0.0   37.826417   0.0
 hole 2012 0.0  -37.826417   0.0
 hole 3012  21.839092   0.0   0.0
 hole 4012 -21.839092   0.0   0.0
unit 5013
'cv flange above cv well [Elev=37.070 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   2.92100   0.0
 hole 1013 0.0   37.826417   0.0
 hole 2013 0.0  -37.826417   0.0
 hole 3013  21.839092   0.0   0.0
 hole 4013 -21.839092   0.0   0.0
unit 5014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   1.01600   0.0
 hole 1014 0.0   37.826417   0.0
 hole 2014 0.0  -37.826417   0.0
 hole 3014  21.839092   0.0   0.0
 hole 4014 -21.839092   0.0   0.0
unit 5015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    20 1 2p21.839092  2p37.826417   0.15240   0.0
 hole 1015 0.0   37.826417   0.0
 hole 2015 0.0  -37.826417   0.0
```

```
 hole 3015  21.839092   0.0   0.0
 hole 4015 -21.839092   0.0   0.0
unit 5016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    20 1 2p21.839092 2p37.826417   8.17880   0.0
 hole 1016 0.0   37.826417   0.0
 hole 2016 0.0  -37.826417   0.0
 hole 3016  21.839092   0.0   0.0
 hole 4016 -21.839092   0.0   0.0
unit 5017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    20 1 2p21.839092 2p37.826417   4.44500   0.0
 hole 1017 0.0   37.826417   0.0
 hole 2017 0.0  -37.826417   0.0
 hole 3017  21.839092   0.0   0.0
 hole 4017 -21.839092   0.0   0.0
unit 5018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    20 1 2p21.839092 2p37.826417   0.63500   0.0
 hole 1018 0.0   37.826417   0.0
 hole 2018 0.0  -37.826417   0.0
 hole 3018  21.839092   0.0   0.0
 hole 4018 -21.839092   0.0   0.0
unit 5019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    20 1 2p21.839092 2p37.826417   1.90500   0.0
 hole 1019 0.0   37.826417   0.0
 hole 2019 0.0  -37.826417   0.0
 hole 3019  21.839092   0.0   0.0
 hole 4019 -21.839092   0.0   0.0
unit 5020
'es3100 drum [Elev=43.500 in.]'
array 3          -21.839092   -37.826417    0.0
 cuboid    20  1 2p21.839592 2p37.826917 110.4905 0.0 com='interst. array space'
unit 6001
'drum bottom flat cover'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.26670 0.0
 hole 1001 0.0   0.0   0.0
unit 6002
'above drum bottom flat cover and below containment vessel'
 cuboid    20  1 2p21.839092 0.0 -21.839092 11.59510 0.0
 hole 1002 0.0   0.0   0.0
unit 6003
'cv bottom'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.63500 0.0
 hole 1003 0.0   0.0   0.0
unit 6006
'drum stand'
'content (collapsed)'
 cuboid    20  1 2p21.839092 0.0 -21.839092 12.11746 0.0
 hole 1006 0.0   0.0   0.0
unit 6007
'np277_4 spacer'
 cuboid    20  1 2p21.839092 0.0 -21.839092  3.55710 0.0
 hole 1007 0.0   0.0   0.0
unit 6008
'top of content stack to bottom of 1st step'
 cuboid    20  1 2p21.839092 0.0 -21.839092 33.62072 0.0
 hole 1008 0.0   0.0   0.0
unit 6010
'cv at 1st step in liner'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.15240 0.0
 hole 1010 0.0   0.0   0.0
unit 6011
'vertical gap between 1st step in liner and cv flange'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.22860 0.0
 hole 1011 0.0   0.0   0.0
unit 6012
'cv flange to top of cv well'
 cuboid    20  1 2p21.839092 0.0 -21.839092  1.27000 0.0
 hole 1012 0.0   0.0   0.0
```

```
unit 6013
'cv flange above cv well'
 cuboid    20  1 2p21.839092 0.0 -21.839092  2.92100 0.0
 hole 1013 0.0   0.0   0.0
unit 6014
'plugpad2 below liner 2nd step'
 cuboid    20  1 2p21.839092 0.0 -21.839092  1.01600 0.0
 hole 1014 0.0   0.0   0.0
unit 6015
'2nd step in liner'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.15240 0.0
 hole 1015 0.0   0.0   0.0
unit 6016
'abv 2nd step in liner to bottom of angle iron'
 cuboid    20  1 2p21.839092 0.0 -21.839092  8.17880 0.0
 hole 1016 0.0   0.0   0.0
unit 6017
'bottom of angle iron to bend in angle iron'
 cuboid    20  1 2p21.839092 0.0 -21.839092  4.44500 0.0
 hole 1017 0.0   0.0   0.0
unit 6018
'bend in angle iron to top of angle iron'
 cuboid    20  1 2p21.839092 0.0 -21.839092  0.63500 0.0
 hole 1018 0.0   0.0   0.0
unit 6019
'drum lid and lip'
 cuboid    20  1 2p21.839092 0.0 -21.839092  1.90500 0.0
 hole 1019 0.0   0.0   0.0
unit 6020
'es3100 drum'
array 4          2r-21.839092     0.0
 cuboid    20  1 2p21.839592 0.0005 -21.839592 110.4905 0.0
unit 7001
 cuboid    20  1 2p21.839092 21.839092 0.0  0.26670 0.0
 hole 2001 0.0   0.0   0.0
unit 7002
 cuboid    20  1 2p21.839092 21.839092 0.0 11.59510 0.0
 hole 2002 0.0   0.0   0.0
unit 7003
 cuboid    20  1 2p21.839092 21.839092 0.0  0.63500 0.0
 hole 2003 0.0   0.0   0.0
unit 7006
 cuboid    20  1 2p21.839092 21.839092 0.0 12.11746 0.0
 hole 2006 0.0   0.0   0.0
unit 7007
 cuboid    20  1 2p21.839092 21.839092 0.0  3.55710 0.0
 hole 2007 0.0   0.0   0.0
unit 7008
 cuboid    20  1 2p21.839092 21.839092 0.0 33.62072 0.0
 hole 2008 0.0   0.0   0.0
unit 7010
 cuboid    20  1 2p21.839092 21.839092 0.0  0.15240 0.0
 hole 2010 0.0   0.0   0.0
unit 7011
 cuboid    20  1 2p21.839092 21.839092 0.0  0.22860 0.0
 hole 2011 0.0   0.0   0.0
unit 7012
 cuboid    20  1 2p21.839092 21.839092 0.0  1.27000 0.0
 hole 2012 0.0   0.0   0.0
unit 7013
 cuboid    20  1 2p21.839092 21.839092 0.0  2.92100 0.0
 hole 2013 0.0   0.0   0.0
unit 7014
 cuboid    20  1 2p21.839092 21.839092 0.0  1.01600 0.0
 hole 2014 0.0   0.0   0.0
unit 7015
 cuboid    20  1 2p21.839092 21.839092 0.0  0.15240 0.0
 hole 2015 0.0   0.0   0.0
unit 7016
 cuboid    20  1 2p21.839092 21.839092 0.0  8.17880 0.0
 hole 2016 0.0   0.0   0.0
```

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unit 7017
 cuboid    20  1 2p21.839092 21.839092 0.0  4.44500 0.0
 hole 2017 0.0   0.0   0.0
unit 7018
 cuboid    20  1 2p21.839092 21.839092 0.0  0.63500 0.0
 hole 2018 0.0   0.0   0.0
unit 7019
 cuboid    20  1 2p21.839092 21.839092 0.0  1.90500 0.0
 hole 2019 0.0   0.0   0.0
unit 7020
'es3100 drum'
array 5          -21.839092     0.0     0.0
 cuboid    20  1 2p21.839592 21.839592 -0.0005 110.4905 0.0
unit 8001
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.26670 0.0
 hole 3001 0.0   0.0   0.0
unit 8002
 cuboid    20  1 0.0 -21.839092 2p37.826417 11.59510 0.0
 hole 3002 0.0   0.0   0.0
unit 8003
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.63500 0.0
 hole 3003 0.0   0.0   0.0
unit 8006
 cuboid    20  1 0.0 -21.839092 2p37.826417 12.11746 0.0
 hole 3006 0.0   0.0   0.0
unit 8007
 cuboid    20  1 0.0 -21.839092 2p37.826417  3.55710 0.0
 hole 3007 0.0   0.0   0.0
unit 8008
 cuboid    20  1 0.0 -21.839092 2p37.826417 33.62072 0.0
 hole 3008 0.0   0.0   0.0
unit 8010
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.15240 0.0
 hole 3010 0.0   0.0   0.0
unit 8011
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.22860 0.0
 hole 3011 0.0   0.0   0.0
unit 8012
 cuboid    20  1 0.0 -21.839092 2p37.826417  1.27000 0.0
 hole 3012 0.0   0.0   0.0
unit 8013
 cuboid    20  1 0.0 -21.839092 2p37.826417  2.92100 0.0
 hole 3013 0.0   0.0   0.0
unit 8014
 cuboid    20  1 0.0 -21.839092 2p37.826417  1.01600 0.0
 hole 3014 0.0   0.0   0.0
unit 8015
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.15240 0.0
 hole 3015 0.0   0.0   0.0
unit 8016
 cuboid    20  1 0.0 -21.839092 2p37.826417  8.17880 0.0
 hole 3016 0.0   0.0   0.0
unit 8017
 cuboid    20  1 0.0 -21.839092 2p37.826417  4.44500 0.0
 hole 3017 0.0   0.0   0.0
unit 8018
 cuboid    20  1 0.0 -21.839092 2p37.826417  0.63500 0.0
 hole 3018 0.0   0.0   0.0
unit 8019
 cuboid    20  1 0.0 -21.839092 2p37.826417  1.90500 0.0
 hole 3019 0.0   0.0   0.0
unit 8020
'es3100 drum'
array 6          -21.839092    -37.826417    0.0
 cuboid    20  1 0.0005 -21.839592 2p37.826917 110.4905 0.0
unit 9001
 cuboid    20  1 21.839092 0.0 2p37.826417  0.26670 0.0
 hole 4001 0.0   0.0   0.0
unit 9002
 cuboid    20  1 21.839092 0.0 2p37.826417 11.59510 0.0
 hole 4002 0.0   0.0   0.0
```

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unit 9003
 cuboid    20  1 21.839092 0.0 2p37.826417  0.63500 0.0
 hole 4003 0.0   0.0   0.0
unit 9006
 cuboid    20  1 21.839092 0.0 2p37.826417 12.11746 0.0
 hole 4006 0.0   0.0   0.0
unit 9007
 cuboid    20  1 21.839092 0.0 2p37.826417  3.55710 0.0
 hole 4007 0.0   0.0   0.0
unit 9008
 cuboid    20  1 21.839092 0.0 2p37.826417 33.62072 0.0
 hole 4008 0.0   0.0   0.0
unit 9010
 cuboid    20  1 21.839092 0.0 2p37.826417  0.15240 0.0
 hole 4010 0.0   0.0   0.0
unit 9011
 cuboid    20  1 21.839092 0.0 2p37.826417  0.22860 0.0
 hole 4011 0.0   0.0   0.0
unit 9012
 cuboid    20  1 21.839092 0.0 2p37.826417  1.27000 0.0
 hole 4012 0.0   0.0   0.0
unit 9013
 cuboid    20  1 21.839092 0.0 2p37.826417  2.92100 0.0
 hole 4013 0.0   0.0   0.0
unit 9014
 cuboid    20  1 21.839092 0.0 2p37.826417  1.01600 0.0
 hole 4014 0.0   0.0   0.0
unit 9015
 cuboid    20  1 21.839092 0.0 2p37.826417  0.15240 0.0
 hole 4015 0.0   0.0   0.0
unit 9016
 cuboid    20  1 21.839092 0.0 2p37.826417  8.17880 0.0
 hole 4016 0.0   0.0   0.0
unit 9017
 cuboid    20  1 21.839092 0.0 2p37.826417  4.44500 0.0
 hole 4017 0.0   0.0   0.0
unit 9018
 cuboid    20  1 21.839092 0.0 2p37.826417  0.63500 0.0
 hole 4018 0.0   0.0   0.0
unit 9019
 cuboid    20  1 21.839092 0.0 2p37.826417  1.90500 0.0
 hole 4019 0.0   0.0   0.0
unit 9020
'es3100 drum'
array 7         0.0    -37.826417    0.0
 cuboid    20  1 21.839592 -0.0005 2p37.826917 110.4905 0.0
unit 9021
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.26670 0.0
unit 9022
 cuboid    20  1 21.839092 0.0 21.839092 0.0 11.59510 0.0
unit 9023
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.63500 0.0
unit 9026
 cuboid    20  1 21.839092 0.0 21.839092 0.0 12.11746 0.0
unit 9027
 cuboid    20  1 21.839092 0.0 21.839092 0.0  3.55710 0.0
unit 9028
 cuboid    20  1 21.839092 0.0 21.839092 0.0 33.62072 0.0
unit 9030
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.15240 0.0
unit 9031
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.22860 0.0
unit 9032
 cuboid    20  1 21.839092 0.0 21.839092 0.0  1.27000 0.0
unit 9033
 cuboid    20  1 21.839092 0.0 21.839092 0.0  2.92100 0.0
unit 9034
 cuboid    20  1 21.839092 0.0 21.839092 0.0  1.01600 0.0
unit 9035
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.15240 0.0
unit 9036
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 cuboid    20  1 21.839092 0.0 21.839092 0.0  8.17880 0.0
unit 9037
 cuboid    20  1 21.839092 0.0 21.839092 0.0  4.44500 0.0
unit 9038
 cuboid    20  1 21.839092 0.0 21.839092 0.0  0.63500 0.0
unit 9039
 cuboid    20  1 21.839092 0.0 21.839092 0.0  1.90500 0.0
unit 9040
'array end space'
array 8         0.0    0.0    0.0
 cuboid    20  1 21.839592 -0.0005 21.839592 -0.0005 110.4905 0.0
global
unit 9050
array 9    3r0.0
reflector  21 2  6r3.0  10
end geometry
read array
ara=1 nux=3 nuy=3 nuz=4   fill 27r1004  9r1005      end fill
ara=3 nux=1 nuy=1 nuz=19 fill
5001 5002 5003 5006 5007 5006 5007 5006 5008 5010
5011 5012 5013 5014 5015 5016 5017 5018 5019       end fill
ara=4 nux=1 nuy=1 nuz=19                               fill
6001 6002 6003 6006 6007 6006 6007 6006 6008 6010
6011 6012 6013 6014 6015 6016 6017 6018 6019       end fill
ara=5 nux=1 nuy=1 nuz=19                               fill
7001 7002 7003 7006 7007 7006 7007 7006 7008 7010
7011 7012 7013 7014 7015 7016 7017 7018 7019       end fill
ara=6 nux=1 nuy=1 nuz=19                               fill
8001 8002 8003 8006 8007 8006 8007 8006 8008 8010
8011 8012 8013 8014 8015 8016 8017 8018 8019       end fill
ara=7 nux=1 nuy=1 nuz=19                               fill
9001 9002 9003 9006 9007 9006 9007 9006 9008 9010
9011 9012 9013 9014 9015 9016 9017 9018 9019       end fill
ara=8 nux=1 nuy=1 nuz=19                               fill
9021 9022 9023 9026 9027 9026 9027 9026 9028 9030
9031 9032 9033 9034 9035 9036 9037 9038 9039       end fill
ara=9 nux=7 nuy=3 nuz=3                                fill
9040 5r6020 9040 8020 5r5020 9020 9040 5r7020 9040 2q21 end fill
end array
read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciaoxt11,0.0in np,disp.24000.0gUO2 (21124.9g235, 6533.9gH2O hx=  9.90),fr=1.0e-04
238groupndf5 infhommedium
'HEU volume =3669.72477, SPACER volume    0.00000'
'HEU oxide, bulk density of oxide in cans=  6.54000 g/cm3'
'wrapped dry content can hx=0.79, CV void volume 6545.63717'
'oxide= 24000.0 g, sat. moisture in HEU oxide=1477.3 g, oxide htox= 1.83'
arbmuox    6.54000   2 0 0 0  92235   88.0203
                               8016   11.9797    1  1.0000  293  end
arbmastm  4.0256e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
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                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  9.9820e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
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                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0    12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0    11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0     6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0     1001   11.1913
                                 8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0     1001   11.1913
                                 8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0     1001   11.1913
'                                 8016   88.8087   21  1.0     293  end
end comp
nciaoxt11,0.0in np,disp.24000.0gUO2 (21124.9g235, 6533.9gH2O,hx=  9.90),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                      end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.276 in.]'
 cylinder  3  1    6.426200   77.72400  28.92123 com='cavity abv HEU'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cylinder  15 1    7.924800   77.72400   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   77.72400   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   77.72400   0.0     com='np277_4'
 cylinder  16 1   11.074400   77.72400   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   77.72400   0.0     com='kaolite'
 cylinder  19 1   21.722275   77.72400   0.0     com='drum'
 cuboid    20 1 4p22.866096   77.72400   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
```

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 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0     com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
```

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unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    1120.337  0.0    com='bare package'
'cuboid    21  1 4p55.067200   1150.817 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciask,0.0 21300.0g soc(19865.3uox,15672.8u235,  921.0c),hx= 12.82,fr=1.0e+00
238groupndf5 infhommedium
'  cm3: Skull oxide content 6974.5, SPACER    0.0, CV void 3240.9; CV htox=12.82'
'g/cm3: Skull oxide content  3.05400'
'U3O8   (19865.33gUOX,16816.3gU,15672.8g235U, 3801.4g.sat.H2O, HX=  7.43)'
'Carbon (  921.00gC,   58764.1mgC/g235U)'
'Poly   (  513.00gCH2)'
'Other  (    0.67gUnident (assumed H2O)'
''
'Increm (  921.0gC,15672.8g235U,   58764.1mgC/g235U)'
'GREP1:21300.00 19865.33 3.8014e+03    7.43 16816.35 15672.84   921.00  58764.1
'GREP2: 3235.07   513.00      12.82    0.67  1.0e+00
''
arbmuox    2.84830    3 0 0 0  92235   78.8954
                                92238    5.7563
                                 8016   15.3483    1  1.0000  293  end
arbmc     1.3205e-01  1 0 0 0   6012  100.0000    1  1.0000  293  end
arbmastm  5.4505e-01  2 0 0 0   1001   11.1913
                                 8016   88.8087    1  1.0000  293  end
arbmpoly   0.07355    2 0 0 0   1001   14.3798
                                 6012   85.6202    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
```

