

(14)

btf.inp

04/08/2003

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!-----
!
! Holtec HISTAR 100 MPC-24
! ANSYS 5.5
!
!   btf.inp  -- HOLTEC HISTAR 100 / MPC-24
!   fire thermal analysis for MPC
!   Units: btu, inch, hour, F, lbm
!
! Required macros and files:
!   btf.inp      - main input deck (this file)
!   btf.des      - description file with geometry and material specs
!   borai.mac    - borai gap radiation/conduction macro
!   fuel.mac     - fuel conductivity macro
!-----
!
! Initialize the ANSYS build
!-----
!
! fini $/clear $/anno,dele $/devd,font,1,,,,14 $/devd,font,1,,,,14
! /config,nproc,2
! /nerr,,1000000000
! *afun,deg $/filn,mpc24
! /prep7
! /out,build,out
! *get,t_start,active,,time,wall
! immed,0 $/pnum,kp,1 $/pnum,line,1 $/pnum,area,1
! abbres,new,default,abbr
!-----
!
! Input the MPC in overpack description file
! Normal transport - transient fire load - cooldown
!-----
!
! /input,btf,des
!-----
!
! Define element types
!-----
!
! et,1,plane55,1
! et,2,link31
! et,3,mesh200,6
! ET,11, solid70
!-----
!
! Define mesh element size factors
!-----
!
! esf=1.5           ! Fuel region default element size
! edefsiz=3         ! Default element size of unit cell
! engg=2            ! Elements across gas gap in unit cell
! enrcth=2          ! Elements across radial channel thickness
!-----

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! Begin model construction
!-----
!
!----- generate primary cell configuration ----
!
! This sample cell will be used to generate all of the cells in the
! basket. A cell of the proper pitch is created by dragging a set of
! lines along a path of lines. Each set of lines is sectioned into
! appropriate lengths to create areas to aid in defining the various
! components (fuel, guide tube, etc.) as well as features found only
! on the bounding cells. This cell is symmetric along the 45 degree
! line, although that is not necessary for this procedure. These areas
! will be meshed and the generation of the remaining cells create areas
! and elements, although there will be coincident nodes and keypoints
! that need to be NUMM together. The unit cell in this case goes from
! the lower left corner of the basket plate intersection to the upper
! right corner of the air gap between the guide tube and basket plates.
!-----
!
!---- define cutting planes for unit cell ----
!
! There are cuts for the support plates on cells 2, 7, 12, and 24. These
! probably could have been omitted to have less areas to mess with, and
! find another way to generate those supports.
!
vertnum=17 $*dim,vertcut,array,vertnum
vertcut(1)=tk1 ! left inside guide tube
vertcut(2)=tk1+fuelgap ! left outside fuel
vertcut(3)=tk1+(gtube_i-wd3)/2 ! left side wide boral
plate
vertcut(4)=.999+1/32 ! tube 7 support plate
vertcut(5)=.999+1/32+tk1 ! tube 7 support plate
vertcut(6)=tk1+(gtube_i-wd6)/2 ! left side narrow boral
plate
vertcut(7)=tk1+(gtube_i+wd6)/2 ! right side narrow boral
plate
vertcut(8)=tk1+gtube_i+tk1-.999-1/32-tk1 ! tube 12 support plate
vertcut(9)=tk1+gtube_i+tk1-.999-1/32 ! tube 12 support plate
vertcut(10)=tk1+(gtube_i+wd3)/2 ! right side wide boral
plate
vertcut(11)=tk1+gtube_i-fuelgap ! right outside fuel
vertcut(12)=tk1+gtube_i ! right inside guide tube
vertcut(13)=tk1+gtube_i+tk1a ! right outside guide tube
vertcut(14)=tk1+gtube_i+tk1a+(tk4+2*gp1) ! left boral plate/air gap
combo thickness
vertcut(15)=tk1+gtube_i+tk1a+(tk4+2*gp1)+tk3 ! left boral sheathing
thickness
vertcut(16)=celptch-(tk4+2*gp1)-tk3 ! right boral sheathing
thickness
vertcut(17)=celptch-(tk4+2*gp1) ! right boral plate/air
gap combo thickness
horiznum=17 $*dim,horizcut,array,horiznum
*do,i,1,horiznum
horizcut(i)=vertcut(i)
*enddo
!
!---- create unit cell by drag operation ----
!
csys,0
xoff1=-100 !x construction location offset
yoff1=+100 !y construction location offset
_do=100 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
! horizontal line creation (for sweeping)

```

```

k,_do+1,xoff1,yoff1
*do,i,1,vertnum
  k,_do+i+1,xoff1+vertcut(i),yoff1
  l,_do+i,_do+i+1
*enddo
k,_do+vertnum+2,xoff1+celptch,yoff1
l,_do+vertnum+1,_do+vertnum+2
! vertical line creation (for sweeping along)
k,_do+vertnum+3,xoff1,yoff1+vertcut(1)
l,_do+1,_do+vertnum+3
*do,i,2,vertnum
  k,_do+i+vertnum+2,xoff1,yoff1+vertcut(i)
  l,_do+i+vertnum+1,_do+i+vertnum+2
*enddo
k,_do+vertnum+3+vertnum,xoff1,yoff1+celptch
l,_do+vertnum+2+vertnum,_do+vertnum+3+vertnum
lsel,,loc,y,yoff1 $cm,linedrag,line
alls

adrag,linedrag,,,,,_do+vertnum+1,_do+vertnum+2,_do+vertnum+3,_do+vertnum+4,
_do+vertnum+5
lsel,,loc,y,yoff1+vertcut(5)-.01,yoff1+vertcut(5)+.01 $cm,linedrag,line
alls

adrag,linedrag,,,,,_do+vertnum+6,_do+vertnum+7,_do+vertnum+8,_do+vertnum+9,
_do+vertnum+10
lsel,,loc,y,yoff1+vertcut(10)-.01,yoff1+vertcut(10)+.01 $cm,linedrag,line
alls

adrag,linedrag,,,,,_do+vertnum+11,_do+vertnum+12,_do+vertnum+13,_do+vertnum
+14,_do+vertnum+15
lsel,,loc,y,yoff1+vertcut(15)-.01,yoff1+vertcut(15)+.01 $cm,linedrag,line
alls
adrag,linedrag,,,,,_do+vertnum+16,_do+2*vertnum,_do+2*vertnum+1
numm,kp
!
! --- create component names and assign element attributes ---
!
alls
cm,gen_cell,area
!
! fuel
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(2),xoff1+vertcut(11)
asel,r,loc,y,yoff1+horizcut(2),yoff1+horizcut(11)
cm,gen_fuel,area
aatt,1,,1
!
! air around fuel
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(1),xoff1+vertcut(12)
asel,r,loc,y,yoff1+horizcut(1),yoff1+horizcut(12)
cmsel,u,gen_fuel
cm,gen_airf,area
aatt,5,,1
!
! guide tube
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(1),xoff1+vertcut(13)
asel,r,loc,y,yoff1+horizcut(1),yoff1+horizcut(13)
cmsel,u,gen_fuel
cmsel,u,gen_airf
cm,gen_guid,area
aatt,2,,1
!

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```

! basket plates
!
cmsel,,gen_cell
asel,u,loc,x,xoff1+vertcut(1),xoff1+celptch
cm,plate1,area
cmsel,,gen_cell
asel,u,loc,y,yoff1+horizcut(1),yoff1+celptch
cm,plate2,area
cmsel,a,plate1
cm,gen_plat,area
aatt,2,,1
!
! boral plate (wide)
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(3),xoff1+vertcut(10)
asel,r,loc,y,yoff1+horizcut(13),yoff1+horizcut(14)
cm,gen_br1w,area
aatt,10,,1
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(3),xoff1+vertcut(10)
asel,r,loc,y,yoff1+horizcut(17),yoff1+celptch
cm,gen_br2w,area
aatt,10,,1
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(13),xoff1+vertcut(14)
asel,r,loc,y,yoff1+horizcut(3),yoff1+horizcut(10)
cm,gen_br3w,area
aatt,9,,1
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(17),xoff1+celptch
asel,r,loc,y,yoff1+horizcut(3),yoff1+horizcut(10)
cm,gen_br4w,area
aatt,9,,1
cmsel,a,gen_br1w $cmsel,a,gen_br2w $cmsel,a,gen_br3w
cm,gen_borw,area
!
! boral sheathing (wide)
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(3),xoff1+vertcut(10)
asel,r,loc,y,yoff1+horizcut(14),yoff1+horizcut(15)
cm,gen_sh1w,area
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(3),xoff1+vertcut(10)
asel,r,loc,y,yoff1+horizcut(16),yoff1+horizcut(17)
cm,gen_sh2w,area
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(14),xoff1+vertcut(15)
asel,r,loc,y,yoff1+horizcut(3),yoff1+horizcut(10)
cm,gen_sh3w,area
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(16),xoff1+vertcut(17)
asel,r,loc,y,yoff1+horizcut(3),yoff1+horizcut(10)
cm,gen_sh4w,area
cmsel,a,gen_sh1w $cmsel,a,gen_sh2w $cmsel,a,gen_sh3w
cm,gen_shw,area
aatt,4,,1
!
! outer air
!
cmsel,,gen_cell
cmsel,u,gen_fuel
cmsel,u,gen_airf
cmsel,u,gen_guid
cmsel,u,gen_plat
cmsel,u,gen_borw
cmsel,u,gen_shw

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```

cm,gen_airo,area
aatt,7,,1
!
! Make components for external areas to generate boundaries of
! the outer basket cells
!
! side edges
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(16),xoff1+celptch
cm,gen_lefo,area
cmsel,,gen_cell
asel,r,loc,x,xoff1,xoff1+vertcut(1)
cm,gen_rigo,area
cmsel,,gen_cell
asel,r,loc,y,yoff1+horizcut(16),yoff1+celptch
cm,gen_boto,area
cmsel,,gen_cell
asel,r,loc,y,yoff1,yoff1+horizcut(1)
cm,gen_topo,area
!
! outer corner edges
!
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(16),xoff1+celptch
asel,r,loc,y,yoff1,yoff1+horizcut(1)
cm,gen_tlo,area
cmsel,,gen_cell
asel,r,loc,x,xoff1,xoff1+vertcut(1)
asel,r,loc,y,yoff1,yoff1+horizcut(1)
cm,gen_tro,area
cmsel,,gen_cell
asel,r,loc,x,xoff1+vertcut(16),xoff1+celptch
asel,r,loc,y,yoff1+horizcut(16),yoff1+celptch
cm,gen_blo,area
cmsel,,gen_cell
asel,r,loc,x,xoff1,xoff1+vertcut(1)
asel,r,loc,y,yoff1+horizcut(16),yoff1+celptch
cm,gen_bro,area
!
!---- mesh the unit cell ----
!
alls
lesize,_do+6,esf
lesize,_do+15,,,engg
lesize,_do+24,esf
lesize,_do+33,,,engg
mshkey,1 $mshape,0,2D $esize,edefsiz
amesh,all
!
!-----
!
!---- create MPC shell ----
!
!-----
!
alls
centx=0 $centy=0
local,21,1,centx,centy
csys,0
_do=30000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,30000,centx,centy
circle,30000,rinner,,,360,4
circle,30000,router,,,360,4
l,_do+1,_do+5
l,_do+2,_do+6
l,_do+3,_do+7
l,_do+4,_do+8

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```

csys,21
lsel,,,do,do+99 $lsel,r,loc,y,0,90 $al,all
lsel,,,do,do+99 $lsel,r,loc,y,90,180 $al,all
lsel,,,do,do+99 $lsel,r,loc,y,180,270 $al,all
lsel,,,do,do+99 $lsel,r,loc,y,270,360 $al,all
asel,,,do,do+99
cm,mpcshell,area
aatt,11,,1

```

```

!--- generate the 24 basket cells ---

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```

!
alls
csys,0
xoff2=xoff1+5-.328125 ! to center in mpc shell -.16688
yoff2=yoff1+5-.3125 ! to center in mpc shell
do=1000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-0.5*celptch,-yoff2+2.5*celptch,,,0,0
agen,2,gen_lefo,,,xoff2-1.5*celptch,-yoff2+2.5*celptch,,,0,0
do=2000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+0.5*celptch,-yoff2+2.5*celptch,,,0,0
agen,2,gen_rigo,,,xoff2+1.5*celptch,-yoff2+2.5*celptch,,,0,0
do=3000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-1.5*celptch,-yoff2+1.5*celptch,,,0,0
agen,2,gen_lefo,,,xoff2-2.5*celptch,-yoff2+1.5*celptch,,,0,0
agen,2,gen_topo,,,xoff2-1.5*celptch,-yoff2+2.5*celptch,,,0,0
agen,2,gen_tlo,,,xoff2-2.5*celptch,-yoff2+2.5*celptch,,,0,0
do=4000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-0.5*celptch,-yoff2+1.5*celptch,,,0,0
do=5000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+0.5*celptch,-yoff2+1.5*celptch,,,0,0
do=6000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+1.5*celptch,-yoff2+1.5*celptch,,,0,0
agen,2,gen_rigo,,,xoff2+2.5*celptch,-yoff2+1.5*celptch,,,0,0
agen,2,gen_topo,,,xoff2+1.5*celptch,-yoff2+2.5*celptch,,,0,0
agen,2,gen_tro,,,xoff2+2.5*celptch,-yoff2+2.5*celptch,,,0,0
do=7000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-2.5*celptch,-yoff2+0.5*celptch,,,0,0
agen,2,gen_lefo,,,xoff2-3.5*celptch,-yoff2+0.5*celptch,,,0,0
agen,2,gen_topo,,,xoff2-2.5*celptch,-yoff2+1.5*celptch,,,0,0
agen,2,gen_tlo,,,xoff2-3.5*celptch,-yoff2+1.5*celptch,,,0,0
do=8000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-1.5*celptch,-yoff2+0.5*celptch,,,0,0
do=9000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-0.5*celptch,-yoff2+0.5*celptch,,,0,0
do=10000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+0.5*celptch,-yoff2+0.5*celptch,,,0,0
do=11000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+1.5*celptch,-yoff2+0.5*celptch,,,0,0
do=12000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+2.5*celptch,-yoff2+0.5*celptch,,,0,0
agen,2,gen_topo,,,xoff2+2.5*celptch,-yoff2+1.5*celptch,,,0,0
do=13000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-2.5*celptch,-yoff2-0.5*celptch,,,0,0
agen,2,gen_boto,,,xoff2-2.5*celptch,-yoff2-1.5*celptch,,,0,0
agen,2,gen_lefo,,,xoff2-3.5*celptch,-yoff2-0.5*celptch,,,0,0
agen,2,gen_blo,,,xoff2-3.5*celptch,-yoff2-1.5*celptch,,,0,0
do=14000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-1.5*celptch,-yoff2-0.5*celptch,,,0,0
do=15000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2-0.5*celptch,-yoff2-0.5*celptch,,,0,0
do=16000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+0.5*celptch,-yoff2-0.5*celptch,,,0,0
do=17000 $nums,area,do $nums,kp,do $nums,line,do
agen,2,gen_cell,,,xoff2+1.5*celptch,-yoff2-0.5*celptch,,,0,0
do=18000 $nums,area,do $nums,kp,do $nums,line,do

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agen,2,gen_cell,,, -xoff2+2.5*celptch, -yoff2-0.5*celptch,,, 0,0
agen,2,gen_boto,,, -xoff2+2.5*celptch, -yoff2-1.5*celptch,,, 0,0
do=19000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2-1.5*celptch, -yoff2-1.5*celptch,,, 0,0
agen,2,gen_boto,,, -xoff2-1.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_lefo,,, -xoff2-2.5*celptch, -yoff2-1.5*celptch,,, 0,0
agen,2,gen_blo, , -xoff2-2.5*celptch, -yoff2-2.5*celptch,,, 0,0
do=20000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2-0.5*celptch, -yoff2-1.5*celptch,,, 0,0
do=21000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2+0.5*celptch, -yoff2-1.5*celptch,,, 0,0
do=22000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2+1.5*celptch, -yoff2-1.5*celptch,,, 0,0
agen,2,gen_rigo,,, -xoff2+2.5*celptch, -yoff2-1.5*celptch,,, 0,0
agen,2,gen_boto,,, -xoff2+1.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_bro, , -xoff2+2.5*celptch, -yoff2-2.5*celptch,,, 0,0
do=23000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2-0.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_boto,,, -xoff2-0.5*celptch, -yoff2-3.5*celptch,,, 0,0
agen,2,gen_lefo,,, -xoff2-1.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_blo, , -xoff2-1.5*celptch, -yoff2-3.5*celptch,,, 0,0
do=24000 $nums,area,_do $nums,kp,_do $nums,line,_do
agen,2,gen_cell,,, -xoff2+0.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_boto,,, -xoff2+0.5*celptch, -yoff2-3.5*celptch,,, 0,0
agen,2,gen_rigo,,, -xoff2+1.5*celptch, -yoff2-2.5*celptch,,, 0,0
agen,2,gen_bro, , -xoff2+1.5*celptch, -yoff2-3.5*celptch,,, 0,0

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```

!
! --- clear the generation cell ---
!

```

```

alls
cmdel,gen_cell $cmdel,gen_fuel $cmdel,gen_airf $cmdel,gen_guid
cmdel,plate1 $cmdel,plate2 $cmdel,gen_plat $cmdel,gen_airo
cmdel,gen_borw $cmdel,gen_shw
cmdel,gen_br1w $cmdel,gen_br2w $cmdel,gen_br3w $cmdel,gen_br4w
cmdel,gen_sh1w $cmdel,gen_sh2w $cmdel,gen_sh3w $cmdel,gen_sh4w
cmdel,gen_topo $cmdel,gen_boto $cmdel,gen_lefo $cmdel,gen_rigo
cmdel,gen_tlo $cmdel,gen_tro $cmdel,gen_blo $cmdel,gen_bro
asel,,,,1,999
aclear,all
adel,all,,,1

```

```

!
!-----
!
! --- modify the outer boundaries of the basket cells ---
!-----
!

```

```

!
! --- cell #1 ---
!
alls
asel,,,,1000,1999 $cm,a_cell1,area $ls1a $ks11
*get,offx1,kp,,mxloc,x $offx1=offx1-celptch
*get,offy1,kp,,mnloc,y
! get rid of extra elements on top
asel,r,loc,y,offy1+vertcut(15),10000
aclear,all $adel,all,,,1
! add the stringer plate
cmsel,,a_cell1
asel,r,loc,y,offy1+horizcut(13),10000
asel,r,loc,x,offx1+vertcut(12),10000
aclear,all $aatt,2,,1 $amesh,all
! shorten the boral on top
cmsel,,a_cell1
asel,r,loc,y,offy1+horizcut(13),10000
asel,r,loc,x,offx1+vertcut(3),offx1+vertcut(10)
asel,u,loc,x,offx1+vertcut(6),offx1+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! fix air on top

```