```
                                  8016   43.4251
                                 11023    0.1174
                                 12000    0.3378
                                 13027   39.0479
                                 14000    2.4672
                                 16000    0.3083
                                 20000   11.8336
                                 26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  9.9820e-01  2 0 0 0   1001   11.1913
                                8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                             8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                             9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                            10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
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                                 8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  1       293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                                 8016   88.8087   20  1       293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                                 8016   88.8087   21  1.0     293  end
end comp
nciask,0.0,21300.0g soc(19865.3uox,15672.8u235,  921.0c),hx= 12.82 fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                      end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.276 in.]'
 cylinder  3  1    6.426200   77.72400  54.39413 com='cavity abv HEU'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cylinder  15 1    7.924800   77.72400   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   77.72400   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   77.72400   0.0     com='np277_4'
 cylinder  16 1   11.074400   77.72400   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   77.72400   0.0     com='kaolite'
 cylinder  19 1   21.722275   77.72400   0.0     com='drum'
```

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 cuboid    20 1 4p22.866096   77.72400   0.0      com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.00000 com='cavity abv HEU'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0     com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
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 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3          2r-22.866096     0.0
'cuboid     0  1 4p24.587200    1120.337  0.0    com='bare package'
'cuboid    21  1 4p55.067200   1150.817 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrunhct11 0.0innp,disp. 9000.0gUNHc( 4238.7g235, 6980.8gH2O hx= 54.99),fr=1.0e+00
238groupndf5 infhommedium
'U(enr)O2(NO3)2+6H2O [2.81 g/cc for U(nat)], gU/L= 414.9296'
'UNH crystals in cans  2.79329 g/cm3. wrapped dry content can hx=3.96'
arbmunh    2.79329  5 0 0 0   92235   47.0962
                              92238    0.0000
                               1001    2.4232
                               7014    5.6116
                               8016   44.8690    1  0.31541 293  end
arbmh2oc  6.8336e-01  2 0 0 0  1001   11.1913
                               8016   88.8087    1  1.0000  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
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                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv  6.8336e-01  2 0 0 0   1001   11.1913
                                8016   88.8087     3  1.0     293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
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arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
ncsrunhct11 0.0innp,disp. 9000.0gUNHc( 4238.7g235, 6980.8gH2O,hx= 54.99),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.270 in.]'
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cylinder  15 1    7.924800   77.72400   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   77.72400   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   77.72400   0.0     com='np277_4'
 cylinder  16 1   11.074400   77.72400   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   77.72400   0.0     com='kaolite'
 cylinder  19 1   23.329900   77.72400   0.0     com='drum'
 cuboid    21 1 4p24.587200   77.72400   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
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 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  1  1    6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  1  1    6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0     com='kaolite'
 cylinder  19 1   23.329900    2.92100   0.0     com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0     com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0     com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0     com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0     com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
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 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0      com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0      com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
icsrunhct12 0.0innp,disp.24000.0gUNHc(11303.1g235, 4874.9gH2O hx= 30.14),fr=1.0e+00
238groupndf5 infhommedium
'U(enr)O2(NO3)2+6H2O [2.81 g/cc for U(nat)], gU/L= 686.6126 dispersed'
'UNH crystals in cans  2.79329 g/cm3. wrapped dry content can hx=1.48'
'UNHc in cv  14892.91919 g.'
'water in cv  4874.89830 g.'
arbmunh    2.79329  5 0 0 0   92235   47.0962
                              92238    0.0000
                               1001    2.4232
                               7014    5.6116
                               8016   44.8690    1  0.52193 293  end
arbmh2oc   0.99820  2 0 0 0    1001   11.1913
                               8016   88.8087    1  0.47807 293  end
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
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arbmwicv  9.9820e-01  2 0 0 0    1001   11.1913
                                 8016   88.8087    3  1.0      293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                              8  1.0      293  end
'steel: cv flange lower use 3.36 lb'
ss304                                              9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                             10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                 8016   88.8087   12  1        293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                 8016   47.0610   12  0.096    293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                 8016   53.2430   12  0.367    293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067    293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012    293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307    293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131    293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020    293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  1        293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096    293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367    293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067    293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012    293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307    293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131    293  end
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arbmna2o   0.33241  2 0 0 0   11023   74.1961
                              8016   25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
'UNHc in cv well   9107.08081 g.'
'water in cv well  2981.02019 g.'
arbmunh    2.79329  5 0 0 0   92235   47.0962
                              92238    0.0000
                               1001    2.4232
                               7014    5.6116
                               8016   44.8690   15  0.52193 293  end
arbmh2oc   0.99820  2 0 0 0.   1001   11.1913
                               8016   88.8087   15  0.47807 293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                            18  1.23239 293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                            19  1.08401 293  end
'void space external to drum'
'array density is assumed not reduced by hac'
'arbmwed    0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
icsrunhct12 0.0innp,disp.24000.0gUNHc(11303.1g235, 4874.9gH2O,hx= 30.14),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   21.838092    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p21.838092    0.26670   0.0     com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
'v1002=1.36748e+01  '
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510   0.0     com='drum'
 cuboid    21 1 4p21.838092   11.59510   0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom to bottom of 1st step [Elev=35.270 in.]'
'v1003=4.43850e+03  '
 cylinder  1  1    6.426200   77.72400   0.63500 com='HEU content'
 cylinder  8  1    6.680200   77.72400   0.0     com='cv bottom'
 cylinder  15 1    7.924800   77.72400   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   77.72400   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   77.72400   0.0     com='np277_4'
 cylinder  16 1   11.074400   77.72400   0.0     com='kaolite liner'
 cylinder  12 1   21.685692   77.72400   0.0     com='kaolite'
 cylinder  19 1   21.838092   77.72400   0.0     com='drum'
 cuboid    21 1 4p21.838092   77.72400   0.0     com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
'v1010=8.70294e+00  '
 cylinder  1  1    6.426200    0.15240   0.0     com='HEU content'
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 cylinder  8  1.    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1'    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1    11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1    21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1    21.838092    0.15240   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
'v1011=5.36220e+01  '
 cylinder  1  1     6.426200    0.22860   0.0     com='HEU content'
 cylinder  8  1     6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1    10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1    11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1    21.685692    0.22860   0.0     com='kaolite'
 cylinder  19 1    21.838092    0.22860   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.22860   0.0     com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
'v1012=7.43264e+01  '
 cylinder  1  1     6.426200    1.27000   0.0     com='HEU content'
 cylinder  9  1     9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1     9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1    10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1    10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1    11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1    21.685692    1.27000   0.0     com='kaolite'
 cylinder  19 1    21.838092    1.27000   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.27000   0.0     com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
'v1013=1.70951e+02  '
 cylinder  10 1     9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1     9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1    10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1    10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1    11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1    21.685692    2.92100   0.0     com='kaolite'
 cylinder  19 1    21.838092    2.92100   0.0     com='drum'
 cuboid    21 1 4p21.838092    2.92100   0.0     com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
'v1014=1.39785e+02  '
 cylinder  14 1    10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1    10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1    11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1    21.685692    1.01600   0.0     com='kaolite'
 cylinder  19 1    21.838092    1.01600   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.01600   0.0     com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
'v1015=5.71136e+01  '
 cylinder  15 1    10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1    18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1    21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1    21.838092    0.15240   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
'v1016=6.92877e+02  '
 cylinder  13 1    18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1    18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1    18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1    18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1    21.685692    8.17880   0.0     com='kaolite'
 cylinder  19 1    21.838092    8.17880   0.0     com='drum'
 cuboid    21 1 4p21.838092    8.17880   0.0     com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
'v1017=1.83014e+02  '
 cylinder  13 1    18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1    18.249900    4.44500   0.0     com='sides of plug case'
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 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.685692    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.838092    4.44500   0.0     com='drum'
 cuboid    21 1 4p21.838092    4.44500   0.0     com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
'v1018=4.14168e+02  '
'Volume cv well=6.24674e+03  '
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.685692    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1   21.622192    1.90500   0.0     com='drum lid'
 cylinder  21 1   21.685692    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.838092    1.90500   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.90500   0.0     com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0    com='bare package'
 cuboid    21  1 4p52.318092   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=13 fill
1001 1002 1003 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
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                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
```

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                                 8016   28.5185   13  0.307    293  end
arbmmgo    0.33241  2 0 0 0    12000   60.3169
                                 8016   39.6831   13  0.131    293  end
arbmna2o   0.33241  2 0 0 0    11023   74.1961
                                 8016   25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0     6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0     1001   11.1913
                                 8016   88.8087   15  1        293  end
'steel: liner'
ss304                                             16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                             18  1.0      293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
ss304                                             19  1.0      293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0     1001   11.1913
'                                 8016   88.8087   20  1        293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0     1001   11.1913
                                 8016   88.8087   21  1.0      293  end
end comp
ncsrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0      com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0      com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0      com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
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'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   23.329900   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   38.98540   0.0     com='kaolite'
 cylinder  19 1   23.329900   38.98540   0.0     com='drum'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
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 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0      com='kaolite'
 cylinder  19 1   23.329900    2.92100   0.0      com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0      com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0      com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0      com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0      com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0      com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0      com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0      com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0     com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
```

```
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
```

```
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok    0.63931  2 0 0 0    1001   11.1913
                                8016   88.8087   12  0.0287  293  end
arbmal2o3   0.42622  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096   293  end
arbmsio2    0.42622  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367   293  end
arbmfe2o3   0.42622  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067   293  end
arbmtio2    0.42622  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012   293  end
arbmcao     0.42622  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307   293  end
arbmmgo     0.42622  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131   293  end
arbmna2o    0.42622  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  0.0287  293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067   293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012   293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307   293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131   293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru    1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed     1.16026  2 0 0 0    1001   11.1913
                                8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   21  1.0     293  end
end comp
nciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                      end boun
```

```
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0      com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0      com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0      com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.926 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.926 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.722275   38.98540   0.0     com='drum'
 cuboid    20 1 4p22.866096   38.98540   0.0     com='drum chine outer radius'
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unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1     6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1     6.680200    0.15240   0.0      com='cv at 1st step'
 cylinder  15 1     7.924800    0.15240   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    0.15240   0.0      com='liner 1st step'
 cylinder  12 1    21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1    21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096     0.15240   0.0      com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1     6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1     6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cylinder  15 1    10.922000    0.22860   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    0.22860   0.0      com='liner wall'
 cylinder  12 1    21.555075    0.22860   0.0      com='kaolite'
 cylinder  19 1    21.722275    0.22860   0.0      com='drum'
 cuboid    20 1 4p22.866096     0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1     6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1     9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1     9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1    21.555075    1.27000   0.0      com='kaolite'
 cylinder  19 1    21.722275    1.27000   0.0      com='drum'
 cuboid    20 1 4p22.866096     1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1     9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1     9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1    10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1    21.555075    2.92100   0.0      com='kaolite'
 cylinder  19 1    21.722275    2.92100   0.0      com='drum'
 cuboid    20 1 4p22.866096     2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1    10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1    21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1    21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096     1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1    10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1    18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1    21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1    21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096     0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1    18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1    18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1    18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1    21.555075    8.17880   0.0      com='kaolite'
 cylinder  19 1    21.722275    8.17880   0.0      com='drum'
 cuboid    20 1 4p22.866096     8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1    18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1    18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1    18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1    19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1    21.555075    4.44500   0.0      com='kaolite'
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 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3          2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0    com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=300000
atdmr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46,Rc= 6.05465cm
238groupndf5 multiregion
'HEU volume = 372.12095'
'U= 7000.0g, poly=513.0g, content hx=2.46'
'core htox= 2.46'
uranium  1 den=18.81109 0.4002 293  92235  100.00
                                    92238   0.000                end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  0.5998  293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0000  293  end
end comp
spherical end
1   6.05465
7  26.05465
end zone
atdmr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46 Rc= 6.05465cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Mass of fm in core region   = 7000.00000 g'
'Mass of poly in core region =  513.00000 g'
'Mass of core region         = 7513.00000 g'
'Vol of fm                   =  372.12095 cm3'
'Vol of poly                 =  557.60870 cm3'
'Volume of core region       =  929.72965 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  =   2.4580'
```

```
read geometry
global
unit 1001
'fissile material dry core with 20.0 cm water reflection'
sphere  1  1   6.05465  com='HEU core'
sphere  7  1  26.05465  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
atdmsr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46,Rc= 6.05465cm, 66133.1gSS,Rs=13.0264cm
238groupndf5 multiregion
'HEU volume = 372.12095'
'U= 7000.0g, poly=513.0g, content hx=2.46'
'core htox= 2.46'
uranium  1 den=18.81109 0.4002 293  92235  100.00
                                    92238   0.000                end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  0.5998  293  end
'steel: cv, drum liner, plug liner, angle iron, drum'
ss304                                            3  1.0     293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0000  293  end
end comp
spherical end
1   6.05465
3  13.02645
7  33.02645
end zone
atdmsr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46 Rc= 6.05465cm, 66133.1gSS,Rs=13.0264cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Mass of fm in core region   = 7000.00000 g'
'Mass of poly in core region =  513.00000 g'
'Mass of core region         = 7513.00000 g'
'Vol of fm                   =  372.12095 cm3'
'Vol of poly                 =  557.60870 cm3'
'Volume of core region       =  929.72965 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  =  2.4580'
' '
'Mass of steel is derived from the mass of the steel in the CV,'
'steel liner, plug liner, angle iron and drum.  The mass of each'
'was taken directly from Case hciabmt12_36_1_8_1_in.output'
'Model volume taken as stainless steel mass divided by ss density'
'total mass of ss304=  66133.15000'
'total volume of ss304= 8329.1'
'maximum ss304 radius = 13.02635'
read geometry
global
unit 1001
'fissile material dry core, ss304 shell, 20.0 cm h2o reflector'
'increase ss304 shell by equal volume increments'
'8.32911e+02  cm3  volume of increment'
'9258.841 cm3              accumulative volume of core and ss304'
'13.02645 cm               accumulative radius of ss304 shell'
'6.61331e+04  g            accumulative mass of ss304 shell'
sphere  1  1   6.05465  com='HEU core'
sphere  3  1  13.02645  com='ss304 shell around HEU core'
sphere  7  1  33.02645  com='20cm h2o reflector around ss304 shell'
end geometry
end data
end


=csas25    parm=size=300000
atdmkr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46,Rc= 6.05465cm,128034.0gKao,Rk=31.0814cm
238groupndf5 multiregion
'HEU volume = 372.12095'
```

```
'U= 7000.0g, poly=513.0g, content hx=2.46'
'core htox= 2.46'
uranium  1 den=18.81109 0.4002 293  92235  100.00
                                    92238   0.000                end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  0.5998  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    4  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    4  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430    4  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460    4  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465    4  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185    4  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831    4  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039    4  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460    5  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                               8016   88.8087    6  1.0e+00  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                               8016   47.0610    6  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                               8016   53.2430    6  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
                               8016   30.0460    6  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000   59.9535
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                                  8016    40.0465    6  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000    71.4815
                                  8016    28.5185    6  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000    60.3169
                                  8016    39.6831    6  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023    74.1961
                                  8016    25.8039    6  0.020   293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001    11.1913
                                  8016    88.8087    7  1.0000  293  end
end comp
spherical end
1   6.05465
6  31.08141
7  51.08141
end zone
atdmkr,[ 7000.0U, 7000.0U235,513.0CH2]g htox= 2.46 Rc= 6.05465cm,128034.0gKao,Rk=31.0814cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Mass of fm in core region   = 7000.00000 g'
'Mass of poly in core region =  513.00000 g'
'Mass of core region         = 7513.00000 g'
'Vol of fm                   =  372.12095 cm3'
'Vol of poly                 =  557.60870 cm3'
'Volume of core region       =  929.72965 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  =   2.4580'
read geometry
global
unit 1001
'fissile material dry core with 20.0 cm water reflection'
'fissile material dry core, kaolite shell, 20.0 cm h2o reflector'
'maximum kaolite radius =  31.08131 cm'
'increase kaolite shell by equal volume increments'
'1.24843e+04  cm3 volume of increment'
'125772.7 cm3 accumulative volume of core and kaolite'
'31.08141 cm accumulative radius of kaolite shell'
'1.28034e+05  g accumulative mass of kaolite shell'
sphere  1  1   6.05465  com='HEU core'
sphere  6  1  31.08141  com='kaolite shell around HEU core'
sphere  7  1  51.08141  com='20cm h2o reflector around kaolite shell'
end geometry
end data
end


=csas25    parm=size=300000
atdzr,[10400.UZrHx, 921.0U235,500.0CH2]g htox=43.37,Rc= 7.46774cm
238groupndf5 multiregion
'UZrHx=10400.0g, poly=500.0g, content hx=18.2'
'core htox=43.37'
arbmtriga  8.65974  4 0 0 0    1001     0.9554
                              40000    54.0446
                              92235     8.8558
                              92238    36.1442    1  0.6885 293  end
arbmpoly   0.92000   2 0 0 0   1001    14.3798
                                  6012    85.6202    1  0.3115  293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001    11.1913
                                  8016    88.8087    7  1.0000  293  end
end comp
spherical end
1   7.46774
7  27.46774
end zone
atdzr,[10400.UZrHx, 921.0U235,500.0CH2]g htox=43.37 Rc= 7.46774cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Mass of fm in core region   = 10400.0010 g'
'Mass of poly in core region =  500.00000 g'
'Mass of core region         = 10900.0010 g'
'Vol of fm                   = 1200.95996 cm3'
'Vol of poly                 =  543.47826 cm3'
```

```
'Volume of core region        = 1744.43822 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  =  43.3700'
read geometry
global
unit 1001
'fissile material dry core with 20.0 cm water reflection'
sphere  1  1   7.46774  com='HEU core'
sphere  7  1  27.46774  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athzpkr,[10400.UZrHx, 921.0U235,500.0CH2,76819.H2O]g htox=2220.,Rc=39.15407cm
238groupndf5 multiregion
'UZrHx=10400.0g, poly=500.0g, content hx=18.2'
'H2O in Kaolite= 76819.4g, homogenized htox=2220.'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  0.0048 293  end
arbmpoly   0.92000   2 0 0 0    1001   14.3798
                                6012   85.6202    1  0.0022  293  end
arbmh2ok   0.61533   2 0 0 0    1001   11.1913
                                8016   88.8087    1  0.4965   293  end
arbmal2o3  0.20369   2 0 0 0   13027   52.9390
                                8016   47.0610    1  0.096   293  end
arbmsio2   0.20369   2 0 0 0   14000   46.7570
                                8016   53.2430    1  0.367   293  end
arbmfe2o3  0.20369   2 0 0 0   26000   69.9540
                                8016   30.0460    1  0.067   293  end
arbmtio2   0.20369   2 0 0 0   22000   59.9535
                                8016   40.0465    1  0.012   293  end
arbmcao    0.20369   2 0 0 0   20000   71.4815
                                8016   28.5185    1  0.307   293  end
arbmmgo    0.20369   2 0 0 0   12000   60.3169
                                8016   39.6831    1  0.131   293  end
arbmna2o   0.20369   2 0 0 0   11023   74.1961
                                8016   25.8039    1  0.020   293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0000  293  end
end comp
spherical end
1  39.15407
7  59.15407
end zone
athzpkr,[10400.UZrHx, 921.0U235,500.0CH2,76819.H2O]g htox=2220. Rc=39.15407cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'                             CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                             CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                             CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region   = 10400.0010 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 76819.3531 g'
'Mass of kao in homogenized region  = 51214.8849 g'
'Mass of homogenized region         = 138934.239 g'
'Vol of homogenized fm              = 1200.95996 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 124842.528 cm3'
'Vol of kao                         = 124844.318 cm3'
'Volume of homogenized region       = 251431.285 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 2220.409'
read geometry
```

```
global
unit 1001
'fissile material homogenized with Kaolite, 20.0 cm refl'
sphere  1  1  39.15407  com='HEU core/water mixture'
sphere  7  1  59.15407  com='20.0 cm water reflector'
end geometry
end data
end

=csas25    parm=size=300000
athzpwskr,[10400.UZrHx, 921.0U235,500.0CH2,74614.H2O]g
htox=2157.,Rc=26.33372cm,53419.6,Rs=36.35905cm
238groupndf5 multiregion
'UZrHx=10400.0g, poly=500.0g, content hx=18.2'
'H2O in Kaolite= 74614.6g, homogenized htox=2157.'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.5700e-02   293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  7.1049e-03    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  9.7719e-01    293  end
'kaolite 1600 shell'
arbmh2ok 1.7660e-02  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    8  1.0000  293  end
end comp
spherical end
1  26.33372
2  36.35905
8  56.35905
end zone
athzpwskr,[10400.UZrHx, 921.0U235,500.0CH2,74614.H2O]g htox=2157.
Rc=26.33372cm,53419.6,Rs=36.35905cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'                            CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                            CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                            CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region   = 10400.0010 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 74614.6376 g'
'Mass of homogenized region         = 85514.6387 g'
'Vol of homogenized fm              = 1200.95996 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 74749.1862 cm3'
'Volume of homogenized region       = 76493.6244 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 2157.928'
' '
```

```
'Mass of h2o in shell region        = 2204.71543 g'
'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 53419.6003 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'fissile material homogenized with water of Kaolite, 20.0 cm refl'
'Radius of homogenized mix          =   26.33372 cm'
'Radius of kaolite shell                =   36.35905 cm'
sphere  1  1  26.33372  com='HEU core/water mixture'
sphere  2  1  36.35905  com='radius of kaolite shell'
sphere  8  1  56.35905  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athmpkr,[ 4000.0U, 4000.0U235,513.0CH2,76819.H2O]g htox=505.5,Rc=39.10344cm
238groupndf5 multiregion
'wrapped dry content can hx=4.30''HEU= 4000.0g, H2O in Kaolite= 76819.4g, poly=513.0g htox=505.5'
uranium  1 den=18.81109 8.4901e-04  293   92235  100.00
                                          92238    0.000              end
arbmpoly   0.92000   2 0 0 0    1001   14.3798
                                6012   85.6202    1  2.2264e-03    293  end
arbmh2ok   0.61533   2 0 0 0    1001   11.1913
                                8016   88.8087    1  4.9846e-01    293  end
arbmal2o3  0.20449   2 0 0 0   13027   52.9390
                                8016   47.0610    1  0.096   293  end
arbmsio2   0.20449   2 0 0 0   14000   46.7570
                                8016   53.2430    1  0.367   293  end
arbmfe2o3  0.20449   2 0 0 0   26000   69.9540
                                8016   30.0460    1  0.067   293  end
arbmtio2   0.20449   2 0 0 0   22000   59.9535
                                8016   40.0465    1  0.012   293  end
arbmcao    0.20449   2 0 0 0   20000   71.4815
                                8016   28.5185    1  0.307   293  end
arbmmgo    0.20449   2 0 0 0   12000   60.3169
                                8016   39.6831    1  0.131   293  end
arbmna2o   0.20449   2 0 0 0   11023   74.1961
                                8016   25.8039    1  0.020   293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0000  293  end
end comp
spherical end
1  39.10344
7  59.10344
end zone
athmpkr,[ 4000.0U, 4000.0U235,513.0CH2,76819.H2O]g htox=505.5 Rc=39.10344cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of homogenized fm             = 4000.00000 g'
'Mass of poly in homogenized region =  513.00000 g'
'Mass of h2o in homogenized region  = 76819.3531 g'
'Mass of kao in homogenized region  = 51214.8849 g'
'Mass of homogenized region         = 132547.238 g'
'Vol of homogenized fm              =  212.64054 cm3'
'Vol of h2o                         = 124842.528 cm3'
'Vol of kao                         = 124844.318 cm3'
'Volume of homogenized region       = 250457.096 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 505.5652'
```