```

cmsel,,a_cell11
asel,r,loc,y,offy1+horizcut(13),10000
asel,r,loc,x,offx1,offx1+vertcut(3)
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell11
asel,r,loc,y,offy1,offy1+horizcut(1)
asel,r,loc,x,offx1-celptch+vertcut(16),offx1
aclear,all $adel,all,,1
! thicken the stringer plate
_do=1000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell11 $sls $ksll
ksel,r,loc,y,offy1+horizcut(15)-.01,offy1+horizcut(15)+.01
ksel,r,loc,x,offx1+vertcut(12),10000
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,y,offy1+horizcut(14),offy1+horizcut(15)
asel,r,loc,x,offx1+vertcut(11),10000
aclear,all $sls
kmod,all,,offy1+horizcut(15)+platdrag
amesh,all
! add keypoint to outside of stringer plate
cmsel,a,a_cell11 $cm,a_cell11,area
asel,r,loc,y,offy1+horizcut(14),offy1+horizcut(15)+platdrag
asel,r,loc,x,offx1+vertcut(15),offx1+vertcut(16)
aclear,all $sls $ksll
k111=kp(-10000,-10000,0)
k222=kp(-10000,10000,0)
k333=kp(10000,-10000,0)
k444=kp(10000,10000,0)
a000=arnext(1)
lsel,r,loc,y,offy1+horizcut(15)+platdrag-.01,offy1+horizcut(15)+platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell11 $cm,a_cell11,area
!
!--- cell #2 ---
!
alls
asel,,,,2000,2999 $cm,a_cell12,area $sls $ksll
*get,offx2,kp,,mnloc,x
*get,offy2,kp,,mnloc,y
! get rid of extra elements on top
asel,r,loc,y,offy2+vertcut(15),10000
aclear,all $adel,all,,1
! add the stringer plate
! (done by generation already)
! shorten the boral on top
cmsel,,a_cell12
asel,r,loc,y,offy2+horizcut(13),10000
asel,r,loc,x,offx2+vertcut(3),offx2+vertcut(10)
asel,u,loc,x,offx2+vertcut(6),offx2+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on the side
cmsel,,a_cell12
asel,r,loc,x,offx2+horizcut(13),offx2+horizcut(15)
asel,r,loc,y,offy2+vertcut(3),offy2+vertcut(10)
asel,u,loc,y,offy2+vertcut(6),offy2+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! remove the outer boral on the side
cmsel,,a_cell12
asel,r,loc,x,offx2+horizcut(16),offx2+celptch
asel,r,loc,y,offy2+vertcut(3),offy2+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! add the support plate
cmsel,,a_cell12
asel,r,loc,x,offx2+horizcut(13),10000
asel,r,loc,y,offy2+vertcut(8),offy2+vertcut(9)

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```

aclear,all $aatt,2,,1 $amesh,all
! remove air on top right
cmsel,,a_cell12
asel,r,loc,x,offx2+horizcut(13),10000
asel,r,loc,y,offy2+vertcut(9),10000
aclear,all $adel,all,,,1
! remove duplicate areas
cmsel,,a_cell12
asel,r,loc,y,offy2,offy2+horizcut(1)
asel,r,loc,x,offx2+celptch,offx2+celptch+vertcut(1)
aclear,all $adel,all,,,1
! thicken the stringer plate
_do=2000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell12 $sls1 $ksl1
ksel,r,loc,y,offy2+horizcut(15)-.01,offy2+horizcut(15)+.01
ksel,r,loc,x,offx2,offx2+vertcut(1)
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,y,offy2+horizcut(14),offy2+horizcut(15)
asel,r,loc,x,offx2,offx2+vertcut(2)
aclear,all $sls1
kmod,all,,offy2+horizcut(15)+platdrag
amesh,all
! add a better approximation of support so basket fits in shell
cmsel,,a_cell12
asel,r,loc,x,offx2+horizcut(15),10000
asel,r,loc,y,offy2+vertcut(6),10000
aclear,all
aatt,2,,1
asel,r,loc,x,offx2+horizcut(15),offx2+celptch
asel,r,loc,y,offy2+vertcut(6),offy2+vertcut(8)
aatt,7,,1
asel,r,loc,x,offx2+horizcut(16),offx2+celptch
asel,r,loc,y,offy2+vertcut(7),offy2+vertcut(8)
aatt,2,,1
cmsel,,a_cell12
asel,r,loc,x,offx2+celptch,offx2+celptch+tk1
asel,r,loc,y,offy2+vertcut(8),offy2+vertcut(9)
adel,all,,,1
cmsel,,a_cell12 $sls1 $ksl1 $cm,kp_work,kp
cmsel,,kp_work
ksel,r,loc,x,offx2+horizcut(16)
ksel,r,loc,y,offy2+vertcut(7),offy2+vertcut(9)
kmod,all,offx2+celptch-tk1
cmsel,,kp_work
ksel,r,loc,x,offx2+horizcut(17)
ksel,r,loc,y,offy2+vertcut(7),offy2+vertcut(9)
kmod,all,offx2+celptch-tk1/2
cmsel,,kp_work
ksel,r,loc,y,offy2+horizcut(7)-.01,offy2+horizcut(7)+.01
ksel,r,loc,x,offx2+celptch-tk1,offx2+celptch+vertcut(1)
kmod,all,,offy2+horizcut(8)-tk1
cmsel,,kp_work
ksel,r,loc,y,offy2+horizcut(9)-.01,offy2+horizcut(9)+.01
ksel,r,loc,x,offx2+celptch-tk1
kmod,all,offx2+celptch-tk1-tk1/2
cmsel,,kp_work
ksel,r,loc,y,offy2+horizcut(9)-.01,offy2+horizcut(9)+.01
ksel,r,loc,x,offx2+celptch
kmod,all,offx2+celptch-tk1/2
!cmsel,,kp_work
!ksel,r,loc,x,offx2+celptch+tk1
!ksel,r,loc,y,offy2+horizcut(8)-.01,offy2+horizcut(8)+.01
!kmod,all,,offy2+horizcut(8)-tk1/2

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```

asel,,,,,2000,2999
cmsel,u,a_cell2
amesh,all
cmsel,a,a_cell2 $cm,a_cell2,area
!
!---- cell #3 ---
!
alls
asel,,,,,3000,3999 $cm,a_cell3,area $lsla $ksll
*get,offx3,kp,,mxloc,x $offx3=offx3-celptch
*get,offy3,kp,,mnloc,y
! remove the outer boral on the top
cmsel,,a_cell3
asel,r,loc,y,offy3+horizcut(16),offy3+celptch
asel,r,loc,x,offx3+vertcut(3),offx3+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! fix air on top left
cmsel,,a_cell3
asel,r,loc,x,offx3-celptch+vertcut(16),offx3-celptch+vertcut(17)
asel,r,loc,y,offy3+vertcut(10),10000
aclear,all $aatt,7,,1 $amesh,all
cmsel,,a_cell3
asel,r,loc,x,offx3-celptch+vertcut(17),offx3
asel,r,loc,y,offy3+vertcut(10),10000
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell3
asel,r,loc,y,offy3,offy3+horizcut(1)
asel,r,loc,x,offx3-celptch+vertcut(16),offx3
aclear,all $adel,all,,,1
!
!---- cell #6 ---
!
alls
asel,,,,,6000,6999 $cm,a_cell6,area $lsla $ksll
*get,offx6,kp,,mnloc,x
*get,offy6,kp,,mnloc,y
! remove the outer boral on the top
cmsel,,a_cell6
asel,r,loc,y,offy6+horizcut(16),offy6+celptch
asel,r,loc,x,offx6+vertcut(3),offx6+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! remove the outer boral on the side
cmsel,,a_cell6
asel,r,loc,x,offx6+horizcut(16),offx6+celptch
asel,r,loc,y,offy6+vertcut(3),offy6+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell6
asel,r,loc,y,offy6,offy6+horizcut(1)
asel,r,loc,x,offx6+celptch,offx6+celptch+vertcut(1)
aclear,all $adel,all,,,1
!
!---- cell #7 ---
!
alls
asel,,,,,7000,7999 $cm,a_cell7,area $lsla $ksll
*get,offx7,kp,,mxloc,x $offx7=offx7-celptch
*get,offy7,kp,,mnloc,y
! remove the outer boral on the top
cmsel,,a_cell7
asel,r,loc,y,offy7+horizcut(16),offy7+celptch
asel,r,loc,x,offx7+vertcut(3),offx7+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on top
cmsel,,a_cell7
asel,r,loc,y,offy7+horizcut(13),offy7+horizcut(15)
asel,r,loc,x,offx7+vertcut(3),offx7+vertcut(10)

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asel,u,loc,x,offx7+vertcut(6),offx7+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on the side
cmsel,,a_cell7
asel,r,loc,x,offx7-celptch+horizcut(16),offx7
asel,r,loc,y,offy7+vertcut(3),offy7+vertcut(10)
asel,u,loc,y,offy7+vertcut(6),offy7+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! add the support plate
cmsel,,a_cell7
asel,r,loc,y,offy7+horizcut(13),10000
asel,r,loc,x,offx7+vertcut(4),offx7+vertcut(5)
aclear,all $aatt,2,,1 $amesh,all
! remove air on top left
cmsel,,a_cell7
asel,r,loc,y,offy7+horizcut(13),10000
asel,r,loc,x,-10000,offx7+vertcut(4)
aclear,all $adel,all,,1
! add the stringer plate
! (done by generation already)
! thicken the stringer plate
_do=7000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell7 $ls1a $ks11
ksel,r,loc,x,offx7-celptch+horizcut(16)-.01,offx7-celptch+horizcut(16)+.01
ksel,r,loc,y,offy7,offy7+vertcut(1)
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,x,offx7-celptch+horizcut(16),offx7-celptch+horizcut(17)
asel,r,loc,y,offy7,offy7+vertcut(2)
aclear,all $ls1a
kmod,all,offx7-celptch+horizcut(16)-platdrag
amesh,all
! add a better approximation of support so basket fits in shell
cmsel,,a_cell7
asel,r,loc,y,offy7+horizcut(15),10000
asel,r,loc,x,-10000,offx7+vertcut(7)
aclear,all
aatt,2,,1
asel,r,loc,y,offy7+horizcut(15),offy7+celptch
asel,r,loc,x,offx7+vertcut(5),offx7+vertcut(7)
aatt,7,,1
asel,r,loc,y,offy7+horizcut(16),offy7+celptch
asel,r,loc,x,offx7+vertcut(5),offx7+vertcut(6)
aatt,2,,1
cmsel,,a_cell7
asel,r,loc,y,offy7+celptch,offy7+celptch+tk1
asel,r,loc,x,offx7+vertcut(4),offx7+vertcut(5)
adel,all,,1
cmsel,,a_cell7 $ls1a $ks11 $cm,kp_work,kp
cmsel,,kp_work
ksel,r,loc,y,offy7+horizcut(16)
ksel,r,loc,x,offx7+vertcut(4),offx7+vertcut(6)
kmod,all,,offy7+celptch-tk1
cmsel,,kp_work
ksel,r,loc,y,offy7+horizcut(17)
ksel,r,loc,x,offx7+vertcut(4),offx7+vertcut(6)
kmod,all,,offy7+celptch-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offx7+horizcut(6)-.01,offx7+horizcut(6)+.01
ksel,r,loc,y,offy7+celptch-tk1,offy7+celptch+vertcut(1)
kmod,all,offx7+horizcut(5)+tk1
cmsel,,kp_work
ksel,r,loc,x,offx7+horizcut(4)-.01,offx7+horizcut(4)+.01
ksel,r,loc,y,offy7+celptch-tk1
kmod,all,,offy7+celptch-tk1-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offx7+horizcut(4)-.01,offx7+horizcut(4)+.01
ksel,r,loc,y,offy7+celptch-tk1/2

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kmod,all,,offy7+celptch-tk1
cmsel,,kp_work
ksel,r,loc,x,offx7+horizcut(4)-.01,offx7+horizcut(4)+.01
ksel,r,loc,y,offy7+celptch
kmod,all,,offy7+celptch-tk1/2
!cmsel,,kp_work
!ksel,r,loc,y,offy7+celptch+tk1
!ksel,r,loc,x,offx7+horizcut(8)-.01,offx7+horizcut(8)+.01
!kmod,all,offx7+horizcut(8)-tk1/2
asel,,,,7000,7999
cmsel,u,a_cell17
amesh,all
cmsel,a,a_cell17 $cm,a_cell17,area
!
!--- cell #12 ---
!
alls
asel,,,,12000,12999 $cm,a_cell12,area $sls $skll
*get,offx12,kp,,mnloc,x
*get,offy12,kp,,mnloc,y
! get rid of extra elements on right
asel,r,loc,x,offx12+vertcut(15),10000
aclear,all $adel,all,,,1
! remove the outer boral on the top
cmsel,,a_cell12
asel,r,loc,y,offy12+horizcut(16),offy12+celptch
asel,r,loc,x,offx12+vertcut(3),offx12+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on top
cmsel,,a_cell12
asel,r,loc,y,offy12+horizcut(13),offy12+horizcut(15)
asel,r,loc,x,offx12+vertcut(3),offx12+vertcut(10)
asel,u,loc,x,offx12+vertcut(6),offx12+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on the side
cmsel,,a_cell12
asel,r,loc,x,offx12+horizcut(13),offx12+horizcut(15)
asel,r,loc,y,offy12+vertcut(3),offy12+vertcut(10)
asel,u,loc,y,offy12+vertcut(6),offy12+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! add the support plate
cmsel,,a_cell12
asel,r,loc,y,offy12+horizcut(13),10000
asel,r,loc,x,offx12+vertcut(8),offx12+vertcut(9)
aclear,all $aatt,2,,1 $amesh,all
! remove air on top left
cmsel,,a_cell12
asel,r,loc,y,offy12+horizcut(13),10000
asel,r,loc,x,offx12+vertcut(9),1000
aclear,all $adel,all,,,1
! add the stringer plate
! (done by generation already)
! thicken the stringer plate
_do=12000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell12 $sls $skll
ksel,r,loc,x,offx12+horizcut(15)-.01,offx12+horizcut(15)+.01
ksel,r,loc,y,offy12,offy12+vertcut(1)
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,x,offx12+horizcut(14),offx12+horizcut(15)
asel,r,loc,y,offy12,offy12+vertcut(2)
aclear,all $sls
kmod,all,offx12+horizcut(15)+platdrag
amesh,all
! add a better approximation of support so basket fits in shell
cmsel,,a_cell12
asel,r,loc,y,offy12+horizcut(15),10000
asel,r,loc,x,offx12+vertcut(6),10000

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aclear,all
aatt,2,,1
asel,r,loc,y,offyl2+horizcut(15),offyl2+celptch
asel,r,loc,x,offxl2+vertcut(6),offxl2+vertcut(8)
aatt,7,,1
asel,r,loc,y,offyl2+horizcut(16),offyl2+celptch
asel,r,loc,x,offxl2+vertcut(7),offxl2+vertcut(8)
aatt,2,,1
cmsel,,a_cell12
asel,r,loc,y,offyl2+celptch,offyl2+celptch+tk1
asel,r,loc,x,offxl2+vertcut(8),offxl2+vertcut(9)
adel,all,,,1
cmsel,,a_cell12 $lsla $ksll $cm,kp_work,kp
cmsel,,kp_work
ksel,r,loc,y,offyl2+horizcut(16)
ksel,r,loc,x,offxl2+vertcut(7),offxl2+vertcut(9)
kmod,all,,offyl2+celptch-tk1
cmsel,,kp_work
ksel,r,loc,y,offyl2+horizcut(17)
ksel,r,loc,x,offxl2+vertcut(7),offxl2+vertcut(9)
kmod,all,,offyl2+celptch-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offxl2+horizcut(7)-.01,offxl2+horizcut(7)+.01
ksel,r,loc,y,offyl2+celptch-tk1,offyl2+celptch+vertcut(1)
kmod,all,offxl2+horizcut(8)-tk1
cmsel,,kp_work
ksel,r,loc,x,offxl2+horizcut(9)-.01,offxl2+horizcut(9)+.01
ksel,r,loc,y,offyl2+celptch-tk1
kmod,all,,offyl2+celptch-tk1-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offxl2+horizcut(9)-.01,offxl2+horizcut(9)+.01
ksel,r,loc,y,offyl2+celptch-tk1/2
kmod,all,,offyl2+celptch-tk1
cmsel,,kp_work
ksel,r,loc,x,offxl2+horizcut(9)-.01,offxl2+horizcut(9)+.01
ksel,r,loc,y,offyl2+celptch
kmod,all,,offyl2+celptch-tk1/2
!cmsel,,kp_work
!ksel,r,loc,y,offyl2+celptch+tk1
!ksel,r,loc,x,offxl2+horizcut(8)-.01,offxl2+horizcut(8)+.01
!kmod,all,offxl2+horizcut(8)-tk1/2
asel,,,,12000,12999
cmsel,u,a_cell12
amesh,all
cmsel,a,a_cell12 $cm,a_cell12,area
!
!--- cell #13 ---
!
alls
asel,,,,13000,13999 $cm,a_cell13,area $lsla $ksll
*get,offxl3,kp,,mxloc,x $offxl3=offxl3-celptch
*get,offyl3,kp,,mxloc,y $offyl3=offyl3-celptch
! shorten the boral on the side
cmsel,,a_cell13
asel,r,loc,x,offxl3-celptch+horizcut(16),offxl3
asel,r,loc,y,offyl3+vertcut(3),offyl3+vertcut(10)
asel,u,loc,y,offyl3+vertcut(6),offyl3+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! add the stringer plate
cmsel,,a_cell13
asel,r,loc,x,offxl3-celptch+horizcut(16),offxl3-celptch+horizcut(17)
asel,r,loc,y,offyl3+vertcut(12),offyl3+celptch
aclear,all $aatt,2,,1 $amesh,all
cmsel,,a_cell13
asel,r,loc,x,offxl3-celptch+horizcut(17),offxl3
asel,r,loc,y,offyl3+vertcut(12),offyl3+celptch
aclear,all $aatt,2,,1 $amesh,all
! fix air on bottom left