```
read geometry
global
unit 1001
'fissile material homogenized with Kaolite, 20.0 cm refl'
sphere  1  1  39.10344  com='HEU core/water mixture'
sphere  7  1  59.10344  com='20.0 cm water reflector'
end geometry
end data
end


csas25    parm=size=300000
athmpwskr,[ 1000.0U, 1000.0U235,513.0CH2,74614.H2O]g
htox=1964.,Rc=26.20298cm,53419.6,Rs=36.29068cm
238groupndf5 multiregion
'wrapped dry content can hx=17.2'
'HEU= 1000.0g, H2O in Kaolite= 74614.6g, poly=513.0g htox=1964.'
uranium  1 den=18.81109 7.0542e-04   293   92235  100.00
                                           92238    0.000                end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  7.3993e-03    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  9.9190e-01    293  end
'kaolite 1600 shell'
arbmh2ok 1.7660e-02  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv body, lower flange, upper flange, drum liner'
ss304                                             4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
```

```
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087    6  0.0287  293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610    6  0.096   293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430    6  0.367   293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460    6  0.067   293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465    6  0.012   293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185    6  0.307   293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831    6  0.131   293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok    0.61533  2 0 0 0    1001   11.1913
                                8016   88.8087    7  0.0287  293  end
arbmal2o3   0.41023  2 0 0 0   13027   52.9390
                                8016   47.0610    7  0.096   293  end
arbmsio2    0.41023  2 0 0 0   14000   46.7570
                                8016   53.2430    7  0.367   293  end
arbmfe2o3   0.41023  2 0 0 0   26000   69.9540
                                8016   30.0460    7  0.067   293  end
arbmtio2    0.41023  2 0 0 0   22000   59.9535
                                8016   40.0465    7  0.012   293  end
arbmcao     0.41023  2 0 0 0   20000   71.4815
                                8016   28.5185    7  0.307   293  end
arbmmgo     0.41023  2 0 0 0   12000   60.3169
                                8016   39.6831    7  0.131   293  end
arbmna2o    0.41023  2 0 0 0   11023   74.1961
                                8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087    8  1.0000  293  end
end comp
spherical end
1  26.20298
2  36.29068
8  56.29068
end zone
athmpwkr,[ 1000.0U, 1000.0U235,513.0CH2,74614.H2O]g htox=1964.
Rc=26.20298cm,53419.6,Rs=36.29068cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of homogenized fm              = 1000.00000 g'
'Mass of poly in homogenized region =  513.00000 g'
'Mass of h2o in homogenized region  = 74614.6376 g'
'Mass of homogenized region          = 76127.6376 g'
'Vol of homogenized fm               =   53.16014 cm3'
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'Vol of poly                          =  557.60870 cm3'
'Vol of h2o                           = 74749.1862 cm3'
'Volume of homogenized region         = 75359.9550 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 1964.715'
' '
'Mass of h2o in shell region          = 2204.71543 g'
'Mass of kao in shell region          = 51214.8849 g'
'Mass of kaolite in shell             = 53419.6003 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'Radius of homogenized mix            =   26.20298 cm'
'Radius of kaolite shell                  =   36.29068 cm'
sphere  1  1  26.20298  com='HEU core/water mixture'
sphere  2  1  36.29068  com='radius of kaolite shell'
sphere  8  1  56.29068  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athm2pwskr,[ 3500.0U,  700.0U235,513.0CH2,14922.H2O]g
htox=116.2,Rc=15.53077cm,113111.,Rs=32.25271cm
238groupndf5 multiregion
'wrapped dry content can hx=24.5'
'HEU= 3500.0g, H2O in Kaolite= 14922.9g, poly=513.0g htox=116.2'
uranium  1 den=19.00312 1.1737e-02   293   92235  20.000
                                           92238   80.000                end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  3.5535e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  9.5273e-01    293  end
'kaolite 1600 shell'
arbmh2ok 4.9579e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv body, lower flange, upper flange, drum liner'
ss304                                             4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok.  0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
```

```
                                 8016    53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000    69.9540
                                 8016    30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000    59.9535
                                 8016    40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000    71.4815
                                 8016    28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000    60.3169
                                 8016    39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023    74.1961
                                 8016    25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001    11.1913
                                 8016    88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027    52.9390
                                 8016    47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000    46.7570
                                 8016    53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000    69.9540
                                 8016    30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000    59.9535
                                 8016    40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000    71.4815
                                 8016    28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000    60.3169
                                 8016    39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023    74.1961
                                 8016    25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001    11.1913
                                 8016    88.8087    7  0.0287  293  end
arbmal2o3  0.41023  2 0 0 0   13027    52.9390
                                 8016    47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000    46.7570
                                 8016    53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000    69.9540
                                 8016    30.0460    7  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000    59.9535
                                 8016    40.0465    7  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000    71.4815
                                 8016    28.5185    7  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000    60.3169
                                 8016    39.6831    7  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023    74.1961
                                 8016    25.8039    7  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001    11.1913
                                 8016    88.8087    8  1.0000  293  end
end comp
spherical end
1  15.53077
2  32.25271
8  52.25271
end zone
athmpwkr,[ 3500.0U,  700.0U235,513.0CH2,14922.H2O]g htox=116.2
Rc=15.53077cm,113111.,Rs=32.25271cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
```

```
'                                CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                                CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                                CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of homogenized fm              = 3500.00000 g'
'Mass of poly in homogenized region =  513.00000 g'
'Mass of h2o in homogenized region  = 14922.9275 g'
'Mass of homogenized region          = 18935.9275 g'
'Vol of homogenized fm               =  184.18032 cm3'
'Vol of poly                         =  557.60870 cm3'
'Vol of h2o                          = 14949.8372 cm3'
'Volume of homogenized region        = 15691.6262 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 116.2023'
' '
'Mass of h2o in shell region         = 61896.4255 g'
'Mass of kao in shell region         = 51214.8849 g'
'Mass of kaolite in shell            = 113111.310 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'Radius of homogenized mix           =   15.53077 cm'
'Radius of kaolite shell                 =   32.25271 cm'
sphere  1  1  15.53077  com='HEU core/water mixture'
sphere  2  1  32.25271  com='radius of kaolite shell'
sphere  8  1  52.25271  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athmpkmr,17.5kgU,[1000.0U235,513.0CH2,76819.4H2O]g
htox=404.45,Rc=39.10606cm,2500.0U235,Rs=39.14036cm
238groupndf5 multiregion
'dry CV hx=4.92 for 17.5 kilograms HEU metal wrapped content'
'Core  1000.0g235U,513.0g Poly, 76819.4gH2O in Kaolite.  htox=404.4'
uranium  1 den=19.00312 1.0503e-03   293   92235  20.000
                                           92238   80.00                end
arbmpoly   0.92000   2 0 0 0    1001   14.3798
                                6012   85.6202    1  2.2259e-03    293  end
arbmh2ok   0.61533   2 0 0 0    1001   11.1913
                                8016   88.8087    1  4.9836e-01    293  end
arbmal2o3  0.20444   2 0 0 0   13027   52.9390
                                8016   47.0610    1  0.096   293  end
arbmsio2   0.20444   2 0 0 0   14000   46.7570
                                8016   53.2430    1  0.367   293  end
arbmfe2o3  0.20444   2 0 0 0   26000   69.9540
                                8016   30.0460    1  0.067   293  end
arbmtio2   0.20444   2 0 0 0   22000   59.9535
                                8016   40.0465    1  0.012   293  end
arbmcao    0.20444   2 0 0 0   20000   71.4815
                                8016   28.5185    1  0.307   293  end
arbmmgo    0.20444   2 0 0 0   12000   60.3169
                                8016   39.6831    1  0.131   293  end
arbmna2o   0.20444   2 0 0 0   11023   74.1961
                                8016   25.8039    1  0.020   293  end
uranium  2 den=19.00312  1.0   293   92235  20.000
                                     92238   80.00               end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    8  1.0000  293  end
end comp
spherical end
1  39.10606
2  39.14036
```

```
8  59.14036
end zone
athmpkmr,17.5kgU,[1000.0U235,513.0CH2,76819.4H2O]g htox=404.45
Rc=39.10606cm,2500.0U235,Rs=39.14036cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of homogenized fissile U     = 5000.00000 g'
'Mass of poly in homogenized region=  513.00000 g'
'Mass of h2o in homogenized region = 76819.3531 g'
'Mass of kao in homogenized region = 51214.8849 g'
'Mass of homogenized core region   = 133547.238 g'
'Vol of homogenized fissile U      =  263.11475 cm3'
'Vol of poly                       =  557.60870 cm3'
'Vol of h2o                        = 124842.528 cm3'
'Vol of kao                        = 124844.318 cm3'
'Volume of homogenized core region = 250507.570 cm3'
'Calculate HTOX ratio for use of 513.0 grams can pads,vinyl tape, polyethylene in CV'
'Core hydrogen to fissile U ratio  = 404.4521'
' '
read geometry
global
unit 1001
'fissile material, homog, remaining fm as shell around mixture, 20.0 cm refl'
'Radius of homogenized core        =   39.10606 cm'
'Mass of fm shell                  = 12500.0000 g'
'Vol of fm shell                   =  657.78687 cm3'
'Radius of fm shell                =   39.14036 cm'
sphere  1  1  39.10606  com='HEU core/water mixture'
sphere  2  1  39.14036  com='radius of fissile material shell'
sphere  8  1  59.14036  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=3000000
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235,    0.0gH2O hx=  0.00),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
```

```
                                8016   88.8087    3  1e-20   293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                             8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                             9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                            10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
```

```
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0     1001   11.1913
                                8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0     1001   11.1913
                                8016   88.8087   21  1.0     293  end
end comp
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235,    0.0gH2O,hx=  0.00),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
```

```
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
```

```
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
```

```
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh2Or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
```

```
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
```

```
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga 1.4in thk np,10400.0gUZrHx(  921.0g235, 8384.6gH2O hx=237.62),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume  614.68012'
'TRIGA wrapped dry content can hx=18.2, CV void volume 8399.72186'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
```

```
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrtriga 1.4in thk np,10400.0gUZrHx(  921.0g235, 8384.6gH2O,hx=237.62),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
```

```
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=11.321 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'45.21560              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   31.87340   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   31.87340   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   31.87340   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
```

```
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019       end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235,    0.0gH2O hx=  0.00),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1e-20   293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
```

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                                  7014    0.0141
                                  8016   43.4251
                                 11023    0.1174
                                 12000    0.3378
                                 13027   39.0479
                                 14000    2.4672
                                 16000    0.3083
                                 20000   11.8336
                                 26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                                 8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                                 8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                                 8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  1       293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
```

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ss304                                          19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                          19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0     293  end
end comp
cvcrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235,    0.0gH2O,hx=  0.00),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                         end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
```

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 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O hx=575.64),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
```

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'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
```

```
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  1       293  end
'steel: liner'
ss304                                           16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                           17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                           18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                          18  1.25705 293  end
'steel: drum steel for single units'
ss304                                           19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                          19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                              8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O,hx=575.64),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun      all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360            stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
```

```
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
cvcrtriga_70 1.4in thk np, 6847.1gUZrHx(  408.0g235, 8384.6gH2O hx=536.39),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume  614.68012'
'TRIGA wrapped dry content can hx=41.1, CV void volume 8399.72186'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
```

```
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.31846e4 cm3 = (8.0457422e2 in3)(16.387064)'
'den.multiplier = 1.31846e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.518047 = (den.mult)(np277-4 min.den.) = 0.9935052*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.26267e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.06375e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.81674e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
```

```
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   21  1.0     293  end
end comp
cvcrtriga_70 1.4in thk np, 6847.1gUZrHx(  408.0g235, 8384.6gH2O,hx=536.39),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
```

```
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev=11.321 in.]'
 cylinder  2  1    5.24510     3.55610   0.0     com='np spacer'
 cylinder  3  1    6.426200    3.55620  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    3.55620  -0.0001  com='cv below 1st step'
 cuboid    21 1 4p24.587200    3.55620  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'45.21560             stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   31.87340   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   31.87340   0.0     com='cv below 1st step'
 cuboid    21 1 4p24.587200   31.87340   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
```

```
'ara=4 nux=13 nuy=13 nuz=06 fill f1020                end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                           8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                           9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                          10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
```

```
                                 8016   88.8087   12  1        293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                                 8016   47.0610   12  0.096    293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                                 8016   53.2430   12  0.367    293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067    293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012    293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307    293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131    293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020    293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  1        293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096    293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367    293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067    293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012    293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307    293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131    293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  1        293  end
'steel: liner'
ss304                                             16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388  293  end
'steel: angle iron (ai) for single units'
ss304                                             18  1.0      293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
ss304                                             19  1.0      293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                                 8016   88.8087   20  1        293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   21  1.0      293  end
end comp
ncsrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                           end boun
read geometry
unit 1001
```

```
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   23.329900   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   38.98540   0.0     com='kaolite'
 cylinder  19 1   23.329900   38.98540   0.0     com='drum'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
```

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 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0     com='kaolite'
 cylinder  19 1   23.329900    2.92100   0.0     com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0     com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0     com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0     com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0     com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
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unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0     com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O hx=575.64),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1       293  end
```

```
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                          8  1.0      293  end
'steel: cv flange lower use 3.36 lb'
ss304                                          9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                         10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
```

```
                                8016   21.5782
                               14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  1        293  end
'steel: liner'
ss304                                            16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                            18  1.0      293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
ss304                                            19  1.0      293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1        293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0      293  end
end comp
ncsrtriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O,hx=575.64),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                          end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
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 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   23.329900   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   38.98540   0.0     com='kaolite'
 cylinder  19 1   23.329900   38.98540   0.0     com='drum'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0     com='kaolite'
 cylinder  19 1   23.329900    2.92100   0.0     com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
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 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0     com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0     com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0     com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0     com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0     com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0     com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
```

```
end start
end data
end


=csas25    parm=size=3000000
ncsrt55d2 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1   0.11756  293  end
arbmwicv 9.9820e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    1   0.88244  293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
arbmh2ok   0.52294  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.34864  2 0 0 0   13027   52.9390
```

```
                                 8016   47.0610   12  0.096   293  end
arbmsio2   0.34864  2 0 0 0   14000   46.7570
                                 8016   53.2430   12  0.367   293  end
arbmfe2o3  0.34864  2 0 0 0   26000   69.9540
                                 8016   30.0460   12  0.067   293  end
arbmtio2   0.34864  2 0 0 0   22000   59.9535
                                 8016   40.0465   12  0.012   293  end
arbmcao    0.34864  2 0 0 0   20000   71.4815
                                 8016   28.5185   12  0.307   293  end
arbmmgo    0.34864  2 0 0 0   12000   60.3169
                                 8016   39.6831   12  0.131   293  end
arbmna2o   0.34864  2 0 0 0   11023   74.1961
                                 8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                 1001    8.1573
                                 8016   21.5782
                                14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   15  1       293  end
'steel: liner'
ss304                                             16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for single units'
ss304                                             18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                             18  1.25705 293  end
'steel: drum steel for single units'
ss304                                             19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                             19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                                8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087   21  1.0     293  end
end comp
ncsrt55d2 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                           end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0     com='extended radius not used'
```

```
 cylinder  19 1   23.329900    0.26670   0.0      com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0      com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0      com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0      com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0      com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0      com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0      com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
 cylinder  1  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   23.329900   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0      com='np spacer'
 cylinder  1  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  1  1    6.426200   38.98540   0.0      com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0      com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0      com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0      com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0      com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0      com='kaolite liner'
 cylinder  12 1   23.177500   38.98540   0.0      com='kaolite'
 cylinder  19 1   23.329900   38.98540   0.0      com='drum'
 cuboid    21 1 4p24.587200   38.98540   0.0      com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  1  1    6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0      com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0      com='liner 1st step'
 cylinder  12 1   23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  1  1    6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0      com='void btw cv and liner'
```

```
 cylinder  16 1   11.074400    0.22860   0.0      com='liner wall'
 cylinder  12 1   23.177500    0.22860   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.22860   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  1  1    6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1   23.177500    1.27000   0.0      com='kaolite'
 cylinder  19 1   23.329900    1.27000   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   23.177500    2.92100   0.0      com='kaolite'
 cylinder  19 1   23.329900    2.92100   0.0      com='drum'
 cuboid    21 1 4p24.587200    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   23.177500    1.01600   0.0      com='kaolite'
 cylinder  19 1   23.329900    1.01600   0.0      com='drum'
 cuboid    21 1 4p24.587200    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1   23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   23.177500    8.17880   0.0      com='kaolite'
 cylinder  19 1   23.329900    8.17880   0.0      com='drum'
 cuboid    21 1 4p24.587200    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   23.177500    4.44500   0.0      com='kaolite'
 cylinder  19 1   23.329900    4.44500   0.0      com='drum'
 cuboid    21 1 4p24.587200    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0      com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
```

```
 cylinder  19 1   23.114000    1.90500   0.0     com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25  parm=size=3000000
hcsrtriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
```

```
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                8016   88.8087   12  1       293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  1       293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  1       293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
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ss304                                          17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                          18  1.23239 293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                          19  1.08401 293  end
'void space external to drum'
'array density is assumed not reduced by hac'
'arbmwed    0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1       293  end
'reflective water'
arbmh20r   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0     293  end
end comp
hcsrtriga 0.0in thk np,10400.0gU(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                        end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   21.838092    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p21.838092    0.26670   0.0     com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510   0.0     com='drum'
 cuboid    21 1 4p21.838092   11.59510   0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.685692    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.685692   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.838092   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p21.838092   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
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 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.685692    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.838092    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p21.838092    0.00020  -0.0001  com='drum(chine)outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.685692   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.838092   38.98540   0.0     com='drum'
 cuboid    21 1 4p21.838092   38.98540   0.0     com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.685692    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.22860   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.22860   0.0     com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.685692    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.838092    1.27000   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.27000   0.0     com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.685692    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.838092    2.92100   0.0     com='drum'
 cuboid    21 1 4p21.838092    2.92100   0.0     com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.685692    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.838092    1.01600   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.01600   0.0     com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
```

```
 cuboid    21 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.685692    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.838092    8.17880   0.0     com='drum'
 cuboid    21 1 4p21.838092    8.17880   0.0     com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.685692    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.838092    4.44500   0.0     com='drum'
 cuboid    21 1 4p21.838092    4.44500   0.0     com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.685692    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1   21.622192    1.90500   0.0     com='drum lid'
 cylinder  21 1   21.685692    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.838092    1.90500   0.0     com='drum'
 cuboid    21 1 4p21.838092    1.90500   0.0     com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0    com='bare package'
 cuboid    21  1 4p52.318092   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
hcsrtriag_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O hx=575.64),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
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'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087   12  1       293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
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'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  1        293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096    293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367    293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067    293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012    293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307    293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131    293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru    1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  1        293  end
'steel: liner'
ss304                                             16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                             18  1.23239 293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                             19  1.08401 293  end
'void space external to drum'
'array density is assumed not reduced by hac'
'arbmwed    0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1        293  end
'reflective water'
arbmh20r    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0      293  end
end comp
hcsrtriag_70 0.0in thk np, 6847.1gU(  408.0g235, 8998.2gH2O,hx=575.64),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                           end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   21.838092    0.26670   0.0     com='drum bottom flat cover'
 cuboid    21 1 4p21.838092    0.26670   0.0     com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510   0.0     com='drum'
 cuboid    21 1 4p21.838092   11.59510   0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
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 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.685692    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.685692   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.838092   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p21.838092   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.685692    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.838092    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p21.838092    0.00020  -0.0001  com='drum(chine)outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.685692   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.838092   38.98540   0.0     com='drum'
 cuboid    21 1 4p21.838092   38.98540   0.0     com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.685692    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.22860   0.0     com='drum'
 cuboid    21 1 4p21.838092    0.22860   0.0     com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
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 cylinder  9  1     9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1     9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1    21.685692    1.27000   0.0      com='kaolite'
 cylinder  19 1    21.838092    1.27000   0.0      com='drum'
 cuboid    21 1 4p21.838092    1.27000   0.0      com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1     9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1     9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1    10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1    21.685692    2.92100   0.0      com='kaolite'
 cylinder  19 1    21.838092    2.92100   0.0      com='drum'
 cuboid    21 1 4p21.838092    2.92100   0.0      com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1    10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1    21.685692    1.01600   0.0      com='kaolite'
 cylinder  19 1    21.838092    1.01600   0.0      com='drum'
 cuboid    21 1 4p21.838092    1.01600   0.0      com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1    10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1    18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1    21.685692    0.15240   0.0      com='kaolite'
 cylinder  19 1    21.838092    0.15240   0.0      com='drum'
 cuboid    21 1 4p21.838092    0.15240   0.0      com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1    18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1    18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1    18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1    21.685692    8.17880   0.0      com='kaolite'
 cylinder  19 1    21.838092    8.17880   0.0      com='drum'
 cuboid    21 1 4p21.838092    8.17880   0.0      com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1    18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1    18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1    18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1    19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1    21.685692    4.44500   0.0      com='kaolite'
 cylinder  19 1    21.838092    4.44500   0.0      com='drum'
 cuboid    21 1 4p21.838092    4.44500   0.0      com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1    18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1    18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1    18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1    21.685692    0.63500   0.0      com='bend section of ai'
 cylinder  19 1    21.838092    0.63500   0.0      com='drum'
 cuboid    21 1 4p21.838092    0.63500   0.0      com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1    21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1    21.622192    1.90500   0.0      com='drum lid'
 cylinder  21 1    21.685692    1.90500   0.0      com='void btw lid - drum wall'
 cylinder  19 1    21.838092    1.90500   0.0      com='drum'
 cuboid    21 1 4p21.838092    1.90500   0.0      com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
```

```
array 3          2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0     com='bare package'
 cuboid    21  1 4p52.318092   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                           8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                           9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                          10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
```

```
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
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ss304                                                19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                                8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                                8016   88.8087   21  1.0     293  end
end comp
nciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                         end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.926 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.926 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    0.00020  -0.0001  com='drum chine outer radius'
```

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unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'38.10360            stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0      com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0      com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0      com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0      com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0      com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0      com='kaolite liner'
 cylinder  12 1   21.555075   38.98540   0.0      com='kaolite'
 cylinder  19 1   21.722275   38.98540   0.0      com='drum'
 cuboid    20 1 4p22.866096   38.98540   0.0      com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0      com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0      com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0      com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0      com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0      com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
```

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 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0     com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0    com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020              end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciatriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O hx=575.64),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
```

```
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
```

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arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                            18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                            18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                            19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                            19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                               8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                              8016   88.8087   21  1.0     293  end
end comp
nciatriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O,hx=575.64),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                     end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
```

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unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0      com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.926 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0      com='cyl1'
 hole  1004    2.490443  1.437900  0.0      com='cyl2'
 hole  1004    0.0      -2.875700  0.0      com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.926 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.722275   38.98540   0.0     com='drum'
 cuboid    20 1 4p22.866096   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
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 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0     com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0     com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0     com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0     com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0     com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0     com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0     com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0     com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0     com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3         2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0    com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0    com='interstital array space'
'global
```

```
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
hciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O hx=255.01),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=18.2, CV void volume 9014.40198'
arbmtriga  8.65974  4 0 0 0    1001    0.9554
                              40000   54.0446
                              92235    8.8558
                              92238   36.1442    1  1.0     293  end
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                              8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                           8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                           9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                          10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
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arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                8016   88.8087   12  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020   293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                            16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                            17  1.06388 293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                            18  1.23239 293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                            19  1.08401 293  end
'void space external to drum'
'array density is assumed not reduced by hac'
arbmwed    0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   20  0.0001  293  end
'reflective water'
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'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   21  1.0     293  end
end comp
hciatriga 0.0in thk np,10400.0gUZrHx(  921.0g235, 8998.2gH2O,hx=255.01),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                    end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670   0.0     com='extended radius not used'
 cylinder  19 1   21.838092    0.26670   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p21.838092    0.26670   0.0     com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510   0.0     com='drum'
 cuboid    20 1 4p21.838092   11.59510   0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.685692    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004  -2.490443  1.437900  0.0     com='cyl1'
 hole  1004   2.490443  1.437900  0.0     com='cyl2'
 hole  1004   0.0       -2.875700  0.0    com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.685692   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.838092   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p21.838092   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.685692    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.838092    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p21.838092    0.00020  -0.0001  com='drum(chine)outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
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 cylinder  16 1    8.077200   38.98540   0.0      com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0      com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0      com='kaolite liner'
 cylinder  12 1   21.685692   38.98540   0.0      com='kaolite'
 cylinder  19 1   21.838092   38.98540   0.0      com='drum'
 cuboid    20 1 4p21.838092   38.98540   0.0      com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0      com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0      com='liner 1st step'
 cylinder  12 1   21.685692    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0      com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0      com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0      com='liner wall'
 cylinder  12 1   21.685692    0.22860   0.0      com='kaolite'
 cylinder  19 1   21.838092    0.22860   0.0      com='drum'
 cuboid    20 1 4p21.838092    0.22860   0.0      com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1   21.685692    1.27000   0.0      com='kaolite'
 cylinder  19 1   21.838092    1.27000   0.0      com='drum'
 cuboid    20 1 4p21.838092    1.27000   0.0      com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   21.685692    2.92100   0.0      com='kaolite'
 cylinder  19 1   21.838092    2.92100   0.0      com='drum'
 cuboid    20 1 4p21.838092    2.92100   0.0      com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.685692    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.838092    1.01600   0.0      com='drum'
 cuboid    20 1 4p21.838092    1.01600   0.0      com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.685692    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0      com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0      com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.685692    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.838092    8.17880   0.0      com='drum'
 cuboid    20 1 4p21.838092    8.17880   0.0      com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
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 cylinder  13 1   18.097500    4.44500   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0     com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0     com='lower angle iron'
 cylinder  12 1   21.685692    4.44500   0.0     com='kaolite'
 cylinder  19 1   21.838092    4.44500   0.0     com='drum'
 cuboid    20 1 4p21.838092    4.44500   0.0     com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   21.685692    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   21.838092    0.63500   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.63500   0.0     com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  20 1   21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1   21.622192    1.90500   0.0     com='drum lid'
 cylinder  20 1   21.685692    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   21.838092    1.90500   0.0     com='drum'
 cuboid    20 1 4p21.838092    1.90500   0.0     com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3         2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0    com='bare package'
'cuboid    21  1 4p52.318092   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
hciatriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O hx=575.64),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume =1200.95996, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=41.1, CV void volume 9014.40198'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (HAC_MD&H)'
'HAC min.den.(95.3157 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07071e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
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                                16000    0.3083
                                20000   11.8335
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.82995e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (HAC_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.526803 = (95.3157 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.476265 = (den.mult)(np277-4 min.den.) = 0.9668933*1.526803'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9188
                                 7014    0.0141
                                 8016   43.4254
                                11023    0.1174
                                12000    0.3378
                                13027   39.0477
                                14000    2.4671
                                16000    0.3083
                                20000   11.8335
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.70316e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                8016   88.8087   12  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
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                                 8016    30.0460   13  0.067    293  end
arbmtio2   0.33241  2 0 0 0    22000    59.9535
                                 8016    40.0465   13  0.012    293  end
arbmcao    0.33241  2 0 0 0    20000    71.4815
                                 8016    28.5185   13  0.307    293  end
arbmmgo    0.33241  2 0 0 0    12000    60.3169
                                 8016    39.6831   13  0.131    293  end
arbmna2o   0.33241  2 0 0 0    11023    74.1961
                                 8016    25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru   1.21791  4 0 0 0     6012    32.3767
                                 1001     8.1573
                                 8016    21.5782
                                14000    37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0     1001    11.1913
                                 8016    88.8087   15  0.0001   293  end
'steel: liner'
ss304                                              16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                              17  1.06388  293  end
'steel: angle iron (ai) for HAC'
'nct density is multiplied by volume fraction 7.08030/5.74516'
ss304                                              18  1.23239  293  end
'steel: drum steel for HAC'
'nct density is multiplied by volume fraction 3.20482/2.95645'
ss304                                              19  1.08401  293  end
'void space external to drum'
'array density is assumed not reduced by hac'
arbmwed    0.9982   2 0 0 0     1001    11.1913
                                 8016    88.8087   20  0.0001   293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0     1001    11.1913
'                                8016    88.8087   21  1.0      293  end
end comp
hciatriga_70 0.0in thk np, 6847.1gUZrHx(  408.0g235, 8998.2gH2O,hx=575:64),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                       end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   21.838092    0.26670    0.0      com='extended radius not used'
 cylinder  19 1   21.838092    0.26670    0.0      com='drum bottom flat cover'
 cuboid    20 1 4p21.838092    0.26670    0.0      com='drum(chine)outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510   11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510   11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510   11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510   11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510   10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.685692   11.59510    0.0     com='kaolite'
 cylinder  19 1   21.838092   11.59510    0.0     com='drum'
 cuboid    20 1 4p21.838092   11.59510    0.0     com='drum(chine)outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500    0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500    0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500    0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500    0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500    0.0     com='kaolite liner'
 cylinder  12 1   21.685692    0.63500    0.0     com='kaolite'
 cylinder  19 1   21.838092    0.63500    0.0     com='drum'
 cuboid    20 1 4p21.838092    0.63500    0.0     com='drum(chine)outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.828800   12.70000    0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
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'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.685692   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.838092   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p21.838092   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.685692    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.838092    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p21.838092    0.00020  -0.0001  com='drum(chine)outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.685692   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.838092   38.98540   0.0     com='drum'
 cuboid    20 1 4p21.838092   38.98540   0.0     com='drum(chine)outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.685692    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0     com='drum(chine)outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.685692    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.838092    0.22860   0.0     com='drum'
 cuboid    20 1 4p21.838092    0.22860   0.0     com='drum(chine)outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.685692    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.838092    1.27000   0.0     com='drum'
 cuboid    20 1 4p21.838092    1.27000   0.0     com='drum(chine)outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
```

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 cylinder  14 1   10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1   21.685692    2.92100   0.0      com='kaolite'
 cylinder  19 1   21.838092    2.92100   0.0      com='drum'
 cuboid    20 1 4p21.838092    2.92100   0.0      com='drum(chine)outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.685692    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.838092    1.01600   0.0      com='drum'
 cuboid    20 1 4p21.838092    1.01600   0.0      com='drum(chine)outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.685692    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.838092    0.15240   0.0      com='drum'
 cuboid    20 1 4p21.838092    0.15240   0.0      com='drum(chine)outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.685692    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.838092    8.17880   0.0      com='drum'
 cuboid    20 1 4p21.838092    8.17880   0.0      com='drum(chine)outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   21.685692    4.44500   0.0      com='kaolite'
 cylinder  19 1   21.838092    4.44500   0.0      com='drum'
 cuboid    20 1 4p21.838092    4.44500   0.0      com='drum(chine)outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   21.685692    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   21.838092    0.63500   0.0      com='drum'
 cuboid    20 1 4p21.838092    0.63500   0.0      com='drum(chine)outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  20 1   21.469792    1.90500   0.15240 com='void above lid'
 cylinder  19 1   21.622192    1.90500   0.0      com='drum lid'
 cylinder  20 1   21.685692    1.90500   0.0      com='void btw lid - drum wall'
 cylinder  19 1   21.838092    1.90500   0.0      com='drum'
 cuboid    20 1 4p21.838092    1.90500   0.0      com='drum(chine)outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-21.838092     0.0
'cuboid     0  1 4p21.838092    110.4905  0.0     com='bare package'
'cuboid    21  1 4p52.318092   140.9700 -30.48    com='reflected package'
 cuboid    20  1 4p22.889718    110.5048  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
```

```
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
ncsrT70131 0.0in thk np, 5666.6gUZrHx(  337.7g235, 9204.9gH2O hx=711.53),fr=1.0e+00
238groupndf5 infhommedium
'TRIGA volume = 993.90789, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=49.6, CV void volume 9221.45406'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                            8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                            9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                           10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
```

```
arbmh2ok    0.52294  2 0 0 0    1001   11.1913
                                8016   88.8087   12  1        293  end
arbmal2o3   0.34864  2 0 0 0   13027   52.9390
                                8016   47.0610   12  0.096    293  end
arbmsio2    0.34864  2 0 0 0   14000   46.7570
                                8016   53.2430   12  0.367    293  end
arbmfe2o3   0.34864  2 0 0 0   26000   69.9540
                                8016   30.0460   12  0.067    293  end
arbmtio2    0.34864  2 0 0 0   22000   59.9535
                                8016   40.0465   12  0.012    293  end
arbmcao     0.34864  2 0 0 0   20000   71.4815
                                8016   28.5185   12  0.307    293  end
arbmmgo     0.34864  2 0 0 0   12000   60.3169
                                8016   39.6831   12  0.131    293  end
arbmna2o    0.34864  2 0 0 0   11023   74.1961
                                8016   25.8039   12  0.020    293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087   13  1        293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610   13  0.096    293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430   13  0.367    293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460   13  0.067    293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465   13  0.012    293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185   13  0.307    293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831   13  0.131    293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039   13  0.020    293  end
'silicone rubber pads'
arbmsiru    1.21791  4 0 0 0    6012   32.3767
                                1001    8.1573
                                8016   21.5782
                               14000   37.8878   14  1.0      293  end
'void space external to containment vessel'
arbmwecv    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   15  1        293  end
'steel: liner'
ss304                                             16  1.0      293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                             17  1.06388  293  end
'steel: angle iron (ai) for single units'
ss304                                             18  1.0      293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
'ss304                                            18  1.25705  293  end
'steel: drum steel for single units'
ss304                                             19  1.0      293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
'ss304                                            19  0.99981  293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
'arbmwed    1.16026  2 0 0 0    1001   11.1913
'                               8016   88.8087   20  1        293  end
'reflective water'
arbmh20r    0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087   21  1.0      293  end
end comp
ncsrT70131 0.0in thk np; 5666.6gUZrHx(  337.7g235, 9204.9gH2O,hx=711.53),fr=1.0e+00
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=vac                           end boun
read geometry
```