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```

cmsel,,a_cell13
asel,r,loc,y,offy13-celptch+horizcut(13),offy13
asel,r,loc,x,-10000,offx13+vertcut(3)
aclear,all $aatt,7,,1 $amesh,all
cmsel,,a_cell13
asel,r,loc,x,offx13-celptch+vertcut(13),offx13
asel,r,loc,y,-10000,offy13+horizcut(3)
aclear,all $aatt,7,,1 $amesh,all
! thicken the stringer plate
_do=13000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell13 $lsla $ksll
ksel,r,loc,x,offx13-celptch+horizcut(16)-.01,offx13-celptch+horizcut(16)+.01
ksel,r,loc,y,offy13+vertcut(12),10000
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,x,offx13-celptch+horizcut(16),offx13-celptch+horizcut(17)
asel,r,loc,y,offy13+vertcut(11),offy13+celptch
aclear,all $lsla
kmod,all,offx13-celptch+horizcut(16)-platdrag
amesh,all
! add keypoint to outside of stringer plate
cmsel,a,a_cell13 $cm,a_cell13,area
asel,r,loc,y,offy13+horizcut(15),offy13+horizcut(16)
asel,r,loc,x,offx13-celptch+horizcut(16)-platdrag,offx13-
celptch+horizcut(16)
aclear,all $lsla $ksll
k111=kp(-10000,-10000,0)
k222=kp(-10000,10000,0)
k333=kp(10000,-10000,0)
k444=kp(10000,10000,0)
a000=arnext(1)
lsel,r,loc,x,offx13-celptch+horizcut(16)-platdrag-.01,offx13-
celptch+horizcut(16)-platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell13 $cm,a_cell13,area
!
!--- cell #18 ---
!
alls
asel,,18000,18999 $cm,a_cell18,area $lsla $ksll
*get,offx18,kp,,mnlloc,x
*get,offy18,kp,,mxloc,y $offy18=offy18-celptch
! get rid of extra elements on right
asel,r,loc,x,offx18+vertcut(15),10000
aclear,all $adel,all,,1
! shorten the boral on the side
cmsel,,a_cell18
asel,r,loc,x,offx18+horizcut(13),offx18+horizcut(15)
asel,r,loc,y,offy18+vertcut(3),offy18+vertcut(10)
asel,u,loc,y,offy18+vertcut(6),offy18+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! fix air on bottom right
cmsel,,a_cell18
asel,r,loc,x,offx18+vertcut(13),10000
asel,r,loc,y,-10000,offy18+vertcut(3)
aclear,all $aatt,7,,1 $amesh,all
! add the stringer plate
cmsel,,a_cell18
asel,r,loc,x,offx18+vertcut(13),10000
asel,r,loc,y,offy18+horizcut(12),offy18+celptch
aclear,all $aatt,2,,1 $amesh,all
! thicken the stringer plate
_do=18000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell18 $lsla $ksll
ksel,r,loc,x,offx18+horizcut(15)-.01,offx18+horizcut(15)+.01
ksel,r,loc,y,offy18+vertcut(12),offy18+celptch
cm,dragline,kp

```

```

platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,x,offx18+horizcut(14),offx18+horizcut(15)
asel,r,loc,y,offy18+vertcut(11),offy18+celptch
aclear,all $sls1a
kmod,all,offx18+horizcut(15)+platdrag
amesh,all
! add keypoint to outside of stringer plate
cmsel,a,a_cell118 $cm,a_cell118,area
asel,r,loc,y,offy18+horizcut(15),offy18+horizcut(16)
asel,r,loc,x,offx18+horizcut(14),offx18+horizcut(14)+platdrag
aclear,all $sls1a $ks11
k111=kp(-10000,-10000,0)
k222=kp(-10000,10000,0)
k333=kp(10000,-10000,0)
k444=kp(10000,10000,0)
a000=arnext(1)
lsel,r,loc,x,offx18+horizcut(15)+platdrag-.01,offx18+horizcut(15)
+platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell118 $cm,a_cell118,area
!
!--- cell #19 ---
!
alls
asel,,,19000,19999 $cm,a_cell119,area $sls1a $ks11
*get,offx19,kp,,mxloc,x $offx19=offx19-celptch
*get,offy19,kp,,mxloc,y $offy19=offy19-celptch
! fix air on bottom left
cmsel,,a_cell119
asel,r,loc,y,offy19-celptch+horizcut(13),offy19
asel,r,loc,x,-10000,offx19+vertcut(3)
aclear,all $aatt,7,,1 $amesh,all
cmsel,,a_cell119
asel,r,loc,x,offx19-celptch+vertcut(13),offx19
asel,r,loc,y,-10000,offy19+horizcut(3)
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell119
asel,r,loc,y,offy19+horizcut(16),offy19+celptch
asel,r,loc,x,offx19-celptch+vertcut(16),offx19
aclear,all $adel,all,,,1
!
!--- cell #22 ---
!
alls
asel,,,22000,22999 $cm,a_cell122,area $sls1a $ks11
*get,offx22,kp,,mxloc,x
*get,offy22,kp,,mxloc,y $offy22=offy22-celptch
! remove the outer boral on the side
cmsel,,a_cell122
asel,r,loc,x,offx22+horizcut(16),offx22+celptch
asel,r,loc,y,offy22+vertcut(3),offy22+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! fix air lower left
cmsel,,a_cell122
asel,r,loc,x,offx22+celptch,10000
asel,r,loc,y,offy22-celptch+vertcut(15),offy22
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell122
asel,r,loc,y,offy22+horizcut(16),offy22+celptch
asel,r,loc,x,offx22+celptch,offx22+celptch+vertcut(1)
aclear,all $adel,all,,,1
!
!--- cell #23 ---
!
alls

```

```

asel,,,,23000,23999 $cm,a_cell23,area $ls1a $ks11
*get,offx23,kp,,mxloc,x $offx23=offx23-celptch
*get,offy23,kp,,mxloc,y $offy23=offy23-celptch
! make the bottom plate 9/32 instead of 5/16 so basket dimesnions OK
kpfixer=(5/16-9/32)
offy23k=offy23+kpfixer
cmsel,,a_cell23
asel,r,loc,y,offy23,offy23+horizcut(1) $ls1a $ks11 $aclear,all
ksel,r,loc,y,offy23-.0001,offy23+.0001
kpcur=kpnex(0) $kmod,all,,ky(kpcur)+kpfixer $ls1a $ks11 $amesh,all
cmsel,a,a_cell23 $cm,a_cell23,area
cmsel,,a_cell23
asel,r,loc,y,-10000,offy23 $ls1a $ks11
agen,2,all,,,kpfixer,,,1
! fix air on bottom left
cmsel,,a_cell23
asel,r,loc,y,offy23k-celptch+horizcut(13),offy23k
asel,r,loc,x,-10000,offx23+vertcut(3)
aclear,all $aatt,7,,1 $amesh,all
cmsel,,a_cell23
asel,r,loc,x,offx23-celptch+vertcut(13),offx23
asel,r,loc,y,-10000,offy23+horizcut(3)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on bottom
cmsel,,a_cell23
asel,r,loc,y,offy23k-celptch+horizcut(15),offy23k
asel,r,loc,x,offx23+vertcut(3),offx23+vertcut(10)
asel,u,loc,x,offx23+vertcut(6),offx23+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! add the stringer plate
cmsel,,a_cell23
asel,r,loc,y,offy23k-celptch+horizcut(16),offy23k-celptch+horizcut(17)
asel,r,loc,x,offx23+vertcut(12),10000
aclear,all $aatt,2,,1 $amesh,all
cmsel,,a_cell23
asel,r,loc,y,offy23k-celptch+horizcut(17),offy23k
asel,r,loc,x,offx23+vertcut(12),10000
aclear,all $aatt,2,,1 $amesh,all
! fix the air on bottom right
cmsel,,a_cell23
asel,r,loc,y,offy23k,offy23k+horizcut(1)
asel,r,loc,x,offx23+vertcut(13),offx23+celptch
aclear,all $aatt,7,,1 $amesh,all
! remove duplicate areas
cmsel,,a_cell23
asel,r,loc,y,offy23+horizcut(16),offy23+celptch
asel,r,loc,x,offx23-celptch+vertcut(16),offx23
aclear,all $adel,all,,,1
! thicken the stringer plate
_do=23000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell23 $ls1a $ks11
ksel,r,loc,y,offy23k-celptch+horizcut(16)-.01,offy23k-celptch+horizcut(16)
+.01
ksel,r,loc,x,offx23+vertcut(12),10000
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,y,offy23k-celptch+horizcut(16),offy23k-celptch+horizcut(17)
asel,r,loc,x,offx23+vertcut(11),offx23+celptch
aclear,all $ls1a
kmod,all,,offy23k-celptch+horizcut(16)-platdrag
amesh,all
! add keypoint to outside of stringer plate
cmsel,a,a_cell23 $cm,a_cell23,area
asel,r,loc,x,offx23+horizcut(15),offx23+horizcut(16)
asel,r,loc,y,offy23k-celptch+horizcut(16)-platdrag,offy23k-
celptch+horizcut(16)
aclear,all $ls1a $ks11
k111=kp(-10000,-10000,0)

```