```
unit 1001
'drum bottom flat cover [Elev= 0.105 in. at top of unit]'
'cylinder  19 1   24.587200    0.26670   0.0      com='extended radius not used'
 cylinder  19 1   23.329900    0.26670   0.0      com='drum bottom flat cover'
 cuboid    21 1 4p24.587200    0.26670   0.0      com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.670 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'.
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   23.177500   11.59510   0.0     com='kaolite'
 cylinder  19 1   23.329900   11.59510   0.0     com='drum'
 cuboid    21 1 4p24.587200   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.920 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   23.177500    0.63500   0.0     com='kaolite'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.663700   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.920 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   23.177500   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   23.329900   12.70050  -0.0005  com='drum'
 cuboid    21 1 4p24.587200   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.921 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   23.177500    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   23.329900    0.00020  -0.0001  com='drum'
 cuboid    21 1 4p24.587200    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.270 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   23.177500   38.98540   0.0     com='kaolite'
 cylinder  19 1   23.329900   38.98540   0.0     com='drum'
 cuboid    21 1 4p24.587200   38.98540   0.0     com='drum chine outer radius'
unit 1010
```

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'cv at 1st step in liner [Elev=35.330 in.]'
 cylinder  3  1     6.426200    0.15240   0.0      com='cv well cavity'
 cylinder  8  1     6.680200    0.15240   0.0      com='cv at 1st step'
 cylinder  15 1     7.924800    0.15240   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    0.15240   0.0      com='liner 1st step'
 cylinder  12 1    23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1    23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200     0.15240   0.0      com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.420 in.]'
 cylinder  3  1     6.426200    0.22860   0.0      com='cv well cavity'
 cylinder  8  1     6.680200    0.22860   0.0      com='cv at gap btwn step-flng'
 cylinder  15 1    10.922000    0.22860   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    0.22860   0.0      com='liner wall'
 cylinder  12 1    23.177500    0.22860   0.0      com='kaolite'
 cylinder  19 1    23.329900    0.22860   0.0      com='drum'
 cuboid    21 1 4p24.587200     0.22860   0.0      com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.920 in.]'
 cylinder  3  1     6.426200    1.27000   0.0      com='cavity'
 cylinder  9  1     9.525000    1.27000   0.0      com='flange to top of well'
 cylinder  15 1     9.525000    1.27000   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    1.27000   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.27000   0.0      com='void btw cv and liner'
 cylinder  16 1    11.074400    1.27000   0.0      com='liner wall'
 cylinder  12 1    23.177500    1.27000   0.0      com='kaolite'
 cylinder  19 1    23.329900    1.27000   0.0      com='drum'
 cuboid    21 1 4p24.587200     1.27000   0.0      com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.070 in.]'
 cylinder  10 1     9.525000    2.92100   0.0      com='flange above cv well'
 cylinder  15 1     9.525000    2.92100   0.0      com='void btw cv and pad-2'
 cylinder  14 1    10.033000    2.92100   0.0      com='pad-2'
 cylinder  15 1    10.922000    2.92100   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    2.92100   0.0      com='liner wall'
 cylinder  12 1    23.177500    2.92100   0.0      com='kaolite'
 cylinder  19 1    23.329900    2.92100   0.0      com='drum'
 cuboid    21 1 4p24.587200     2.92100   0.0      com='drum chine outer radius'
unit 1014
'plugpad2 below liner 2nd step [Elev=37.470 in.]'
 cylinder  14 1    10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1    10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1    11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1    23.177500    1.01600   0.0      com='kaolite'
 cylinder  19 1    23.329900    1.01600   0.0      com='drum'
 cuboid    21 1 4p24.587200     1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.530 in.]'
 cylinder  15 1    10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1    18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1    23.177500    0.15240   0.0      com='kaolite'
 cylinder  19 1    23.329900    0.15240   0.0      com='drum'
 cuboid    21 1 4p24.587200     0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.750 in.]'
 cylinder  13 1    18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1    18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1    18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1    23.177500    8.17880   0.0      com='kaolite'
 cylinder  19 1    23.329900    8.17880   0.0      com='drum'
 cuboid    21 1 4p24.587200     8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.500 in.]'
 cylinder  13 1    18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1    18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1    18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1    18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1    19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1    23.177500    4.44500   0.0      com='kaolite'
 cylinder  19 1    23.329900    4.44500   0.0      com='drum'
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 cuboid    21 1 4p24.587200    4.44500   0.0     com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.750 in.]'
 cylinder  13 1   18.097500    0.11176   0.0     com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0     com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0     com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0     com='liner wall'
 cylinder  18 1   23.177500    0.63500   0.0     com='bend section of ai'
 cylinder  19 1   23.329900    0.63500   0.0     com='drum'
 cuboid    21 1 4p24.587200    0.63500   0.0     com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.500 in.]'
 cylinder  21 1   22.961600    1.90500   0.15240 com='void above lid'
 cylinder  19 1   23.114000    1.90500   0.0     com='drum lid'
 cylinder  21 1   23.177500    1.90500   0.0     com='void btw lid - drum wall'
 cylinder  19 1   23.329900    1.90500   0.0     com='drum'
 cuboid    21 1 4p24.587200    1.90500   0.0     com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.500 in.]'
array 3          2r-24.587200     0.0
'cuboid     0  1 4p24.587200    110.4905  0.0    com='bare package'
 cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
'cuboid    20  1 4p22.889718    110.5048  0.0    com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
end start
end data
end


=csas25    parm=size=3000000
nciaT70131 0.0in thk np, 5666.6gUZrHx(  337.7g235, 9204.9gH2O hx=711.53),fr=1.0e-04
238groupndf5 infhommedium
'TRIGA volume = 993.90789, SPACER volume    0.00000'
'TRIGA wrapped dry content can hx=49.6, CV void volume 9221.45406'
arbmtriga  5.70132  4 0 0 0    1001    1.5894
                              40000   89.9107
                              92235    5.9587
                              92238    2.5412    1  1.0     293  end
'np277-4: spacer (NCT_MD&H)'
'NCT min.den.(95.3886 lb/ft3) and hydrogen'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.31015e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520    2  0.7500  293  end
arbmnpmx  1.07070e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298    2  1.0000  293  end
arbmnph2o 3.84169e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087    2  1.0000  293  end
'flooded containmment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
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                                8016   88.8087    3  1       293  end
'steel: containment vessel body 16.60 lb but use 15.74 lb'
ss304                                             8  1.0     293  end
'steel: cv flange lower use 3.36 lb'
ss304                                             9  0.97267 293  end
'steel: cv flange upper use 13.75 lb'
ss304                                            10  0.94348 293  end
'np277-4: confinement -- neutron poison inner liner (NCT_MD&H)'
'actual vol.= 1.28314e4 cm3 = (7.83023e2 in3)(16.387064)'
'den.multiplier = 1.28314e4 cm3 (actual vol.) / 1.32708e4 cm3 (model vol.)'
'np277-4 min.den.= 1.527971 = (95.3886 lb/ft3)(453.59 g/lb)/(28316.84 cm3/ft3)'
'density = 1.477385 = (den.mult)(np277-4 min.den.) = 0.9668933*1.527971'
'use 75% of boron in calculations per NUREG-1609 Section 6.5.3.2'
arbmboron 7.06813e-2  2 0 0 0    5010   18.1479
                                 5011   81.8520   11  0.7500  293  end
arbmnpmx  1.03525e+0 10 0 0 0    6012    1.9189
                                 7014    0.0141
                                 8016   43.4251
                                11023    0.1174
                                12000    0.3378
                                13027   39.0479
                                14000    2.4672
                                16000    0.3083
                                20000   11.8336
                                26000    0.5298   11  1.0000  293  end
arbmnph2o 3.71451e-1  2 0 0 0    1001   11.1913
                                 8016   88.8087   11  1.0000  293  end
'kaolite 1600 body'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.012373*0.51655,  for rest = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'nct array densities are s.u.dens. multiplied by volume ratio 1.34888/1.10336'
arbmh2ok   0.63931  2 0 0 0    1001   11.1913
                               8016   88.8087   12  0.0287  293  end
arbmal2o3  0.42622  2 0 0 0   13027   52.9390
                               8016   47.0610   12  0.096   293  end
arbmsio2   0.42622  2 0 0 0   14000   46.7570
                               8016   53.2430   12  0.367   293  end
arbmfe2o3  0.42622  2 0 0 0   26000   69.9540
                               8016   30.0460   12  0.067   293  end
arbmtio2   0.42622  2 0 0 0   22000   59.9535
                               8016   40.0465   12  0.012   293  end
arbmcao    0.42622  2 0 0 0   20000   71.4815
                               8016   28.5185   12  0.307   293  end
arbmmgo    0.42622  2 0 0 0   12000   60.3169
                               8016   39.6831   12  0.131   293  end
arbmna2o   0.42622  2 0 0 0   11023   74.1961
                               8016   25.8039   12  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087   13  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610   13  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430   13  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460   13  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465   13  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185   13  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831   13  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039   13  0.020   293  end
'silicone rubber pads'
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arbmsiru   1.21791  4 0 0 0    6012   32.3767
                               1001    8.1573
                               8016   21.5782
                              14000   37.8878   14  1.0     293  end
'void space external to containment vessel'
arbmwecv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087   15  0.0001  293  end
'steel: liner'
ss304                                           16  1.0     293  end
'steel: plug cover (pc) use 9.907 lb'
ss304                                           17  1.06388 293  end
'steel: angle iron (ai) for single units'
'ss304                                           18  1.0     293  end
'steel: angle iron (ai) for arrays'
'array density is multiplied by a volume fraction 7.08030/5.63249'
ss304                                           18  1.25705 293  end
'steel: drum steel for single units'
'ss304                                           19  1.0     293  end
'steel: drum steel for arrays'
'array density is multiplied by a volume fraction 3.20482/3.20544'
ss304                                           19  0.99981 293  end
'void space external to drum'
'array density is multiplied by a volume ratio 8.11698/6.98323'
arbmwed    1.16026  2 0 0 0    1001   11.1913
                               8016   88.8087   20  0.0001  293  end
'reflective water'
'arbmh20r   0.9982   2 0 0 0    1001   11.1913
'                               8016   88.8087   21  1.0     293  end
end comp
nciaT70131 0.0in thk np, 5666.6gUZrHx(  337.7g235, 9204.9gH2O,hx=711.53),fr=1.0e-04
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
read boun       all=specular                    end boun
read geometry
unit 1001
'drum bottom flat cover [Elev= 0.111 in. at top of unit]'
'cylinder  19 1   22.866096    0.28150   0.0     com='extended radius not used'
 cylinder  19 1   21.722275    0.28150   0.0     com='drum bottom flat cover'
 cuboid    20 1 4p22.866096    0.28150   0.0     com='drum chine outer radius'
unit 1002
'above drum bottom flat cover and below containment vessel [Elev= 4.676 in.]'
 cylinder  15 1    3.175000   11.59510  11.16330 com='void in pad-1'
 cylinder  14 1    7.924800   11.59510  11.16330 com='pad-1'
 cylinder  16 1    8.077200   11.59510  11.16330 com='np277_4 liner'
 cylinder  11 1   10.922000   11.59510  11.16330 com='np277_4'
 cylinder  16 1   11.074400   11.59510  10.85850 com='kaolite liner bottom'
 cylinder  12 1   21.555075   11.59510   0.0     com='kaolite'
 cylinder  19 1   21.722275   11.59510   0.0     com='drum'
 cuboid    20 1 4p22.866096   11.59510   0.0     com='drum chine outer radius'
unit 1003
'cv bottom [Elev= 4.926 in.]'
 cylinder  8  1    6.680200    0.63500   0.0     com='cv bottom'
 cylinder  15 1    7.924800    0.63500   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.63500   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000    0.63500   0.0     com='np277_4'
 cylinder  16 1   11.074400    0.63500   0.0     com='kaolite liner'
 cylinder  12 1   21.555075    0.63500   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.63500   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0     com='drum chine outer radius'
unit 1004
'UZrHx fuel element'
 cylinder  1  1    1.663700   12.70000   0.0     com='cylindrical content'
unit 1006
'content (collapsed) [Elev= 9.926 in.]'
'1.437900   plus-y location upper cylinders'
'-2.875700  minus-y location lower cylinder'
'2.490443   plus-x location upper cylinder'
'-2.490443  minus-x location upper cylinder'
 cylinder  3  1    6.426200   12.70050  -0.0005  com='cv well cavity'
 hole  1004   -2.490443  1.437900  0.0     com='cyl1'
 hole  1004    2.490443  1.437900  0.0     com='cyl2'
 hole  1004    0.0      -2.875700  0.0     com='cyl3'
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 cylinder  8  1    6.680200   12.70050  -0.0005  com='cv below 1st step'
 cylinder  15 1    7.924800   12.70050  -0.0005  com='void btw cv-np liner'
 cylinder  16 1    8.077200   12.70050  -0.0005  com='np277_4 liner'
 cylinder  11 1   10.922000   12.70050  -0.0005  com='np277_4'
 cylinder  16 1   11.074400   12.70050  -0.0005  com='kaolite liner'
 cylinder  12 1   21.555075   12.70050  -0.0005  com='kaolite'
 cylinder  19 1   21.722275   12.70050  -0.0005  com='drum'
 cuboid    20 1 4p22.866096   12.70050  -0.0005  com='drum chine outer radius'
unit 1007
'np277_4 spacer [Elev= 9.926 in.]'
 cylinder  2  1    5.24510     0.00010   0.0     com='np spacer'
 cylinder  3  1    6.426200    0.00020  -0.0001  com='cv well cavity'
 cylinder  8  1    6.680200    0.00020  -0.0001  com='cv below 1st step'
 cylinder  15 1    7.924800    0.00020  -0.0001  com='void btw cv-np liner'
 cylinder  16 1    8.077200    0.00020  -0.0001  com='np277_4 liner'
 cylinder  11 1   10.922000    0.00020  -0.0001  com='np277_4'
 cylinder  16 1   11.074400    0.00020  -0.0001  com='kaolite liner'
 cylinder  12 1   21.555075    0.00020  -0.0001  com='kaolite'
 cylinder  19 1   21.722275    0.00020  -0.0001  com='drum'
 cuboid    20 1 4p22.866096    0.00020  -0.0001  com='drum chine outer radius'
unit 1008
'top of content stack to bottom of 1st step [Elev=35.276 in.]'
'38.10360              stack height (content spacers)       CALCULATED
 cylinder  3  1    6.426200   38.98540   0.0     com='cv well cavity'
 cylinder  8  1    6.680200   38.98540   0.0     com='cv below 1st step'
 cylinder  15 1    7.924800   38.98540   0.0     com='void btw cv-np liner'
 cylinder  16 1    8.077200   38.98540   0.0     com='np277_4 liner'
 cylinder  11 1   10.922000   38.98540   0.0     com='np277_4'
 cylinder  16 1   11.074400   38.98540   0.0     com='kaolite liner'
 cylinder  12 1   21.555075   38.98540   0.0     com='kaolite'
 cylinder  19 1   21.722275   38.98540   0.0     com='drum'
 cuboid    20 1 4p22.866096   38.98540   0.0     com='drum chine outer radius'
unit 1010
'cv at 1st step in liner [Elev=35.336 in.]'
 cylinder  3  1    6.426200    0.15240   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.15240   0.0     com='cv at 1st step'
 cylinder  15 1    7.924800    0.15240   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.15240   0.0     com='liner 1st step'
 cylinder  12 1   21.555075    0.15240   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0     com='drum chine outer radius'
unit 1011
'vertical gap between 1st step in liner and cv flange [Elev=35.426 in.]'
 cylinder  3  1    6.426200    0.22860   0.0     com='cv well cavity'
 cylinder  8  1    6.680200    0.22860   0.0     com='cv at gap btwn step-flng'
 cylinder  15 1   10.922000    0.22860   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    0.22860   0.0     com='liner wall'
 cylinder  12 1   21.555075    0.22860   0.0     com='kaolite'
 cylinder  19 1   21.722275    0.22860   0.0     com='drum'
 cuboid    20 1 4p22.866096    0.22860   0.0     com='drum chine outer radius'
unit 1012
'cv flange to top of cv well [Elev=35.926 in.]'
 cylinder  3  1    6.426200    1.27000   0.0     com='cavity'
 cylinder  9  1    9.525000    1.27000   0.0     com='flange to top of well'
 cylinder  15 1    9.525000    1.27000   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    1.27000   0.0     com='pad-2'
 cylinder  15 1   10.922000    1.27000   0.0     com='void btw cv and liner'
 cylinder  16 1   11.074400    1.27000   0.0     com='liner wall'
 cylinder  12 1   21.555075    1.27000   0.0     com='kaolite'
 cylinder  19 1   21.722275    1.27000   0.0     com='drum'
 cuboid    20 1 4p22.866096    1.27000   0.0     com='drum chine outer radius'
unit 1013
'cv flange above cv well [Elev=37.076 in.]'
 cylinder  10 1    9.525000    2.92100   0.0     com='flange above cv well'
 cylinder  15 1    9.525000    2.92100   0.0     com='void btw cv and pad-2'
 cylinder  14 1   10.033000    2.92100   0.0     com='pad-2'
 cylinder  15 1   10.922000    2.92100   0.0     com='void btw pad2 and liner'
 cylinder  16 1   11.074400    2.92100   0.0     com='liner wall'
 cylinder  12 1   21.555075    2.92100   0.0     com='kaolite'
 cylinder  19 1   21.722275    2.92100   0.0     com='drum'
 cuboid    20 1 4p22.866096    2.92100   0.0     com='drum chine outer radius'
```

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unit 1014
'plugpad2 below liner 2nd step [Elev=37.476 in.]'
 cylinder  14 1   10.033000    0.76200   0.0      com='pad-2'
 cylinder  15 1   10.922000    1.01600   0.0      com='void btw pad2 and liner'
 cylinder  16 1   11.074400    1.01600   0.0      com='liner wall'
 cylinder  12 1   21.555075    1.01600   0.0      com='kaolite'
 cylinder  19 1   21.722275    1.01600   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.01600   0.0      com='drum chine outer radius'
unit 1015
'2nd step in liner [Elev=37.536 in.]'
 cylinder  15 1   10.922000    0.15240   0.0      com='void abv pad2'
 cylinder  16 1   18.757900    0.15240   0.0      com='liner 2nd step'
 cylinder  12 1   21.555075    0.15240   0.0      com='kaolite'
 cylinder  19 1   21.722275    0.15240   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.15240   0.0      com='drum chine outer radius'
unit 1016
'abv 2nd step in liner to bottom of angle iron [Elev=40.756 in.]'
 cylinder  13 1   18.097500    8.17880   0.49276 com='plug kaolite'
 cylinder  17 1   18.249900    8.17880   0.34036 com='sides of plug case'
 cylinder  15 1   18.605500    8.17880   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    8.17880   0.0      com='liner wall'
 cylinder  12 1   21.555075    8.17880   0.0      com='kaolite'
 cylinder  19 1   21.722275    8.17880   0.0      com='drum'
 cuboid    20 1 4p22.866096    8.17880   0.0      com='drum chine outer radius'
unit 1017
'bottom of angle iron to bend in angle iron [Elev=42.506 in.]'
 cylinder  13 1   18.097500    4.44500   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    4.44500   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    4.44500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    4.44500   0.0      com='liner wall'
 cylinder  18 1   19.392900    4.44500   0.0      com='lower angle iron'
 cylinder  12 1   21.555075    4.44500   0.0      com='kaolite'
 cylinder  19 1   21.722275    4.44500   0.0      com='drum'
 cuboid    20 1 4p22.866096    4.44500   0.0      com='drum chine outer radius'
unit 1018
'bend in angle iron to top of angle iron [Elev=42.756 in.]'
 cylinder  13 1   18.097500    0.11176   0.0      com='plug kaolite'
 cylinder  17 1   18.249900    0.26416   0.0      com='sides of plug case'
 cylinder  15 1   18.605500    0.63500   0.0      com='void: plug to liner'
 cylinder  16 1   18.757900    0.63500   0.0      com='liner wall'
 cylinder  18 1   21.555075    0.63500   0.0      com='bend section of ai'
 cylinder  19 1   21.722275    0.63500   0.0      com='drum'
 cuboid    20 1 4p22.866096    0.63500   0.0      com='drum chine outer radius'
unit 1019
'drum lid and lip [Elev=43.512 in.]'
 cylinder  20 1   21.330090    1.91973   0.16720 com='void above lid'
 cylinder  19 1   21.497290    1.91973   0.0      com='drum lid'
 cylinder  20 1   21.555075    1.91973   0.0      com='void btw lid - drum wall'
 cylinder  19 1   21.722275    1.91973   0.0      com='drum'
 cuboid    20 1 4p22.866096    1.91973   0.0      com='drum chine outer radius'
global
unit 1020
'es3100 drum [Elev=43.512 in.]'
array 3          2r-22.866096     0.0
'cuboid     0  1 4p24.587200    110.4900  0.0     com='bare package'
'cuboid    21  1 4p55.067200   140.9700 -30.48   com='reflected package'
 cuboid    20  1 4p22.866096    110.5197  0.0     com='interstital array space'
'global
'unit 1021
'array 4   3r0.0
'reflector  21 2  6r3.0  10
end geometry
read array
ara=3 nux=1 nuy=1 nuz=19 fill
1001 1002 1003 1006 1007 1006 1007 1006 1008 1010
1011 1012 1013 1014 1015 1016 1017 1018 1019        end fill
'ara=4 nux=13 nuy=13 nuz=06 fill f1020               end fill
end array
'read bias id=500 2  11  end bias
read start nst=0
```

```
end start
end data
end


=csas25    parm=size=300000
athopwskr20,[12254.u3o8al, 716.0U235,500.0CH2,14922.H2O]g htox=567.4
238groupndf5
multiregion
'U3O8Al=12254.7g, poly=500.0g, content hx=23.4'
'H2O in Kaolite= 14922.9g, homogenized htox=567.4'
'Rc=16.54607cm,113111.,Rs=32.50193cm'
arbmTHAR   3.52015   4 0 0 0   8016    5.24773
                              13027   65.53981
                              92235    5.84249
                              92238   23.36997   1  1.8347e-01    293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  2.8642e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  7.8789e-01    293  end
'kaolite 1600 shell'
arbmh2ok 4.9579e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv, drum liner, plug liner, angle iron, drum'
ss304                                            4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
```

```
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0e+00  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                               8016   47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                               8016   53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
                               8016   30.0460    7  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000   59.9535
                               8016   40.0465    7  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000   71.4815
                               8016   28.5185    7  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000   60.3169
                               8016   39.6831    7  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023   74.1961
                               8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    8  1.0000  293  end
end comp
spherical end   1  16.54607  2  32.50193  8 52.50193
end zone
athopwskr20,[12254.u3o8al, 716.0U235,500.0CH2,14922.H2O]g htox=567.4
Rc=16.54607cm,113111.,Rs=32.50193cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'                           CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                           CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                           CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region   = 12254.6940 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 14922.9275 g'
'Mass of homogenized region         = 27677.6215 g'
'Vol of homogenized fm              = 3481.29882 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 14949.8372 cm3'
'Volume of homogenized region       = 18974.6143 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 567.4353'
' '
'Mass of h2o in shell region        = 61896.4255 g'
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'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 113111.310 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'fissile material homogenized with water of Kaolite, 20.0 cm refl'
'Radius of homogenized mix          =   16.54607 cm'
'Radius of kaolite shell                =   32.50193 cm'
sphere  1  1  16.54607  com='HEU core/water mixture'
sphere  2  1  32.50193  com='radius of kaolite shell'
sphere  8  1  52.50193  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athopwskr70,[1995.7u3o8al, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
238groupndf5
multiregion
'U3O8Al= 1995.7g, poly=500.0g, content hx=41.1'
'H2O in Kaolite=  7461.5g, homogenized htox=518.4'
'Rc=12.70245cm,120572.,Rs=31.69964cm'
arbmTHAR   3.52095   4 0 0 0   8016    5.28002
                              13027   65.51412
                              92235   20.44410
                              92238    8.76176   1  6.6021e-02   293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  6.3304e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  8.7067e-01    293  end
'kaolite 1600 shell'
arbmh2ok 5.5556e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv, drum liner, plug liner, angle iron, drum'
ss304                                             4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460    5  0.067   293  end
```

```
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                               8016   88.8087    7  1.0e+00  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                               8016   47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                               8016   53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
                               8016   30.0460    7  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000   59.9535
                               8016   40.0465    7  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000   71.4815
                               8016   28.5185    7  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000   60.3169
                               8016   39.6831    7  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023   74.1961
                               8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    8  1.0000  293  end
end comp
spherical end   1  12.70245  2  31.69964  8 51.69964
end zone
athopwskr70,[1995.7u3o8al, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
Rc=12.70245cm,120572.,Rs=31.69964cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
```

```
'Mass of fm in homogenized region   = 1995.70127 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 7461.46377 g'
'Mass of homogenized region         = 9957.16504 g'
'Vol of homogenized fm              =  566.80762 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 7474.91862 cm3'
'Volume of homogenized region       = 8585.20450 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 518.4300'
' '
'Mass of h2o in shell region        = 69357.8893 g'
'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 120572.774 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'fissile material homogenized with water of Kaolite, 20.0 cm refl'
'Radius of homogenized mix          =   12.70245 cm'
'Radius of kaolite shell                =   31.69964 cm'
sphere  1  1  12.70245  com='HEU core/water mixture'
sphere  2  1  31.69964  com='radius of kaolite shell'
sphere  8  1  51.69964  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athopwskr93,[1505.0u3o8al, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
238groupndf5
multiregion
'U3O8Al= 1505.0g, poly=500.0g, content hx=41.1'
'H2O in Kaolite=  7461.5g, homogenized htox=518.4'
'Rc=12.63331cm,120572.,Rs=31.68860cm'
arbmTHAR   3.52132   4 0 0 0   8016    5.29500
                              13027   65.50220
                              92235   27.21701
                              92238    1.98579   1  5.0605e-02   293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  6.4349e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  8.8505e-01    293  end
'kaolite 1600 shell'
arbmh2ok 5.5556e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv, drum liner, plug liner, angle iron, drum'
ss304                                            4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
```

```
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok    0.62843  2 0 0 0    1001   11.1913
                                 8016   88.8087    5  0.0287  293  end
arbmal2o3   0.41898  2 0 0 0   13027   52.9390
                                 8016   47.0610    5  0.096   293  end
arbmsio2    0.41898  2 0 0 0   14000   46.7570
                                 8016   53.2430    5  0.367   293  end
arbmfe2o3   0.41898  2 0 0 0   26000   69.9540
                                 8016   30.0460    5  0.067   293  end
arbmtio2    0.41898  2 0 0 0   22000   59.9535
                                 8016   40.0465    5  0.012   293  end
arbmcao     0.41898  2 0 0 0   20000   71.4815
                                 8016   28.5185    5  0.307   293  end
arbmmgo     0.41898  2 0 0 0   12000   60.3169
                                 8016   39.6831    5  0.131   293  end
arbmna2o    0.41898  2 0 0 0   11023   74.1961
                                 8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok    0.49860  2 0 0 0    1001   11.1913
                                 8016   88.8087    6  0.0287  293  end
arbmal2o3   0.33241  2 0 0 0   13027   52.9390
                                 8016   47.0610    6  0.096   293  end
arbmsio2    0.33241  2 0 0 0   14000   46.7570
                                 8016   53.2430    6  0.367   293  end
arbmfe2o3   0.33241  2 0 0 0   26000   69.9540
                                 8016   30.0460    6  0.067   293  end
arbmtio2    0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465    6  0.012   293  end
arbmcao     0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185    6  0.307   293  end
arbmmgo     0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831    6  0.131   293  end
arbmna2o    0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok    0.61533  2 0 0 0    1001   11.1913
                                 8016   88.8087    7  1.0e+00  293  end
arbmal2o3   0.41023  2 0 0 0   13027   52.9390
                                 8016   47.0610    7  0.096   293  end
arbmsio2    0.41023  2 0 0 0   14000   46.7570
                                 8016   53.2430    7  0.367   293  end
arbmfe2o3   0.41023  2 0 0 0   26000   69.9540
                                 8016   30.0460    7  0.067   293  end
arbmtio2    0.41023  2 0 0 0   22000   59.9535
                                 8016   40.0465    7  0.012   293  end
arbmcao     0.41023  2 0 0 0   20000   71.4815
                                 8016   28.5185    7  0.307   293  end
arbmmgo     0.41023  2 0 0 0   12000   60.3169
                                 8016   39.6831    7  0.131   293  end
arbmna2o    0.41023  2 0 0 0   11023   74.1961
                                 8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or    0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087    8  1.0000  293  end
end comp
```

```
spherical end   1  12.63331  2  31.68860  8 51.68860
end zone
athopwskr93,[1505.0u3o8al, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
Rc=12.63331cm,120572.,Rs=31.68860cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region    = 1505.00732 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 7461.46377 g'
'Mass of homogenized region          = 9466.47109 g'
'Vol of homogenized fm               =  427.39862 cm3'
'Vol of poly                         =  543.47826 cm3'
'Vol of h2o                          = 7474.91862 cm3'
'Volume of homogenized region        = 8445.79550 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 518.4391'
' '
'Mass of h2o in shell region         = 69357.8893 g'
'Mass of kao in shell region         = 51214.8849 g'
'Mass of kaolite in shell            = 120572.774 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'fissile material homogenized with water of Kaolite, 20.0 cm refl'
'Radius of homogenized mix           =   12.63331 cm'
'Radius of kaolite shell                 =   31.68860 cm'
sphere  1  1  12.63331  com='HEU core/water mixture'
sphere  2  1  31.68860  com='radius of kaolite shell'
sphere  8  1  51.68860  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athupwskr93,[ 920.5UO2MgAl, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
238groupndf5
multiregion
'UO2MgAl=  920.5g, poly=500.0g, content hx=41.1'
'H2O in Kaolite=  7461.5g, homogenized htox=518.4'
'Rc=12.53529cm,120572.,Rs=31.67313cm'
arbmuo2mgal  3.96254  5 0 0 0  8016    6.46696
                              12000    7.61234
                              13027   38.36549
                              92235   44.32146
                              92238    3.23375   1  2.8157e-02    293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  6.5870e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  9.0597e-01    293  end
'kaolite 1600 shell'
arbmh2ok 5.5556e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
```

```
                                8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                                8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                                8016   88.8087    3  1.0     293  end
'steel: cv body, lower flange, upper flange, drum liner'
ss304                                              4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                                8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                                8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                                8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                                8016   30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                                8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                                8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                                8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                                8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                                8016   88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                                8016   47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                                8016   53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                                8016   30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                8016   40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                8016   28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                8016   39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843è5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                                8016   88.8087    7  0.0287  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                                8016   47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                                8016   53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
```

```
                                 8016    30.0460    7  0.067    293  end
arbmtio2    0.41023  2 0 0 0    22000    59.9535
                                 8016    40.0465    7  0.012    293  end
arbmcao     0.41023  2 0 0 0    20000    71.4815
                                 8016    28.5185    7  0.307    293  end
arbmmgo     0.41023  2 0 0 0    12000    60.3169
                                 8016    39.6831    7  0.131    293  end
arbmna2o    0.41023  2 0 0 0    11023    74.1961
                                 8016    25.8039    7  0.020    293  end
'reflective water'
arbmh2or    0.9982   2 0 0 0     1001    11.1913
                                 8016    88.8087    8  1.0000   293  end
end comp
spherical end   1  12.53529  2  31.67313  8 51.67313
end zone
athupwskr93,[ 920.5UO2MgAl, 408.0U235,500.0CH2,7461.5H2O]g htox=518.4
Rc=12.53529cm,120572.,Rs=31.67313cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                              CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                              CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                              CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region    =  920.54764 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 7461.46377 g'
'Mass of homogenized region         = 8882.01140 g'
'Vol of homogenized fm              =  232.31252 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 7474.91862 cm3'
'Volume of homogenized region       = 8250.70940 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 518.4339'
' '
'Mass of h2o in shell region        = 69357.8893 g'
'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 120572.774 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'Radius of homogenized mix          =   12.53529 cm'
'Radius of kaolite shell            =   31.67313 cm'
sphere  1  1  12.53529  com='HEU core/water mixture'
sphere  2  1  31.67313  com='radius of kaolite shell'
sphere  8  1  51.67313  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athupwskr20,[7523.6UO2MgAl, 716.0U235,500.0CH2,7461.5H2O]g htox=295.4
238groupndf5
multiregion
'UO2MgAl= 7523.6g, poly=500.0g, content hx=23.4'
'H2O in Kaolite=  7461.5g, homogenized htox=295.4'
'Rc=13.32851cm,120572.,Rs=31.80486cm'
arbmuo2mgal  3.96017  5 0 0 0  8016     6.41096
                              12000     7.61690
                              13027    38.38846
                              92235     9.51674
                              92238    38.06695   1  1.9155e-01    293  end
arbmpoly    0.92000   2 0 0 0  1001    14.3798
                                 6012    85.6202    1  5.4796e-02    293  end
arbmkh2o    0.9982    2 0 0 0  1001    11.1913
                                 8016    88.8087    1  7.5366e-01    293  end
'kaolite 1600 shell'
```

```
arbmh2ok 5.5556e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0   13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0   14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0   26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0   22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0   20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0   12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0   11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv body, lower flange, upper flange, drum liner'
ss304                                             4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0    1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0   13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0   14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0   26000   69.9540
                               8016   30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0   22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0   20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0   12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0   11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0    1001   11.1913
                               8016   88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0   13027   52.9390
                               8016   47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0   14000   46.7570
                               8016   53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0   26000   69.9540
                               8016   30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                               8016   40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                               8016   28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                               8016   39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                               8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh20k = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
```

```
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                               8016   88.8087    7  0.0287  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                               8016   47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                               8016   53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
                               8016   30.0460    7  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000   59.9535
                               8016   40.0465    7  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000   71.4815
                               8016   28.5185    7  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000   60.3169
                               8016   39.6831    7  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023   74.1961
                               8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                               8016   88.8087    8  1.0000  293  end
end comp
spherical end   1  13.32851  2  31.80486  8 51.80486
end zone
athupwskr20,[7523.6UO2MgAl, 716.0U235,500.0CH2,7461.5H2O]g htox=295.4
Rc=13.32851cm,120572.,Rs=31.80486cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                           CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                           CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                           CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region   = 7523.61156 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 7461.46377 g'
'Mass of homogenized region         = 15485.0753 g'
'Vol of homogenized fm              = 1899.82035 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 7474.91862 cm3'
'Volume of homogenized region       = 9918.21723 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 295.4195'
' '
'Mass of h2o in shell region        = 69357.8893 g'
'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 120572.774 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'Radius of homogenized mix          =   13.32851 cm'
'Radius of kaolite shell            =   31.80486 cm'
sphere  1  1  13.32851  com='HEU core/water mixture'
sphere  2  1  31.80486  com='radius of kaolite shell'
sphere  8  1  51.80486  com='20.0 cm water reflector'
end geometry
end data
end


=csas25    parm=size=300000
athupwskr09,[15231.UO2MgAl, 716.8U235,500.0CH2,7461.5H2O]g htox=295.0
238groupndf5
multiregion
```

```
'UO2MgAl=15231.1g, poly=500.0g, content hx=23.4'
'H2O in Kaolite=  7461.5g, homogenized htox=295.0'
'Rc=14.14894cm,120572.,Rs=31.95726cm'
arbmuo2mgal  3.95984  5 0 0 0  8016    6.40322
                              12000    7.61753
                              13027   38.39164
                              92235    4.70615
                              92238   42.88147   1  3.2419e-01    293  end
arbmpoly   0.92000   2 0 0 0   1001   14.3798
                               6012   85.6202    1  4.5806e-02    293  end
arbmkh2o   0.9982    2 0 0 0   1001   11.1913
                               8016   88.8087    1  6.3001e-01    293  end
'kaolite 1600 shell'
arbmh2ok 5.5556e-01  2 0 0 0   1001   11.1913
                               8016   88.8087    2  1.000   293  end
arbmal2o3  0.41023   2 0 0 0  13027   52.9390
                               8016   47.0610    2  0.096   293  end
arbmsio2   0.41023   2 0 0 0  14000   46.7570
                               8016   53.2430    2  0.367   293  end
arbmfe2o3  0.41023   2 0 0 0  26000   69.9540
                               8016   30.0460    2  0.067   293  end
arbmtio2   0.41023   2 0 0 0  22000   59.9535
                               8016   40.0465    2  0.012   293  end
arbmcao    0.41023   2 0 0 0  20000   71.4815
                               8016   28.5185    2  0.307   293  end
arbmmgo    0.41023   2 0 0 0  12000   60.3169
                               8016   39.6831    2  0.131   293  end
arbmna2o   0.41023   2 0 0 0  11023   74.1961
                               8016   25.8039    2  0.020   293  end
'flooded containment vessel and content cans -- 10 CFR 71.55(d)(3)'
arbmwicv   0.9982   2 0 0 0   1001   11.1913
                               8016   88.8087    3  1.0     293  end
'steel: cv body, lower flange, upper flange, drum liner'
ss304                                          4  1.0     293  end
'kaolite 1600 body'
'nct.sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok 0.52294 = 1.012373*0.51655, for rest 0.34864 = 1.012373*0.34438'
'den.mult= 1.36557e5 cm3 (actual vol.) / 1.34888e5 cm3 (model vol.)'
'actual vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'hac.s.u.dens= (hac.mult)(nct.s.u.dens)'
'hac.mult = 1.34888e5 cm3 (nct vol.)/ 1.12246e5 cm3 (model vol.)'
' for arbmh2ok 0.62843 = 1.20172*0.52294,   for rest = 1.20172*0.34864'
'hac array densities are hac s.u.dens.'
arbmh2ok   0.62843  2 0 0 0   1001   11.1913
                               8016   88.8087    5  0.0287  293  end
arbmal2o3  0.41898  2 0 0 0  13027   52.9390
                               8016   47.0610    5  0.096   293  end
arbmsio2   0.41898  2 0 0 0  14000   46.7570
                               8016   53.2430    5  0.367   293  end
arbmfe2o3  0.41898  2 0 0 0  26000   69.9540
                               8016   30.0460    5  0.067   293  end
arbmtio2   0.41898  2 0 0 0  22000   59.9535
                               8016   40.0465    5  0.012   293  end
arbmcao    0.41898  2 0 0 0  20000   71.4815
                               8016   28.5185    5  0.307   293  end
arbmmgo    0.41898  2 0 0 0  12000   60.3169
                               8016   39.6831    5  0.131   293  end
arbmna2o   0.41898  2 0 0 0  11023   74.1961
                               8016   25.8039    5  0.020   293  end
'kaolite 1600 top plug'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 0.965246*0.51655,  for rest = 0.965246*0.34438'
'den.mult= 1.21592e4 cm3 (actual vol.) / 1.25970e4 cm3 (model vol.)'
'actual vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
arbmh2ok   0.49860  2 0 0 0   1001   11.1913
                               8016   88.8087    6  0.0287  293  end
arbmal2o3  0.33241  2 0 0 0  13027   52.9390
                               8016   47.0610    6  0.096   293  end
arbmsio2   0.33241  2 0 0 0  14000   46.7570
                               8016   53.2430    6  0.367   293  end
arbmfe2o3  0.33241  2 0 0 0  26000   69.9540
```

```
                                 8016   30.0460    6  0.067   293  end
arbmtio2   0.33241  2 0 0 0   22000   59.9535
                                 8016   40.0465    6  0.012   293  end
arbmcao    0.33241  2 0 0 0   20000   71.4815
                                 8016   28.5185    6  0.307   293  end
arbmmgo    0.33241  2 0 0 0   12000   60.3169
                                 8016   39.6831    6  0.131   293  end
arbmna2o   0.33241  2 0 0 0   11023   74.1961
                                 8016   25.8039    6  0.020   293  end
'kaolite 1600 combined'
'sing.unit.density= (den.mult)(min.den.)'
' for arbmh2ok = 1.191224*0.51655,  for rest = 1.191224*0.34438'
'den.mult= 1.48716e5 cm3 (actual vol.) / 1.24843e5 cm3 (model vol.)'
'actual body vol.= 1.36557e5 cm3 = (28316.84 cm3/ft3)(108.33188 lb)/(22.464 lb/ft3)'
'actual plug vol.= 1.21592e4 cm3 = (28316.84 cm3/ft3)(9.646 lb)/(22.464 lb/ft3)'
'total Kaolite volume=1.48716e5 cm3 =  1.36557e5 + 1.21592e4 cm3'
'model body vol.= 1.12246e5 cm3'
'model plug vol.= 1.25970e4 cm3'
'total model volume=1.24843e5 cm3 =  1.12246e5 + 1.25970e4 cm3'
arbmh2ok   0.61533  2 0 0 0    1001   11.1913
                                 8016   88.8087    7  0.0287  293  end
arbmal2o3  0.41023  2 0 0 0   13027   52.9390
                                 8016   47.0610    7  0.096   293  end
arbmsio2   0.41023  2 0 0 0   14000   46.7570
                                 8016   53.2430    7  0.367   293  end
arbmfe2o3  0.41023  2 0 0 0   26000   69.9540
                                 8016   30.0460    7  0.067   293  end
arbmtio2   0.41023  2 0 0 0   22000   59.9535
                                 8016   40.0465    7  0.012   293  end
arbmcao    0.41023  2 0 0 0   20000   71.4815
                                 8016   28.5185    7  0.307   293  end
arbmmgo    0.41023  2 0 0 0   12000   60.3169
                                 8016   39.6831    7  0.131   293  end
arbmna2o   0.41023  2 0 0 0   11023   74.1961
                                 8016   25.8039    7  0.020   293  end
'reflective water'
arbmh2or   0.9982   2 0 0 0    1001   11.1913
                                 8016   88.8087    8  1.0000  293  end
end comp
spherical end   1  14.14894  2  31.95726  8 51.95726
end zone
athupwskr09,[15231.UO2MgAl, 716.8U235,500.0CH2,7461.5H2O]g htox=295.0
Rc=14.14894cm,120572.,Rs=31.95726cm
read parameters nub=yes npg=2500 gen=215 nsk=15 tme=100 end parameters
'Maximum mass of water from Kaolite = 76819.35 g'
'                            CHECK=> 76819.64 g'
'Minimum mass of water from Kaolite = 2204.715 g'
'                            CHECK=> 2204.724 g'
'Mass of kao from Kaolite = 51214.88 g'
'                            CHECK=> 51214.34 g'
' '
'Calculate the mass of water contained in the homogenized region'
'Mass of fm in homogenized region   = 15231.1373 g'
'Mass of poly in homogenized region =  500.00000 g'
'Mass of h2o in homogenized region  = 7461.46377 g'
'Mass of homogenized region         = 23192.6011 g'
'Vol of homogenized fm              = 3846.40221 cm3'
'Vol of poly                        =  543.47826 cm3'
'Vol of h2o                         = 7474.91862 cm3'
'Volume of homogenized region       = 11864.7990 cm3'
'Calculate HTOX ratio for use of 500.0 grams can pads,vinyl tape, polyethylene in CV'
'hydrogen to fissile uranium ratio  = 295.0911'
' '
'Mass of h2o in shell region        = 69357.8893 g'
'Mass of kao in shell region        = 51214.8849 g'
'Mass of kaolite in shell           = 120572.774 g'
'Volume of kaolite in shell region  = 124843.000 cm3'
read geometry
global
unit 1001
'Radius of homogenized mix          =   14.14894 cm'
```