```

k222=kp(-10000,10000,0)
k333=kp(10000,-10000,0)
k444=kp(10000,10000,0)
a000=arnext(1)
lsl,r,loc,y,offy23k-celptch+horizcut(16)-platdrag-.01,offy23k-
celptch+horizcut(16)-platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell123 $cm,a_cell123,area
!
!---- cell #24 ---
!
alls
asel,,,24000,24999 $cm,a_cell24,area $lsla $ksll
*get,offx24,kp,,mnloc,x
*get,offy24,kp,,mxloc,y $offy24=offy24-celptch
! make the bottom plate 9/32 instead of 5/16 so basket dimesnions OK
kpfixer=(5/16-9/32)
offy24k=offy23+kpfixer
cmsel,,a_cell124
asel,r,loc,y,offy24,offy24+horizcut(1) $lsla $ksll $aclear,all
ksel,r,loc,y,offy24-.0001,offy24+.0001
kpcur=kpnex(0) $kmod,all,,ky(kpcur)+kpfixer $lsla $ksll $amesh,all
cmsel,a,a_cell124 $cm,a_cell124,area
cmsel,,a_cell124
asel,r,loc,y,-10000,offy24 $lsla $ksll
agen,2,all,,,kpfixer,,,1
! shorten the boral on bottom
cmsel,,a_cell124
asel,r,loc,y,offy24k-celptch+horizcut(16),offy24k
asel,r,loc,x,offx24+vertcut(3),offx24+vertcut(10)
asel,u,loc,x,offx24+vertcut(6),offx24+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! shorten the boral on the side
cmsel,,a_cell124
asel,r,loc,x,offx24+horizcut(13),offx24+horizcut(15)
asel,r,loc,y,offy24+vertcut(3),offy24+vertcut(10)
asel,u,loc,y,offy24+vertcut(6),offy24+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! remove the outer boral on the side
cmsel,,a_cell124
asel,r,loc,x,offx24+horizcut(16),offx24+celptch
asel,r,loc,y,offy24+vertcut(3),offy24+vertcut(10)
aclear,all $aatt,7,,1 $amesh,all
! add the support plate
cmsel,,a_cell124
asel,r,loc,x,offx24+horizcut(13),10000
asel,r,loc,y,offy24+vertcut(4),offy24+vertcut(5)
aclear,all $aatt,2,,1 $amesh,all
! remove air on bottom right
cmsel,,a_cell124
asel,r,loc,x,offx24+horizcut(13),10000
asel,r,loc,y,-10000,offy24+vertcut(4)
aclear,all $adel,all,,,1
! remove duplicate areas
cmsel,,a_cell124
asel,r,loc,y,offy24+horizcut(16),offy24+celptch
asel,r,loc,x,offx24+celptch,offx24+celptch+vertcut(1)
aclear,all $adel,all,,,1
! thicken the stringer plate
_do=24000 $nums,area,_do $nums,kp,_do $nums,line,_do
cmsel,,a_cell124 $lsla $ksll
ksel,r,loc,y,offy24k-celptch+horizcut(16)-.01,offy24k-celptch+horizcut(16)
+.01
ksel,r,loc,x,offx24,offx24+vertcut(1)
cm,dragline,kp
platdrag=tk1-((tk4+2*gp1)+tk3)
asel,r,loc,y,offy24-celptch+horizcut(16),offy24

```

```

asel,r,loc,x,offx24,offx24+vertcut(2)
aclear,all $lsla
kmod,all,,offy24k-celptch+horizcut(16)-platdrag
amesh,all
! add a better approximation of support so basket fits in shell
cmsel,,a_cell24
asel,r,loc,x,offx24+horizcut(15),10000
asel,r,loc,y,-10000,offy24+vertcut(7)
aclear,all
aatt,2,,1
asel,r,loc,x,offx24+horizcut(15),offx24+celptch
asel,r,loc,y,offy24+vertcut(5),offy24+vertcut(7)
aatt,7,,1
asel,r,loc,x,offx24+horizcut(16),offx24+celptch
asel,r,loc,y,offy24+vertcut(5),offy24+vertcut(6)
aatt,2,,1
cmsel,,a_cell24
asel,r,loc,x,offx24+celptch,offx24+celptch+tk1
asel,r,loc,y,offy24+vertcut(4),offy24+vertcut(5)
adel,all,,1
cmsel,,a_cell24 $lsla $ksll $cm,kp_work,kp
cmsel,,kp_work
ksel,r,loc,x,offx24+horizcut(16)
ksel,r,loc,y,offy24+vertcut(4),offy24+vertcut(6)
kmod,all,offx24+celptch-tk1
cmsel,,kp_work
ksel,r,loc,x,offx24+horizcut(17)
ksel,r,loc,y,offy24+vertcut(4),offy24+vertcut(6)
kmod,all,offx24+celptch-tk1/2
cmsel,,kp_work
ksel,r,loc,y,offy24+horizcut(6)-.01,offy24+horizcut(6)+.01
ksel,r,loc,x,offx24+celptch-tk1,offx24+celptch+vertcut(1)
kmod,all,,offy24+horizcut(5)+tk1
cmsel,,kp_work
ksel,r,loc,y,offy24+horizcut(4)-.01,offy24+horizcut(4)+.01
ksel,r,loc,x,offx24+celptch-tk1
kmod,all,offx24+celptch-tk1-tk1/2
cmsel,,kp_work
ksel,r,loc,y,offy24+horizcut(4)-.01,offy24+horizcut(4)+.01
ksel,r,loc,x,offx24+celptch-tk1/2
kmod,all,offx24+celptch-tk1
cmsel,,kp_work
ksel,r,loc,y,offy24+horizcut(4)-.01,offy24+horizcut(4)+.01
ksel,r,loc,x,offx24+celptch
kmod,all,offx24+celptch-tk1/2
!cmsel,,kp_work
!ksel,r,loc,x,offx24+celptch+tk1
!ksel,r,loc,y,offy24+horizcut(8)-.01,offy24+horizcut(8)+.01
!kmod,all,,offy24+horizcut(8)-tk1/2
asel,,,24000,24999
cmsel,u,a_cell24
amesh,all
cmsel,a,a_cell24 $cm,a_cell24,area
!
!--- merge coincident entities on the basket ---
!
alls
asel,,,1,29999 $lsla $ksll $esla $nsle
numm,node
numm,kp
!
!--- Create fuel component ---
!
alls
esel,,mat,,1 $nsle $cm,el_fuel,elem

```

!
 -----
 !

```

--
!--- create gas volume external to basket ---
!-----
!
alls
centx=0 $centy=0
local,21,1,centx,centy
csys,0
asel,none $asel,s,,,1000,24999,1 $cm,thema,area $aclear,thema $alls

csys,0 $wpcsys,-1
wprotat,,,90
_do=0 $nums,area,_do $nums,kp,_do $nums,line,_do
asel,s,mat,,,2,7,5 $lsla $ksll $cm,agrp,area $asbw,agrp,,DELETE
$asel,u,mat,,,2,7,5 $aatt,7,,1
asel,s,,,2,28,26 $asel,a,,,30,32,2 $asel,a,,,68,104,104-68
asel,a,,,140,212,212-140 $asel,a,,,214 $aatt,2,,1
wprotat,,,90
asel,s,loc,x,-100,0 $adel,all,,,1 $alls
1,1304,30002 $1,30004,23469 $1,18032,30001

lsel,s,,,1,2,1 $lsel,a,,,7 $lsel,a,,,30000,30003,3 $cm,tline,line
asel,s,,,1,24999 $lsel,s,ext $lsel,u,loc,x,-0.01,0.01 $cmsel,a,tline
$cm,tline,line
_do=31000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,s,tline $lsel,u,loc,y,-100.,-0.01 $al,all
cmsel,s,tline $lsel,u,loc,y,0.01,100. $al,all
asel,s,,,do,_do+999 $aatt,8,,1 $alls

lsel,s,loc,x,10.21,11 $lsel,a,loc,x,20.98,22. $lsel,r,,,1,24999
$cm,tlines,line
lesize,tlines,,,1 $alls

asel,u,mat,,,8,11,3 $asel,u,,,18284
mshkey,1 $mshape,0,2D $esize,esf
amesh,all $alls

mshkey,0 $mshape,1,2D
amesh,18284

asel,s,mat,,,11 $esize,esf/1.37
mshkey,1 $mshape,0,2D $amesh,all

asel,s,mat,,,8
mshkey,0 $mshape,0,2D
amesh,all

```

```

!-----
!
!--- create the overpack ---
!
! Since the overpack is made of several symmetric enclosure shells,
! generate a small sector and rotate that to make the full overpack.
!-----

```

```

--
!
!
!--- create the overpack section ---
!
alls
local,22,0,centx,centy
_do=40000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do,1,1
circle,30000,ri_opack,,_do,90,1

```

```

circle,30000,ri_opack+shtki,,_do,90,1
circle,30000,rsho,,_do,90,1
ch_angle=360/numch/2
k,_do+13,-rchtk/2,rsho-.2
k,_do+14,rchtk/2,rsho-.2
k,_do+15,-rchtk/2,(rsho+rchdp+rchtk)/cos(ch_angle/2)
k,_do+16,rchtk/2,(rsho+rchdp)/cos(ch_angle/2)
k,_do+17,(rsho+rchdp+rchtk)*sin(ch_angle/2),(rsho+rchdp+rchtk)
*cos(ch_angle/2)
k,_do+18,(rsho+rchdp)*sin(ch_angle/2),(rsho+rchdp)*cos(ch_angle/2)
l,_do+13,_do+15 $l,_do+15,_do+17
l,_do+14,_do+16 $l,_do+16,_do+18
l,_do+13,_do+14
lfil,_do+5,_do+6,rchbri $lfil,_do+3,_do+4,rchbro
k,_do+20,-(rsho+rchdp+eshtk)*sin(ch_angle/2),(rsho+rchdp+eshtk)
*cos(ch_angle/2)
k,_do+21,-(rsho+rchdp)*sin(ch_angle/2),(rsho+rchdp)*cos(ch_angle/2)
k,_do+22,kx(_do+20)+(eshleng/2-.25)*cos(ch_angle/2),ky(_do+20)
+(eshleng/2-.25)*sin(ch_angle/2)
k,_do+23,kx(_do+21)+eshleng/2*cos(ch_angle/2),ky(_do+21)
+eshleng/2*sin(ch_angle/2)
l,_do+20,_do+22 $l,_do+21,_do+23
lang,_do+9,_do+22,45,,.75
lcs1,_do+9,_do+11 $ldel,_do+17,,,1
cskp,23,0,_do+8,_do+18,30000
lgen,2,_do+6,,,fmrk
cskp,23,0,_do+21,_do+12,30000
lgen,2,_do+16,,,fmrk
lcs1,_do+11,_do+14 $ldel,_do+19,,,1
lxt,_do+9,_do+19,.6 $lcs1,_do+8,_do+9 $ldel,_do+19,,,1
lxt,_do+21,_do+23,.1
local,23,0,centx,centy,,ch_angle/2
k,_do+40,0,ro_opack $l,_do+40,30000
local,23,0,centx,centy,,ch_angle/2
k,_do+41,0,ro_opack $l,_do+41,30000
lcs1,_do+9,_do+4,_do+6,_do+21,_do+2,_do+1,_do+0
lcs1,_do+8,_do+10,_do+16,_do+20,_do+27,_do+25,_do+23
lcs1,_do+3,_do+5,_do+41
! make some modifications to aid mapped meshing
l,_do+9,_do+7
l,_do+8,_do+10
l,_do+11,_do+24
lang,_do+11,_do+26,90,,.5
lang,_do+47,_do+12,90,,.5
lang,_do+16,_do+22,90,,.9
lang,_do+32,_do+8,90,,.1
ldiv,_do+14
l,_do+37,_do+26
lang,_do+33,_do+7,90,,.7
ldiv,_do+21
circle,30000,rsho+cutbac2,,_do,90,1
lcs1,_do+60,_do+8,_do+23,_do+39,_do+33

! create the areas finally
alls
asel,none
! make the inner shell
lcomb,_do+21,_do+59
al,_do+21,_do+35,_do+40,_do+42 $aatt,20,,1 $asel,none
! make the intermediate shells
al,_do+34,_do+40,_do+43,_do+44,_do+45,_do+46 $aatt,21,,1 $asel,none
! make the channel neutron shield
al,_do+44,_do+64,_do+72,_do+66
al,_do+58,_do+61,_do+68,_do+72
al,_do+11,_do+32,_do+47,_do+49,_do+53,_do+57,_do+58 $aatt,24,,1 $asel,none
! make the enclosure neutron shield
al,_do+45,_do+65,_do+67,_do+73 $aatt,24,,1 $asel,none
al,_do+17,_do+20,_do+62,_do+63,_do+73 $aatt,24,,1 $asel,none

```

```

! make the channel foam layer
al,_do+6,_do+30,_do+53,_do+54
al,_do+14,_do+32,_do+54,_do+55 $aatt,25,,1 $asel,none
! make the enclosure foam layer
al,_do+20,_do+38,_do+51,_do+56
al,_do+16,_do+18,_do+56 $aatt,25,,1 $asel,none
! make the enclosure shell
al,_do+10,_do+36,_do+51,_do+52
al,_do+13,_do+15,_do+16,_do+52 $aatt,23,,1 $asel,none
! make the channel
al,_do+46,_do+66,_do+67,_do+71 $aatt,27,,1 $asel,none
al,_do+3,_do+61,_do+62,_do+71
al,_do+3,_do+11,_do+48,_do+17
al,_do+48,_do+47,_do+50,_do+18
al,_do+50,_do+49,_do+41,_do+15
al,_do+41,_do+14,_do+5,_do+12,_do+55
al,_do+5,_do+6,_do+28,_do+4
aatt,22,,1 $asel,none
asel,,,,_do,_do+99 $lsla $lsel,inve $lsel,r,,,,_do,_do+99 $ldel,all,,,1
alls
!
!--- mesh the overpack section ---
!
mshkey,1
mshape,0,2D
! mesh the channel
!lesize,_do+46,,,enrchth
esize,2
amesh,40013
amesh,40014
amesh,40015
amesh,40016
!lesize,_do+49,,,1
amesh,40017
!lesize,_do+12,,,2
amap,40018,40024,40008,40010,40011
esize,3
amesh,40019
esize,2
! mesh the enclosure plate
!lesize,_do+13,,,2
!lesize,_do+52,,,enrchth
!lesize,_do+16,,,1
amesh,40012
amesh,40011
! mesh the channel foam
amesh,40007
amesh,40008
! mesh the enclosure foam
mshape,1,2D
mshkey,2
!lesize,_do+56,,,1
amesh,40010
mshkey,1
mshape,0,2D
amesh,40009
esize,4
! mesh the channel neutron shield
amap,40004,40007,40042,40029,40024
amesh,40003
amesh,40002
! mesh the enclosure neutron shield
amap,40006,40048,40047,40026,40025
amesh,40005
! mesh the plates
!lesize,_do+34,,,5
amap,40001,40031,40027,40028,40032
! mesh the inner shell

```

```

!lesize,_do+35,,,3
amap,40000,40031,40030,40019,40027

_do=50000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do+1,0.,0.
circle,_do+1,83.25/2.,.,120
lsel,s,,,do,_do+999 $cm,tlines,line $alls
aclear,40001 $adel,40001
_do=40000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
lcs1,50001,40034,40043 $alls
a,_do+32,_do+34,_do+33,_do+28,_do+1,_do+2
a,_do+2,_do+1,_do+27,_do+31
lesi,_do+1,,,1 $lesi,_do+7,,,1
lesi,_do+0,,,2 $lesi,_do+2,,,2
lesi,_do+19,,,5 $lesi,_do+40,,,5
aatt,21,,1
amap,_do+20,_do+2,_do+31,_do+1,_do+27
amap,_do+1,_do+32,_do+2,_do+28,_do+1

asel,,,,do,_do+999 $ls1a $ks11,,1
cm,gen_opak,area
lsel,s,,,do+8,_do+9,1 $lsel,a,,,do+10000 $ldel,all,,,1 $alls
numm,node
numm,kp

! create the symmetric version of this section
asel,,,,do,_do+999 $ls1a $ks11,,1
local,23,0,centx,centy,,-ch_angle/2
arsym,x,all
cm,gen_opak,area
numm,node
numm,kp

!
!--- revolve overpack section to generate entire overpack ---
!
alls
csys,21
cmsel,,gen_opak
agen,1,gen_opak,,,,-ch_angle/2,,,1
agen,numch/2,gen_opak,,,,-ch_angle*2
alls
numm,node
numm,kp

!
!--- generate helium gap between canister and cask ---
!
alls
_do=50000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
1,30006,40030 $1,30005,40282 $1,30008,40587

lsel,s,,,50000,50001 $lsel,a,,,30004 $lsel,a,,,40008,40021,21-8
$lsel,a,,,40027,40157,157-27
lsel,a,,,40204,40259,59-4 $lsel,a,,,40306,40361,61-6
$lsel,a,,,40408,40463,63-8
cm,tlines,line
al,tlines

lsel,s,,,50001,50002 $lsel,a,,,30007 $lsel,a,,,40510,40565,65-10
$lsel,a,,,40612,40667,67-12
lsel,a,,,40714,40769,69-14 $lsel,a,,,40816,40871,71-16
$lsel,a,,,40918,40973,73-18
cm,tlines,line
al,tlines
alls
aatt,6,,1
amap,_do ,40030,30006,40282,30005

```

```

amap,_do+1,40282,30005,40587,30008
alls
numm,node
numm,kp

```

```

!
!---- extrude 2D cask & canister body into 3D ----
!

```

```

alls
_do=100000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cm,tarea,area $agen,2,all,,,,,0,,0,0 $alls
asel,s,,,1,_do-1,1 $esla $nsle $lsla $ksll $aclear,all $adel,all,,,1 $alls
cm,tareas,area

```

```

csys,0

```

```

!- extrusion Do-Loop -----

```

```

alls
_do=_do+10000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do

```

```

*do,ista,1,zl_tot,1
k,_do+ista,kx(50001),ky(50001),zl(ista)
*if,ista,gt,1,then
l,_do+ista,_do+ista-1
*endif

```

```

*enddo
lsel,s,,,_do,_do+9999 $ksll $cm,tlines,line

```

```

numm,node
numm,kp

```

```

alls
esiz,,1 $type,11

```

```

*do,imat,1,11,1
mat,imat
*if,imat,ne,3,then
cmsel,s,tareas $asel,r,mat,,imat $cm,tareas2,area $lsla $ksll $esla $nsle
cmsel,a,tlines
vdrag,tareas2,,,,,tlines
*endif

```

```

alls
*enddo

```

```

*do,imat,20,27,1
mat,imat
*if,imat,ne,26,then
cmsel,s,tareas $asel,r,mat,,imat $cm,tareas2,area $lsla $ksll $esla $nsle
cmsel,a,tlines
vdrag,tareas2,,,,,tlines
*endif

```

```

alls
*enddo

```

```

numm,node
numm,kp

```

```

!- Clean up extrusion -----

```

```

alls
esel,u,type,,11 $asel,s,type,,1 $aclear,all

```

```

alls
eplo

```

```

alls
etde,1
vsel,s,loc,z,zl(1),zl(4) $csys,1 $vsel,r,loc,x,83.25/2.,100./2. $csys,0
$eslv $vclear,all
vsel,s,loc,z,zl(17),zl(22) $csys,1 $vsel,r,loc,x,83.25/2.,100./2. $csys,0

```