```
'Radius of kaolite shell              =   31.95726 cm'
sphere  1  1  14.14894  com='HEU core/water mixture'
sphere  2  1  31.95726  com='radius of kaolite shell'
sphere  8  1  51.95726  com='20.0 cm water reflector'
end geometry
end data
end
```

SECTION 6 REFERENCES

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7. PACKAGE OPERATIONS

The ES-3100 shipping package shall be operated in accordance with applicable Nuclear Regulatory Commission (NRC), U.S. Department of Transportation (DOT), and other federal, state, and local regulations to protect the health and safety of the public, workers, and the environment. Furthermore, the ES-3100 shall be operated according to a site-approved quality assurance plan.

Specific criteria for operating the ES-3100 package with highly enriched uranium (HEU) contents are presented in this section. The packaging user shall develop detailed site-specific operating procedures based on these criteria and on the NRC-issued Certificate of Compliance (CoC). These procedures shall be in accordance with 10 CFR 71, Subparts A, G, and H. The package operations should be consistent with maintaining occupational radiation exposures as low as reasonably achievable (ALARA) as required by 10 CFR 20.1101.

7.1 PACKAGE LOADING

The user of the packaging shall:

1. have authorization to acquire, package, transport, or transfer radioactive, fissile, or special nuclear material;
2. have the latest NRC CoC and referenced SAR sections for the ES-3100 package with HEU contents;
3. comply with all actions and restrictions specified in the CoC;
4. be registered as a user of the packaging with the NRC; and
5. have a site-approved quality assurance program that meets the requirements of 10 CFR 71, Subpart H.

7.1.1 Preparation for Loading

The ES-3100 Containment Vessel (CV) may be loaded while inside or outside the drum. This decision is site dependent. Detailed, written operating procedures shall include, at a minimum, the process steps listed below before the contents are placed in the ES-3100 package. These steps, initiated by the operating personnel and their supervisor, ensure that:

1. All appropriate documents have been reviewed by operating personnel and are available for further review, if necessary.
2. The radioactive material contents are authorized by the CoC, and the use of the package complies with all conditions in the CoC.
3. The packaging has been properly maintained and is in unimpaired condition. (All required refurbishment and periodic maintenance shall have been performed and documented within the scheduled requirements of the CoC, the SAR, and the maintenance program.)

4. A valid leak-test sticker must be present on the containment vessel to ensure that the required acceptance leak test or the annual leak test has been performed.

5. Packaging interior, nonfixed surface contamination levels are not high enough to significantly contaminate the contents. Nonfixed surface contamination limit requirements are given in 10 CFR 20.1906, 10 CFR 71.87(i), and 49 CFR 173.443 for alpha, beta, and gamma-emitting radionuclides.

6. All closure fasteners are those furnished with the packaging or are certified replacements and are acceptable for use.

7. All required parts of the packaging and all necessary equipment are available and ready for use.

8. The silicone rubber pads, if required, have been inspected prior to use.

The user may replace certain parts during loading. Parts that may be replaced by the user are identified in Table 7.1. The certification of all replacement parts must be traceable. The user must document the replacement.

Table 7.1. Replacement parts for the ES-3100 packaging

Part	Description	Material	Specification/ Drawing[a]
Containment vessel inner O-ring	5.359-in. inner diam (ID) by 0.139-in. diam stock	Ethylene propylene	ASTM D-2000 M2E801580A013
Containment vessel outer O-ring	5.859-in. ID by 0.139-in. diam stock	Ethylene propylene	ASTM D-2000 M2E801580A013
Drum lid washer	0.844-in. ID by 1.375-in. outer diam (OD) × 0.25-in.-thick	Stainless steel	ASTM A240 or ASTM A276 M2E801580A005
Drum lid hex nut	⅝-in.-11 unified coarse thread (UNC)	Silicon bronze	ASTM F467 per ANSI B18.2.2 M2E801580A005
Plug	(Plastic plug around circumference of drum assembly and top of top plug)	Nylon 6/6	62MP0312 Micro Plastic, Inc. M2E801580A002 M2E801580A008
Modified VCO Threaded Plug	Leak-test port plug	Brass	P/N 04-2126 M2E801580A011
Silicone rubber pads		Silicone rubber 22 ± 5 Shore A	M2E801580-A009-1 M2E801580-A009-2 M2E801580-A009-3

[a] Drawings are available in Appendix 1.4.8.

7.1.2 Loading of Contents

The operating procedures for the ES-3100 package with HEU contents shall be specific regarding handling of all package components. Approved procedures shall clearly state all safety aspects or activities such as personnel protection (radiation, chemical, physical); surface contamination or radiation surveys; nuclear criticality safety; and environment temperature.

The detailed operating procedures for inserting the content into the packaging shall include, at a minimum, the process steps listed below:

1. The appropriate CV is positioned for packing and verify that the vessel was loaded according to these steps.

2. The HEU material has been verified as being within the limits specified in this SAR and the NRC CoC for material mass, material dimension, uranium content, and ^{235}U enrichment as required in Sect. 1.2.3. The content shall be verified using accountability records and weight measurements.

3. All contents and their associated cans, bottles and packing material are weighed and are within the allowable weights specified in Sect. 1.2.3.6.

4. The HEU material and associated packing material (convenience cans, spacers, bagging, pads, etc.) have been inserted as required by Sect. 1.2.3.

5. For proper handling of broken metal contents, pyrophoricity concerns must first be addressed. Operators have two options: 1) treat all broken metal as pyrophoric (in this case skip to procedure in Item #7 below) or, 2) determine whether or not the broken metal is pyrophoric (in this case go to procedure in Item #6 below).

6. For pyrophoric categorization of broken metal, first evaluate the specific surface area of the metal pieces (surface-area-to mass ratio). If that value is less than or equal to 1.00 cm^2/g, then the metal pieces are not pyrophoric (and no further action is needed). If the specific surface area is greater than 1.00 cm^2/g, or if the specific surface area can not be evaluated, perform the remainder of this procedure:

   a. Metal pieces must be physically evaluated to ensure that their smallest dimension is larger than a 3/8 inch mesh size.

      i. Single solid-metal pieces that are clearly larger than the 3/8-inch mesh in every dimension do not require sieving, and are acceptable.

      ii. Items which are unacceptable by definition (Sect. 1.2.3), such as powders, foils, wires, and turnings, should be rejected before the sieving.

      iii. Any items that are not obviously larger than the 3/8-inch mesh in every dimension and which have not been rejected must be sieved.

      iv. Any item that falls through the sieve must be rejected.

      v. Any rejected item must be handled according to the procedure in Item #7 below.

b. Operators need to be alert to items which may not fall through the sieve but still may be pyrophoric:

   i. Long, thin shapes such as wires and turnings may not fall through the sieve when shaken. If the wire or turning could be picked up and poked through the mesh it must be rejected, even if it did not fall through unassisted.

   ii. Wires or turnings may form a tangled ball which will not fall through. The above criterion applies: if the wire or turning could be separated and poked through the mesh it must be rejected.

   iii. Foils, thin chips or shards - any item less than 1/8 inch thick – must be rejected.

   iv. Metal showing visible moisture or signs of having been stored in water must be rejected.

   v. Any rejected metal must be handled according to the procedure in Item #7 below.

7. Rejected items must be separated for proper handling:

   a. Rejected items can be shipped in the ES-3100 if packed in a sealed container under an inert cover gas.

   b. An acceptable cover must be high-purity (≥99.997%) and dry (≤5 ppm moisture).

7.1.2.1 CV Assembly and Leak Testing

The detailed operating procedures shall describe activities to prepare the packaging for final closure and shipment. They shall include, at a minimum, the process steps listed below when preparing the containment vessels for closure:

1. The containment vessel O-ring grooves and sealing surfaces are visually checked for scratches that may have occurred during insertion. If scratches are found, Sect. 8.2.2 should be reviewed for criteria for evaluating surface scratches, possible repair methods for minor scratches, and rejection criteria for significant scratches.

2. The O-rings and the containment vessel sealing surfaces are free from debris and have not been damaged during loading operations. Isopropyl alcohol and lint-free cotton cloth or swabs should be used to clean the grooves and sealing surfaces. The O-rings may be wiped with lint-free gloves, cloth, or swabs. Note that the O-rings shall be lubricated with a thin coat of Super O-Lube.

3. The containment vessel sealing lid is secured to the containment vessel body by the containment vessel closure nut.

4. The closure nut is tightened to 162.7 ± 6.78 N·m (120 ± 5 ft-lb) of torque as specified in Drawing M2E801580A011 (Appendix 1.4.8). No impact wrench shall be used.

5. The assembled and loaded containment vessel is prepared for leak testing.

6. The annulus between the O-rings shall be leak tested after the CV is loaded in accordance with ANSI N14.5-1997, Sect. 7.6. The user will perform the following steps:

   - ensure that equipment used to perform leak tests has been properly calibrated to ensure the accuracy of test measurements
   - ensure that all leak testing is performed in accordance with a quality assurance program, procedures, and documents the results
   - ensure that the test method used has a sensitivity of at least 1×10^{-4} ref-cm^3/s air
   - use either the gas-pressure drop (ANSI N14.5-1997, Section A.5.1) or the gas-pressure rise (ANSI N14.5-1997, Section A.5.1) tests
   - remove the modified VCO threaded brass plug from the leak-test port opening
   - hook-up the leak test equipment into the leak-test port opening using an appropriate fitting
   - either pressurize or evacuate the annulus between the O-rings to a suitable pressure and measure the change in pressure and temperature within the test volume during a specified time period
   - pressure measurements must be accurate within 1% or less and tests should be carried out in isothermal conditions
   - calculate the total leakage rate, using the known test volume and test results and ensure that the measured leak rate is less than 1×10^{-4} ref-cm^3/s air.
7. The vacuum coupling is removed.
8. The modified VCO threaded brass plug is tightened into the leak-test port opening.

The user must ensure that their procedure meets the requirements of ANSI N14.5-1997.

If the inner O-ring requires replacement, the containment vessel must be retested per Sect. 8.2.2 prior to use. This requirement does not apply to the outer O-ring, as it is not part of the containment boundary.

Following a successful leak test, the containment vessel with its content is ready to be loaded into the drum assembly.

7.1.2.2 Drum Closing

A radiation check of the contents may be conducted prior to loading to measure the content dose rate. The measured dose rate should be compared with known values for such a test. After loading is complete, radiation measurements shall be taken to determine the package dose rate, which establishes the transport index (TI).

The detailed operating procedures shall include, at a minimum, the process steps listed below when preparing the drum assembly for closing and sealing. The operating personnel and their supervisor shall ensure that:

1. The CV assembly with content is ready for loading into the drum assembly or lowering into the drum assembly, depending on whether it was loaded outside the drum or inside the drum.

2. The drum assembly (with top plug removed) is ready to receive the containment vessel assembly and that the containment vessel assembly, silicone rubber pads, drum lid, drum-lid nuts and washers, and tamper-indicating devices (TIDs) are available.

3. The approved lifting equipment is available and in place. For lifting equipment restrictions, see Sect. 7.1.3.1.

4. The CV swivel hoist ring is removed after the CV is positioned in the drum.

5. The CV flange pad is placed on top of the containment vessel and the plug pad is placed on the inner liner shelf.

6. The top plug is placed into position over the CV using eye bolts attached to the threaded holes provided on the top plug.

7. The eye bolts are removed from the top plug.

8. The drum lid, the drum washers and bronze drum nuts are installed.

9. The nuts are tightened to 40.67 ± 6.78 N·m (30 ± 5 ft-lb) of torque with no sequence specified. No impact wrench shall be used.

10. The TIDs are attached through both TID lugs.

11. The gross package weight does not exceed 190.5 kg (420 lb).

12. Surveys for nonfixed surface contamination and radiation dose rate measurements are conducted. The nonfixed surface contamination survey shall be conducted in accordance with the user's facility procedures. The survey shall use criteria that are derived from the surface radioactivity guidance of 10 CFR 20.1906, 10 CFR 71.87(i), or the user's site-specific criteria, whichever is the most stringent.

13. Nonfixed surface contamination is removed as applicable.

14. All "empty" or inappropriate labels or tags are removed from the exterior surface of the package.

15. The package is labeled with the appropriate material description, nuclides, activity/mass, and TI in accordance with 49 CFR 172.403.

16. The package is marked with the minimum marking "Radioactive Material, Type B(U), Fissile, UN3328" in accordance with 49 CFR 172.310.

17. The package radiation dose rate at the surface is measured. The package radiation dose rate at 1 m from the surface shall be measured to establish the TI for the package and to ensure that the content does not exceed the expected or allowable dose rates (see Sect. 5). The analysis presented in the containment evaluation (Sect. 4) has determined that this is a Type B, fissile material package.

7.1.3 Preparation for Transport

7.1.3.1 Package Handling

Criticality Safety Index (CSI) values for the ES-3100 package with various payloads can be found in Table 1.3.

The ES-3100 is handled using industry-standard drum-handling equipment. Operating procedures shall include requirements to limit clamping pressures on forklift drum-handling equipment to prevent damage to the ES-3100 drum body (see Sect. 1.2.1.1 for limits on forklift gripping forces).

7.1.3.2 Decontamination

The package may be placed onto areas that are covered by disposable covering, such as plastic or paper, to reduce the nonfixed surface contamination of physical structures.

The package must be shipped in an enclosed conveyance. Generally, the exterior surfaces of the package will remain relatively clean. However, each user shall prepare procedures to clean dirty packages. These procedures shall, at a minimum, consider the following:

1. The drum is austenitic stainless steel.
2. The drum nut is silicon bronze.
3. The drum vent holes are covered with plastic push-in plugs.
4. The labels and markings on the drum must remain legible.
5. The cleaning solution must be checked for contamination.

7.1.3.3 Requirements Prior to Shipment

The shipper shall ensure that the quality control requirements of 49 CFR 173.475 and the routine determination requirements of 10 CFR 71.87 have been satisfied prior to each shipment. Detailed operating procedures [10 CFR 71.87(f)], shall provide evidence that these requirements are met and ensure that:

1. the package is proper for the content shipped and verified with the appropriate records by the user prior to content loading [10 CFR 71.87(a)];
2. the package is in unimpaired physical condition [10 CFR 71.87(b)];
3. the closure devices of the package are properly installed, secured, and free of defects [10 CFR 71.87(c)];
4. the containment vessel has been loaded properly and preparation for shipment has been followed, witnessed, and checked;

5. the internal pressure of the containment system does not exceed the design pressure during transportation [10 CFR 71.85(b)] as demonstrated by analysis (Appendix 2.10.1) and that there are no pressure-relief devices [10 CFR 71.87(e)] in the package;

6. the external radiation levels for all transport conditions are within the allowable limits as measured for Normal Conditions of Transport (NCT) [10 CFR 71.87(j)];

7. the nonfixed external contamination levels are within the allowable limits as demonstrated by surface wipes prior to content insertion, containment vessel loading, and package closure [10 CFR 71.87(I)];

8. the contents are adequately sealed and have adequate space for expansion [10 CFR 71.87(d)];

9. all records for shipment are prepared and maintained; and

10. all lifting attachment features are either inoperative during transport [10 CFR 71.87(h)] or meet the requirements of 10 CFR 71.45(a).

7.1.3.4 Leak Testing

Leak tests shall be conducted following the content loading and the containment vessel closure. The annulus between the O-rings shall be leak tested to an acceptable leak rate of 1×10^{-4} ref-cm^3/s air (or equivalent) or lower in accordance with ANSI N14.5-1997, Subclause 7.6.

7.1.3.5 Surveying

The radiation (gamma, neutron) emanating from the contents of the package shall be measured before the package is released for transport [10 CFR 71.47 and 71.87(j)]. The package radiation dose rate at the surface is measured to ensure that the content does not exceed the expected or allowable dose rates. The package radiation dose rate at 1 m from the surface is measured to establish the TI for the package. The package exterior surface contamination level limits are found in 10 CFR 71.87(i) and 49 CFR 173.443. The regulations present both fixed and nonfixed surface contamination level limits for the various radionuclides. In addition to these limits, the user may have more stringent surface contamination levels that shall also be followed.

A final visual survey of the package and loading paperwork shall be conducted to ensure that the package was assembled correctly and that it is ready for final shipment preparation. This survey may include a thorough review of the loading checklists by someone other than those who filled out the list to verify the loading operations. The area immediately surrounding the assembly operations should be surveyed, and all spare or extra parts should be identified. A final package survey may include weighing the package, hand-testing the closure nuts on the drum lid, and flexing the TIDs. The loading checklist should include a place for this final quality check to be properly recorded—including a signature and date—as being successfully completed.

7.1.3.6 Marking

The user shall ensure detailed marking procedures are consistent with 10 CFR 71.85 and the applicable subsections of 49 CFR 172, Subpart D. Each shipper shall ensure that each package containing radioactive material is marked in the manner required.

Two electrochemically etched data plates are affixed to the exterior of the drum body in the locations, and with the methods, indicated on Drawing M2E801580A031 (Appendix 1.4.8).

The packaging components (drum assembly, containment vessel body, lid, and closure nut) are also marked with their serial numbers. The numbers are used to control these parts and to accumulate their respective histories.

7.1.3.7 Labeling

The user shall prepare labeling procedures that are consistent with the applicable subsections of 49 CFR 172, Subpart E. The procedures should include the following steps, to ensure that:

1. the proper label is affixed to the package and the TI is determined at the time of loading;
2. the correct label (White—I, Yellow—II, or Yellow-III) is determined using the table from 49 CFR 172.403(c);
3. the appropriate label is affixed to two places on opposite sides of the drum;
4. the content name, nuclides and activity/mass (49 CFR 173.435), and the TI are entered in the blank spaces on the radioactive label; and
5. the information is entered legibly using a durable, weather-resistant means of marking.

Additionally, two Fissile labels are required per 49 CFR 172.402(d)(2). These labels must be affixed two places on opposite sides of the drum adjacent to the radioactive labels. The CSI must be legibly entered on the Fissile label using a durable, weather-resistant means of marking.

7.1.3.8 Securing to Vehicle

The package shall be secured against movement within the vehicle in which it is being transported under conditions normally incident to transportation [49 CFR 177.834 and 177.842(d)]. The loading procedures shall include the following measures, at a minimum, to ensure that:

1. only an approved conveyance is used,
2. all reasonable precautions are taken to prevent motion of the vehicle during loading,
3. no tampering with packages occurs during transit,
4. no vehicle is loaded or unloaded unless a qualified person is in attendance at all times, and
5. no radioactive material package is loaded onto a vehicle also carrying Div. 1.1 or 1.2 explosives (49 CFR 177.848).

7.2 PACKAGE UNLOADING

7.2.1 Receipt of Package from Carrier

Prior to shipment, the user shall verify that the receiver has agreed to accept the special nuclear material. The user (shipper) shall ensure that appropriate documentation is submitted to the receiver to ensure that the physical characteristics and hazards of the material are conveyed to the receiver.

The user shipping the package shall provide any special instructions to the receiver to safely open the package (10 CFR 71.89), including special tools and precautions for handling or unloading. These instructions shall include special actions in the event that TIDs are not intact, or if surface contamination or radiation surveys are too high.

The receiver shall accept the radioactive material by surveying the conveyance and package surface for contamination and external radiation levels. The receiver's procedures shall clearly indicate that the contamination and radiation surveys and inspections be conducted upon receipt of the package. The receiver shall, at a minimum, include the following in their procedures (in compliance with 10 CFR 71.111):

1. receive the package when offered by the carrier for delivery and,

2. monitor external surfaces of the conveyance and package for radioactive contamination and radiation levels.

All users shall include provisions for reporting safety concerns associated with the packaging or its use. The user shall notify NRC in accordance with 10 CFR 20.2202. Incidents requiring notification include:

1. removable radioactive surface contamination in excess of the limits provided by 10 CFR 71.87, and

2. external radiation levels in excess of the limits provided by 10 CFR 71.47.

The receiver shall compare the cargo with the list provided by the shipper. If a discrepancy appears between the cargo and the list, the receiver shall investigate and report to the NRC as required.

The package shall be removed from the conveyance prior to unloading the content. Unloading procedures shall, at a minimum, ensure that:

1. the package nonfixed surface contamination is below the minimum on-site or off-site requirements,

2. all appropriate package labels are affixed to the package exterior surface,

3. all lifting and handling equipment is certified for use,

4. all transfer equipment is certified for use,

5. the package is visually examined to ascertain surface damage that may have occurred during shipping or handling, and

6. the TIDs are examined to ensure that the package has not been tampered with during shipment.

If the package surface was damaged during handling or shipping, a nonconformance tag shall be completed and attached to the package for subsequent refurbishment (10 CFR 71.131). If the TIDs are found to be compromised, the receiver shall investigate and notify the NRC as required.

7.2.2 Removal of Contents

Detailed operating procedures shall describe activities required for content removal and shall identify any safety and health measures required to protect workers and the environment. The procedures shall include, at a minimum, the process steps listed below:

1. All appropriate labels for the material shipped are affixed to the exterior surface of the drum body.
2. Surveys for nonfixed surface contamination and radiation dose rate measurements are conducted.
3. As applicable, nonfixed surface contamination in excess of limits is addressed as required.
4. The TIDs remain intact until removal.
5. The weld stud nuts and washers are removed and controlled.
6. The drum lid is removed.
7. Visible portions of the interior of the drum body and top plug are still in good condition—no visible signs of damage, water damage, or tears.
8. The top plug is removed using eye bolts that can be attached to the threaded holes provided on the top plug.
9. The silicone rubber CV flange pad is removed from above the containment vessel.
10. The containment vessel top is in good condition—no visible signs of damage or loose closure nut.
11. A surface contamination check is conducted to discover any leak of radioactive material.
12. The containment vessel is removed from the drum assembly. The containment vessel is placed onto the work area. (This step may not be required if CV is unloaded while in the drum.)
13. The external retaining ring, containment vessel closure nut, and containment vessel sealing lid are removed and controlled. (No pressure buildup is expected under NCT.)
14. The O-rings and the O-ring grooves on the containment vessel flange are protected from damage during unloading.
15. The HEU content (convenience cans or bottles) and associated packing materials (can spacers, stainless-steel scrubbers, silicone can pads, etc.) are removed from the containment vessel in accordance with site-specific material-handling procedures.
16. The items removed and the inside of the containment vessel are checked for nonfixed surface contamination.

7.3 PREPARATION OF EMPTY PACKAGE FOR TRANSPORT

The user shall develop detailed procedures to prepare an empty package for storage or transport. These procedures shall, at a minimum, ensure that:

1. The package has been emptied of all radioactive contents.

2. The radiation level at any point on the external surface of the package does not exceed 0.5 mrem/h.

3. The nonfixed radioactive surface contamination on the external surface of the packaging does not exceed the limits specified in 49 CFR 173.443(a), and the internal contamination level does not exceed 100 times the limits in 49 CFR 173.443(a).

4. The package is not damaged, and there is no visible internal or external surface moisture or corrosion.

5. The package is closed.

6. No leakage of radioactive material under conditions normally incident to transportation can occur.

7. Any labels previously affixed in accordance with Subpart E of 49 CFR 172 are removed, obliterated, or covered. Leak-test labels should not be removed from the drum body.

8. The "EMPTY" label prescribed in 49 CFR 172.450 is affixed to the drum.

9. An appropriate notice is provided giving the name of the consignor or consignee. An example notice is, "This package conforms to the conditions and limitations specified in 49 CFR 173.428 for radioactive material, excepted package—empty packaging, UN2908."

7.4 OTHER OPERATIONS

None.

SECTION 7 REFERENCES

10 CFR 20, *Standards for Protection Against Radiation*, Jan. 1, 2007.

10 CFR 71, *Packaging and Transportation of Radioactive Material*, Jan. 1, 2007.

49 CFR, *Transportation*, Oct. 1, 2007.

ANSI N14.5-1997, *Radioactive Materials—Leakage Tests on Packages for Shipment*, American Natl. Standards Institute, Feb. 5, 1998.

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Shipping packages used to transport radioactive materials shall be fabricated, procured, and maintained in accordance with applicable Nuclear Regulatory Commission (NRC), U.S. Department of Transportation (DOT), and other federal, state, and local regulations to protect the health and safety of the public, the workers, and the environment. Furthermore, the packages shall be fabricated, procured, and maintained according to the user site quality assurance (QA) plan.

Minimum requirements for fabricating, procuring, and maintaining the packaging are presented in this section. The owner and user shall develop detailed procedures based on criteria contained herein and on the Certificate of Compliance (CoC). These procedures shall be in accordance with Subparts G and H of 10 CFR 71.

Fabrication specifications for ES-3100 components are listed on fabrication drawings (Appendix 1.4.8) and equipment specifications (Appendices 1.4.2 – 1.4.5). The containment vessel is designed and built to meet American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, Sect. III, Division I, Subsection NB (ASME B&PVC, Sect. III, Div. 1).

8.1 ACCEPTANCE TESTS

The owner shall determine that the packaging has been fabricated in accordance with the approved design [10 CFR 71.85(c)]. The owner may use the inspection guidance provided by the NRC in NUREG/CR-6314 for conducting QA inspections of packaging suppliers. The packaging includes:

1. a reinforced stainless-steel drum, inner liner, lid, weld studs, Kaolite 1600 insulation; Cat 277-4 neutron absorber; drum flat cover plate; nylon vent hole plugs; top plug (consisting of sheet steel and Kaolite 1600); hex nuts; washers; paint; and

2. a containment vessel body, sealing lid, closure nut, and retaining ring; O-rings; modified VCO threaded brass plug.

Requirements are derived from the packaging drawings and specifications and shall be considered as minimum requirements, and their information shall be present in the owner's fabrication records.

The containment vessel procurement specification is presented in Appendix 1.4.3. This specification indicates the records and reports required to properly document the quality of the containment vessel fabricated by a vendor in accordance with the QA requirements.

The minimum acceptance inspection and test requirements for the packaging components (Tables 8.1 and 8.2) are presented in the following sections. Prior to first use of the package, these requirements must be met.

Table 8.1. Acceptance tests for the drum assembly

Packaging[a]	Inspection	Structural and pressure tests	Leak tests
Drum, 30-gal modified, including lid, drum flat cover	Material certification[b], gauging,[c] marking, liquid penetrant, weld inspection (per Sect. 8.1.2), corrosion, dents	Tensile, percent elongation, yield point, chemistry	Pressure test (10 psig for 5 min)
Weld stud, ARC FT 5/8-11UNC × 7/8 LG, 304/304L stainless steel	Part certifications	Tensile, percent elongation, yield point, chemistry	NA[d]
Inner liner weldment and top plug, 304/304L stainless-steel	Material certifications, gauging, weld inspection (per Sect. 8.1.2)	Tensile, percent elongation, yield point, chemistry	NA
304/304L stainless-steel 0.25-in. internal flange	Material certifications, gauging, weld inspection (per Sect. 8.1.2)	Tensile, percent elongation, yield point, chemistry	NA
Nut, ⅝-in.-11UNC silicon bronze	CoC[e], damage	NA	NA
Data plates	Marking	NA	NA
Paint: black enamel	CoC	NA	NA
Cat 277-4	Material certification, sample pour	NA	NA
Kaolite 1600 castable refractory-cured thermal insulation	CoC	NA	NA
Flat washer, 0.812-in. ID × 1.375-in. OD × 0.250-in.-thick stainless steel	CoC, damage	NA	NA
Lid TID lug, modified 304L stainless steel chain 3/16-in trade size, .20 diam	CoC, damage	NA	NA
Plug, plastic push-in, Micro Plastic Inc., 62MP0312	CoC	NA	NA
Silicone rubber pads 22 ± 5 Shore A. Parts M2E801580A009-1 Parts M2E801580A009-2 Parts M2E801580A009-3	CoC, damage, marking	NA	NA

[a] Appendix 1.4.8
[b] Material Certification - Certified quantitative data (physical, mechanical, chemical, functional, dimensional, and/or visual) demonstrating compliance with the drawing/specification requirements.
[c] Gauging refers to dimensional inspections according to "Diamond I" callouts on the drawings.
[d] NA—Not applicable.
[e] CoC, Certification of Compliance - A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.

Table 8.2. Acceptance tests for the containment vessel assembly

Packaging [a]	Inspections	Structural and pressure tests	Leak tests
Body assembly, lid assembly (as applicable)	Material certification [b], gauging, [c] marking, liquid penetrant, weld inspection (per Sect. 8.1.2), qualification tests, corrosion, scratches	Hydrotest	Helium leak test
O-ring (inner), 5.359-in. ID, 0.139-in. diameter stock	Material certification, gauging, packaging, marking	Shore A durometer, elongation	NA [d]
O-ring (outer), 5.859-in. ID, 0.139-in. diameter stock	Material certification, gauging, packaging, marking	Shore A durometer, elongation	NA
Closure nut Nitronic 60 SST, ASME SA-479	Material certifications, gauging,	Tensile, percent elongation, yield, chemistry	NA
External retaining ring	CoC [e], damage	NA	NA
Modified VCO threaded brass plug for leak-test port	CoC, damage	NA	NA
Heavy can spacer assembly [f]	Material certification, sample pour	NA	NA

[a] Appendix 1.4.8.
[b] Material Certification - Certified quantitative data (physical, mechanical, chemical, functional, dimensional, and/or visual) demonstrating compliance with the drawing/specification requirements.
[c] Gauging refers to dimensional inspections for according to "Diamond I" callouts on the drawings.
[d] NA—Not applicable.
[e] CoC, Certification of Compliance - A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.
[f] Not part of containment vessel.

8.1.1 Visual Inspections and Measurements

Visual inspections with the unaided eye of all pertinent features on the package shall be performed during fabrication. These inspections include paint color; surface condition; marking content; gauging (toleranced dimensions, positioning, edge breaks, surface finish); and welding. The required inspections are described in Tables 8.1 and 8.2.

8.1.1.1 Paint color

Paint color, which is not a safety item, is used to identify, segregate, and document packages and packaging. The acceptance criteria for paint color are given in the respective federal specifications referenced by the drawings (Appendix 1.4.8). Incorrect or incomplete application of paint is cause for rejection. An application of incorrect letters or misspelled words is also cause for rejection. The item may be reworked to meet the specification.

8.1.1.2 Surface condition

The surfaces of the drum assembly and containment vessel shall be visually inspected for penetrations, dents, and corrosion. Dents >1-in. deep in the drum body will be cause for the drum body

to be reworked to remove the dent. The containment vessel surfaces must be in accordance with the dimensional requirements on the drawings. Penetrations will be cause for the component to be reworked, including dye-penetrant and radiographic testing.

The ES-3100 components shall be stored in weather-protected indoor facilities. However, before acceptance of any ES-3100 component, all surfaces shall be inspected for corrosion. The presence of surface corrosion (rust) on any component will be cause for further inspection. If the rust can be easily wiped off and no pitting is apparent beneath it, the component is acceptable. If the rust cannot be easily wiped off, or if scaling is present or pitting is observed, then the surface will be repaired and the component must undergo a dimensional inspection and dye-penetrant and/or radiographic testing to determine the extent of the damage. In the case of the containment vessel, a hydrostatic test shall be performed. All acceptance criteria for a newly fabricated component (Appendices 1.4.2, 1.4.3, and 1.4.8) shall apply to the repaired component. If the rust has compromised the structural integrity of the component [i.e., the component no longer meets dimensional criteria for a new part as specified on the drawings], then the component shall be rejected.

8.1.1.3 Marking package components

Markings on the package components identify the hazardous content and provide traceability to the fabrication and past use of the package. All markings (serial numbers, model numbers, instructions, identification) shall be compared with the drawings' requirements for correct content. The acceptance criteria (paint color and dimensions) for markings are given in the drawings in Appendix 1.4.8. Incorrect or incomplete marking is cause for rejection. The item may be reworked to meet the specification.

8.1.1.4 Gauging

The ES-3100 drawings list the dimensions/tolerances (height, width, thickness, diameter); positions (bolt holes, grooves, leak-test port); edge break; and surface finishes (smoothness, passivation, coating, bonding, plating, cleanliness). More important dimensions on the drawings are marked with a "Diamond I" symbol. Inspection of gauging features shall be performed on these "Diamond I" dimensions only to ensure that each component meets dimensional tolerances, which are provided on the drawings. Gauging outside the tolerance is cause for rejection. The item may be reworked to meet the specification, or the specification may be deviated from and accepted.

8.1.2 Weld Examinations

All welded or weld-repair surfaces shall be visually examined by a qualified weld examiner for indications of inclusions, cracks, or porosity using a written weld examination procedure. Weld examiners are qualified to perform visual weld inspections in accordance with SNT-TC-1A (2001 Edition), "Personnel Qualification and Certification in Nondestructive Testing;" or ANSI/ASNT CP-189 (2001 Edition), "ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel;" published by the American Society for Nondestructive Testing. ASME Boiler and Pressure Vessel Code, Section IX is to be employed as the applicable requirement. Section VIII of the ASME B&PVC Code is invoked for acceptance criteria for Code-specified examinations which are to be performed in accordance with the provisions of ASME B&PVC Section V. Any indication of inclusions, cracks, or porosity in the welds is cause for rejection. The item may be reworked to meet the specifications.

8.1.3 Structural and Pressure Tests

Structural tests for the drum and containment vessel include mechanical properties, and chemical tests to ensure that the correct materials are used. The containment vessel is hydrotested (pressure tested) to ensure that the vendor fabrication meets the requirements. These tests are discussed below. The drum body is mechanically tested (handling test) and pressure tested in accordance with the QA provisions in Military Specification, *Drum, Metal—Shipping and Storage*, MIL-D-6054F.

8.1.3.1 Mechanical property tests

Material mechanical property tests shall be performed to determine the ultimate tensile strength, yield strength, percent elongation, percent reduction in area, and hardness of the containment vessel materials. Their acceptance criteria at operating temperature are provided in the appropriate material national standard referenced by the drawings (Appendix 1.4.8). An out-of-specification property is cause for rejection.

8.1.3.2 Chemical tests

Tests shall be performed to determine the chemical properties of the packaging materials. The acceptance criteria and their sensitivity are provided in the appropriate material national standard referenced by the drawings (Appendix 1.4.8). An out-of-specification chemical property is cause for rejection. Material that cannot be traced to the mill or heat-treatment lot shall be rejected.

8.1.3.3 Pressure tests

The containment vessel shall be pressure tested per *ASME Boiler and Pressure Vessel Code*, Sect. III, Div. 1. The vessel shall be subjected to an internal water pressure of 150% of design pressure (Sect. 2.1.2). Visible indication of a leak on the exterior surface of the containment vessel is cause for rejection. All containment vessels will undergo such testing. All surfaces must be thoroughly dried after the hydrostatic test as the CV envelope will undergo final helium leak testing subsequent to the hydrostatic test.

8.1.4 Leakage Tests

For acceptance, all containment vessels will be leak tested when they are initially fabricated, and that test will be witnessed by QA personnel. The fabrication vacuum leak test of the containment boundary shall be performed after the pressure test in accordance with ANSI N14.5-1997, Sect. 7.3, "Fabrication Leakage Rate Test" with a test flange assembly installed. (Note: Periodic and maintenance leak tests are discussed in Sect. 8.2.2.) The fabrication vacuum leak test demonstrates that the containment vessel is fabricated properly and that the containment boundary is "leaktight." An integrated leak rate exceeding 1.9×10^{-7} atm-cm^3/s of helium (or equivalent) is cause for rejection. Per ANSI N14.5-1997, the test procedure should have a sensitivity of one-half the reference air leakage rate (L_R).

The tester must ensure that their procedure meets the requirements of ANSI N14.5-1997. All containment vessel leakage rate tests will be performed using certified equipment.

Following successful completion of the leak-test, the tester will include information such as the name of the operator, expiration date, etc., on leak test labels which will be attached to the containment

vessel and drums. Section 8.2.2 addresses the acceptance vacuum leak test during refurbishment. All containment vessels shall undergo such testing.

8.1.5 Component and Material Tests

8.1.5.1 O-ring tests

The O-ring visual and mechanical tests are described below. Additionally, the fabrication leak test required in Sect. 8.1.4, the periodic and maintenance leak tests required in Sect. 8.2.2, and the preshipment leak test required in Sect. 7.1.2.1 test the functionality of the O-rings within the package.

Visual inspection

A visual inspection of the O-ring surface shall be performed. The surface shall be smooth, nonporous, and free of skin defects. O-rings that do not meet these requirements shall be rejected.

Each O-ring shall be packaged separately to provide traceability. Each O-ring package shall be marked with the O-ring identification number, lot number, cure date, and compound number. The material identification numbers shall be assigned uniquely to each lot and to each size of O-ring. The identifications shall be adequate to trace the O-rings to their raw material master batch. Improper packaging or marking is cause for rejection.

Mechanical properties

The O-ring material mechanical properties of hardness and elongation shall be determined for each lot. Their acceptance criteria and sensitivity are:

1. hardness of Shore A 70 ± 5 durometer, and

2. elongation of 100%, minimum.

All O-rings in a lot that fail to meet these criteria shall be rejected. If O-rings from a rejected lot have already been used, the licensee shall locate all such O-rings and either examine or discard them. O-rings from a rejected lot that are in a containment vessel that is still loaded shall be removed at the earliest possible time.

8.1.6 Shielding Tests

No gamma or neutron radiation shields are integral to the packaging.

The Cat 277-4 neutron absorber material (fabrication specification JS-YMN3-801580-A005, Appendix 1.4.5) is specifically designed for criticality safety. Acceptance testing for the Cat 277-4 liner will be described in the fabrication specification.

8.1.7 Thermal Tests

A thermal acceptance test is not required for this package. The maximum decay heat generated by the radioactive material is 0.4 W (Sect. 1.2.3.7 and 3.1.2), which is negligible. Fabrication of the Kaolite 1600 thermal insulation in accordance with the fabrication specification (Appendix 1.4.4) fulfills the obligation for a thermal acceptance test.

8.1.8 Miscellaneous Tests

Material certification and visual inspection for damage are required for the following packaging components: plastic pieces, washers, tamper-indicating devices (TIDs), and paint. All materials shall be in compliance with the respective material properties and tested when applicable, as stated in their respective specifications. A nonconforming or damaged part is cause for rejection.

To prevent the use of noncertified fasteners, acceptance inspection and tests have been added to ensure their quality. The fastener structural tests include mechanical property tests and chemical tests to ensure that the correct materials were used.

8.2 MAINTENANCE PROGRAM

When the package is being loaded or unloaded, it shall be examined to ensure that all parts are present and functional. A record shall be generated of this examination activity with the affected part numbers, personnel doing the work, and the date of the activity being recorded. This examination activity and the activities associated with the periodic and maintenance leak tests are considered refurbishment activities. Periodic maintenance of the ES-3100 shall be performed on an annual basis, and shall include visual inspections and leak tests. No ES-3100 shall be used unless maintenance documentation reflects the package is current on periodic maintenance. The periodic and maintenance refurbishment requirements are given below.

8.2.1 Structural and Pressure Tests

Structural and/or pressure tests, as identified in Sect. 8.1.3, shall be performed as appropriate for the respective part or component after welding or other structural repairs are made. Welding and structural repairs of the containment vessel involve rework operations and are considered beyond the scope of refurbishment activities.

8.2.2 Leakage Tests

The fabrication leak test must be performed before the first use and periodic leak tests are performed annually thereafter while the package is in use.

Maintenance and periodic leak tests, as defined by ANSI N14.5-1997, Sects. 7.4 ("Maintenance Leakage Rate Test") and 7.5 ("Periodic Leakage Rate Test"), shall be performed during refurbishment when necessary. The fabrication leakage rate test (Sect. 8.1.4) is performed prior to the package's first use; the package must be retested following repair or replacement of a containment system component (maintenance leakage-rate test) or annually while the package is in use (periodic leakage-rate test). Packages that are not in use and have not had a periodic leakage-rate test within the last 12 months must be tested prior to use.

Users may utilize either of the following leakage tests which are conducted in accordance with ANSI N14.5-1997 as long as they have suitable sensitivity:

- A.5.3 - Gas-Filled Envelope
- A.5.4 - Evacuated Envelope (gas detector)

The following steps are required:

- ensure that equipment used to perform leak tests has been properly calibrated to ensure the accuracy of test measurements
- ensure that all leak testing is performed in accordance with a quality assurance program, procedures, and documents the results
- ensure that the test method used has a sensitivity of at least 1×10^{-8} ref-cm^3/s
- use either the gas-filled envelope (ANSI N14.5-1997, Section A.5.3) or the evacuated envelope - gas detector (ANSI N14.5-1997, Section A.5.4) tests
- remove the modified VCO threaded brass plug from the leak-test port opening
- thoroughly dry the test item before assembly
- use the leak testing flange specified in the drawings (Appendix 1.4.8). NOTE: only the inner O-ring is used for these tests
- connect the leak test equipment to the flange fitting
- either evacuate the containment vessel connected to a gas detector and surround the item with an envelope filled with helium; or, fill the containment vessel with helium while the item is placed in a vacuum chamber connected to a gas detector
- measure the actual leak based on comparison with a calibrated standard leak and verify that it is less than 1×10^{-7} ref-cm^3/s.

Maintenance and periodic leak tests shall be performed using the same procedure and with the same acceptance criteria as the fabrication leakage rate test described in Sect. 8.1.4. The maintenance and periodic leak tests test the entire containment boundary with an integrated leak rate exceeding 1.9×10^{-7} atm-cm^3/s of helium (or equivalent) as cause for rejection. With successful completion of the test, the entire containment boundary is considered "leaktight." The user must ensure that his or her procedure meets the requirements of ANSI N14.5-1997. Note that these maintenance and periodic leak tests are required any time the inner O-ring is replaced.

If a package does not pass the preshipment leakage-rate test described in Sect. 7.1.2.1 of this Safety Analysis Report, the O-ring sealing surfaces shall be examined. Nicks and scratches of the O-ring groove in the containment vessel flange or sealing surfaces of the containment vessel sealing lid may be smoothed with a stone or with fine sandpaper to return them to specification. Deep scratches are cause for rejection. The O-rings shall be visually examined with the unaided eye for roughness, porosity, or surface defects and will be replaced as necessary. If such actions fail to rectify the inability of the vessel to pass the leak test, further inspection of the containment boundary, including inspection of the welds if present for cracks, may be performed, or the vessel may be permanently rejected. If further work is required for the containment vessel to pass the leak test (such as repair of deep scratches in the O-ring groove or repair of any of the vessel welds), the vessel shall undergo the acceptance tests outlined in Sect. 8.1 prior to reuse.

8.2.3 Component and Material Tests

Since the Kaolite insulation material and Cat 277-4 are encapsulated within the stainless-steel liner, no damage or deterioration is expected. However, the drum, liner, internal flange, flat cover, and top plug shall all be visually inspected for tears or punctures or other defects that would allow for the escape of insulating or neutron-absorbing material. The drum assembly and top plug will be weighed prior to first use and during each refurbishment to ensure that there have been no density changes in the Kaolite 1600 or the Cat 277-4. A weight change of either item >3 lb is cause for rejection. Other components, such as fasteners, O-rings, etc., are examined at each refurbishment and use and replaced as needed.

8.2.4 Thermal Tests

No thermal test is required.

8.2.5 Miscellaneous Tests

8.2.5.1 Visual inspection for corrosion

The ES-3100 package will be stored in weather-protected indoor facilities; thus, surface corrosion is not expected. However, before each use and during annual inspections, all surfaces shall be visually inspected for corrosion (rust). The observation of surface rust on any component will be cause for further inspection. If the rust can be easily wiped off and no pitting is apparent beneath it, the package is acceptable for use. If the rust cannot be easily wiped off, if scaling is present, or if pitting is observed, the component must undergo dye-penetrant and radiographic testing to determine the extent of the damage before the package can be used.

8.2.5.2 Visual inspection of containment vessel

The containment vessel lid must be removed before performing maintenance or periodic visual inspections on the containment vessel.

The containment vessel surfaces shall be examined for moisture. Water could enter the containment vessel due to improper assembly, defective O-rings, scratches on the O-ring groove or sealing surfaces, or through cracks in welds. Any containment vessel exhibiting signs of water inside will be tagged and segregated until the cause is determined and corrected and the containment vessel has been successfully reinspected.

8.2.5.3 Subsystem maintenance

Defects in the drum (tears, broken welds, or dents >1-in. deep) are cause for rejection and possible reporting to the NRC in accordance with 10 CFR 21 requirements. Failure of the drum seam weld or bottom end-to-body weld shall be recorded as a failure and compared to others. If a statistically significant quantity of drum-weld failures from a single lot exist, then all drums from that lot shall be examined for weld failures. Those with failures shall be repaired; those without failures shall be released for use.

Touch-up paint for cosmetic purposes may be applied to the markings.

The data plates shall be visually examined. The ES-3100 data plate shall contain the appropriate certification numbers and shall be welded to the drum surface. All surfaces of the drum body shall be visually inspected for moisture prior to content loading, during preparation of empty packages for shipment and storage, and during maintenance activities.

8.2.5.4 Fastener inspection

During refurbishment of the ES-3100 package, the operators shall inspect the fasteners to determine if they have the proper certification markings. If there is any question about the certification status of the fasteners, all the fasteners shall be replaced with certified replacements.

Containment vessel lid assembly fasteners (closure nut and retaining ring) and the drum lid fasteners (5/8-in.-11UNC bronze hex nuts) shall be visually inspected during all routine maintenance activities and pre-use inspections. Fasteners with damaged threads (evidence of cross-threading or flattened threads) or excessive wear (visually apparent rounding of the fastener threads) must be replaced with certified replacements. Fastener replacement will be documented in the package maintenance records.

8.2.5.5 Valves, rupture disks, and gaskets on containment vessel

The O-rings are visually inspected for defects such as roughness, porosity, and outer surface defects. Defective O-rings are discarded. After each use, the containment vessel is refurbished; the containment boundary (including the O-rings) is checked for sealing ability. See Sect. 8.2.2 for the requirements of the leak test of the containment boundary during refurbishment.

All O-rings in use will be replaced annually. After O-ring replacement, the containment vessel must be re-tested per Sect. 8.2.2. Furthermore, new O-rings, will not be stored for more than four years from the date of manufacture. Thus, no O-rings will be used that have been manufactured more than five years prior to the date of last use.

There are no valves or rupture disks in the packaging.

8.2.5.6 Miscellaneous

The drum and top plug will be weighed prior to first use and during each refurbishment to ensure that there have been no density changes in the Kaolite 1600 or the Cat 277-4. For the purpose of weight, the drum does not include lid, pads (except the lower CV pad), nuts, or washers. Weights will be compared to the weights prior to first use, and the drum or top plug will be rejected and evaluated for rework if the weight change of either item is >3 lb.

The silicone rubber pads* shall be inspected during the annual recertification maintenance to verify that there are:

1. no pad swellings due to moisture absorption;
2. no gouges, cuts, tears, or nondesign voids in the pads;
3. no unauthorized modifications to the pads; and
4. no substitutions of pads with unauthorized replacements.

* The lower CV pad does not have to be removed unless visual inspection from top of cavity indicates a potential issue as described here.

SECTION 8 REFERENCES

10 CFR 21, *Reporting of Defects and Noncompliance*, Jan. 1, 2007.

10 CFR 71, *Packaging and Transportation of Radioactive Material*, Jan. 1, 2007.

49 CFR, *Transportation*, Oct. 1, 2007.

ANSI N14.5-1997, *Radioactive Materials—Leakage Tests on Packages for Shipment*, American Natl. Standards Institute, Feb. 5, 1998.

ASME Boiler and Pressure Code, An American National Standard, Sect. II, *Materials*, and Section IX, *Welding and Brazing Qualifications*, American Society of Mechanical Engineers, New York, 2001 ed. with 2002 and 2003 addenda.

ASME Boiler and Pressure Code, An American National Standard, Rules for Construction of Nuclear Facilities, Sect. III, Div. 1, American Society of Mechanical Engineers, New York, 2001 ed. with 2002 and 2003 addenda.

MIL-D-6054F, *Drum, Metal—Shipping and Storage*, June 30, 1989.

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