```

$eslv $vclear,all

vsel,s,loc,z,zl(1),zl(2) $csys,1 $vsel,r,loc,x,0.,83.25/2. $csys,0 $eslv
$cm,telem,elem
cmsel,s,telem $nsle $mpchg,20,all

vsel,s,loc,z,zl(21),zl(22) $csys,1 $vsel,r,loc,x,0.,83.25/2. $csys,0 $eslv
$cm,telem,elem
cmsel,s,telem $nsle $mpchg,20,all

vsel,s,loc,z,zl(2),zl(3) $csys,1 $vsel,r,loc,x,0.,68.75/2. $csys,0 $eslv
$cm,telem,elem
cmsel,s,telem $nsle $mpchg,6,all

vsel,s,loc,z,zl(20),zl(21) $csys,1 $vsel,r,loc,x,0.,68.75/2. $csys,0 $eslv
$cm,telem,elem
cmsel,s,telem $nsle $mpchg,6,all

vsel,s,loc,z,zl(1),zl(4) $csys,1 $vsel,r,loc,x,73.75/2.,83.25/2. $csys,0
$eslv
cm,telem,elem $cmsel,s,telem $nsle $mpchg,20,all

vsel,s,loc,z,zl(17),zl(21) $csys,1 $vsel,r,loc,x,73.75/2.,83.25/2. $csys,0
$eslv
cm,telem,elem $cmsel,s,telem $nsle $mpchg,20,all

vsel,s,loc,z,zl(3),zl(4) $aslv $csys,1 $asel,r,loc,x,0.,68.375/2.+1
$vs1a,,1 $csys,0 $eslv
cm,telem,elem $cmsel,s,telem $nsle $mpchg,11,all

vsel,s,loc,z,zl(19),zl(20) $aslv $csys,1 $asel,r,loc,x,0.,68.375/2.+1
$vs1a,,1 $csys,0 $eslv
cm,telem,elem $cmsel,s,telem $nsle $mpchg,11,all

vsel,s,loc,z,zl(18),zl(19) $aslv $csys,1 $asel,r,loc,x,0.,67.375/2.+1
$vs1a,,1 $csys,0 $eslv
cm,telem,elem $cmsel,s,telem $nsle $mpchg,8,all

```

alls

```

!
!--- generate impact limiters ---
!
alls
csys,0
lsgap=0.25
zsign=-1
_do=600000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do , 0., 0. , zsign*(lsgap)
k,_do+1 , 0., 0. , zsign*(lsgap+1.)
k,_do+2 , 0., 0. , zsign*(lsgap+1.+2.5)
k,_do+3 , 0., 0. , zsign*(lsgap+1.+21.625-1)
k,_do+4 , 0., 0. , zsign*(lsgap+1.+21.625)

k,_do+5 , 0., 33./2.-1.375 , zsign*(lsgap)
k,_do+6 , 0., 33./2.-1.375 , zsign*(lsgap+1.)
k,_do+7 , 0., 33./2.-1.375 , zsign*(lsgap+1.+2.5)
k,_do+8 , 0., 33./2.-1.375 , zsign*(lsgap+1.+21.625-1)
k,_do+9 , 0., 33./2.-1.375 , zsign*(lsgap+1.+21.625)

k,_do+10 , 0., 33./2. , zsign*(lsgap)
k,_do+11 , 0., 33./2. , zsign*(lsgap+1.)
k,_do+12 , 0., 33./2. , zsign*(lsgap+1.+2.5)
k,_do+13 , 0., 33./2. , zsign*(lsgap+14.5)
k,_do+14 , 0., 33./2. , zsign*(lsgap+1.+21.625)
k,_do+15 , 0., 33./2. , zsign*(lsgap+31.375)

```



```

k,_do+16, 0., 45./2. , zsign*(lsgap+31.375)
k,_do+17, 0., 45./2. , zsign*(lsgap+41.375)
k,_do+18, 0., 45./2. , zsign*(lsgap+51.375)

k,_do+19, 0., 70./2. , zsign*(lsgap+41.375)
k,_do+20, 0., 70./2. , zsign*(lsgap+51.375)

k,_do+21, 0., 84.625/2.-1.875, zsign*(lsgap)
k,_do+22, 0., 84.625/2.-1.875, zsign*(lsgap+1.)
k,_do+23, 0., 84.625/2.-1.875, zsign*(lsgap+1.+2.5)
k,_do+24, 0., 84.625/2.-1.875, zsign*(lsgap+14.5)

k,_do+25, 0., 84.625/2.-0.5 , zsign*(lsgap-8.375)
k,_do+26, 0., 84.625/2.-0.5 , zsign*(lsgap)

k,_do+27, 0., 84.625/2. , zsign*(lsgap-8.375)
k,_do+28, 0., 84.625/2. , zsign*(lsgap+14.5)

k,_do+29, 0., 128./2. , zsign*(lsgap-8.375)
k,_do+30, 0., 128./2. , zsign*(lsgap+14.5)
k,_do+31, 0., 128./2. , zsign*(lsgap+41.375)

a,_do,_do+1,_do+6,_do+11,_do+22,_do+21,_do+10,_do+5
a,_do+1,_do+6,_do+7,_do+2
a,_do+2,_do+7,_do+8,_do+3
a,_do+3,_do+8,_do+9,_do+4
a,_do+6,_do+7,_do+8,_do+9,_do+14,_do+13,_do+12,_do+11
a,_do+11,_do+12,_do+23,_do+22
a,_do+12,_do+23,_do+24,_do+13
a,_do+25,_do+26,_do+21,_do+22,_do+23,_do+24,_do+28,_do+27
a,_do+27,_do+29,_do+30,_do+28
a,_do+13,_do+24,_do+28,_do+30,_do+31,_do+19,_do+17,_do+16,_do+15,_do+14
a,_do+17,_do+19,_do+20,_do+18

asel,s,,,_do+9 $lsla $ksll
ydist=ky(_do+24) $zdist=kz(_do+24)
wpoffs,,ydist,zdist $wprota,,90 $asbw,all,,DELETE $wprota,,90 $wpoffs,,
ydist,-zdist
ydist=ky(_do+28) $zdist=kz(_do+28)
wpoffs,,ydist,zdist $wprota,,90 $asbw,all,,DELETE $wprota,,90 $wpoffs,,
ydist,-zdist

asel,s,,,_do,_do+7,7 $asel,a,,,_do+3,_do+4,1 $aatt,60,,3
asel,s,,,_do+2 $aatt,61,,3

asel,s,,,_do+1,_do+5,4 $aatt,66,,3
asel,s,,,_do+8 $aatt,62,,3
asel,s,,,_do+6 $aatt,63,,3
asel,s,,,_do+9 $asel,a,,,_do+12,_do+13,1 $aatt,64,,3
asel,s,,,_do+10 $aatt,65,,3

asel,s,,,600000,699999,1 $lsla $ksll

esiz,7

amap,_do ,_do,_do+1,_do+21,_do+22
amap,_do+1,_do+1,_do+2,_do+6,_do+7
amap,_do+2,_do+2,_do+3,_do+7,_do+8
amap,_do+3,_do+3,_do+4,_do+8,_do+9
amap,_do+5,_do+11,_do+12,_do+22,_do+23
amap,_do+6,_do+12,_do+13,_do+23,_do+24
amap,_do+10,_do+17,_do+18,_do+19,_do+20

lesize,_do+17,,,1 $lesize,_do+18,,,2,2
msha,0,2D $mshk,0 $amesh,_do+4

lesize,_do+28,,,5,-.7 $lesize,_do+31,,,5,-.7

```

```

msha,0,2D $mshk,0 $amesh,_do+8

lesize,_do+27,,,1 $lesize,_do+26,,,1 $lesize,_do+29,,,1
$lesize,_do+25,,,2,.6
msha,0,2D $mshk,0 $amesh,_do+7

lesize,_do+42,,,4 $lesize,_do+44,,,1 $lesize,_do+36,,,1 $lesize,_do+37,,,1
lesize,_do+38,,,1 $msha,0,2D $mshk,0 $amesh,_do+12
amap,_do+9,_do+24,_do+28,_do+32,_do+33
amap,_do+13,_do+28,_do+30,_do+33,_do+31

asel,s,,,600000,699999,1 $cm,tarea,area $lsla $ksll $esla $nsle
_do=610000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
csys,5 $agen,2,tarea,,,,180,,,0,0 $csys,0
asel,s,,,610000,699999,1 $cm,tarea,area $lsla $ksll $esla $nsle
agen,2,tarea,,,,,zl(22),,0,1

k,_do+37,kx(610019),ky(610019),kz(610019)-5.
k,_do+38,kx(610022),ky(610022),kz(610022)-5.
a,_do+19,_do+22,_do+38,_do+37 $asel,s,,,_do+13 $aatt,60,,3
amap,_do+13,_do+19,_do+22,_do+37,_do+38

asel,s,,,600000,699999,1 $lsla $ksll $esla $nsle
cm,tareas,area
numm,node
numm,kp

esiz,,12 $type,11

*do,imat,60,66,1
mat,imat
cmsel,s,tareas $asel,r,mat,,imat $cm,tarea,area $lsla $ksll $esla $nsle
ksel,a,,,600000,600004,1
vrot,tarea,,,,,600004,600000,-180,1

alls
*enddo

numm,node
numm,kp

numcmp,node $numcmp,elem

save

/eof

```

!more to come!!

```

!
! rotate the reduced conductivity elements into proper element coordinate
! system
!
alls
csys,21
esel,,mat,,27 $emod,all,esys,21
!
!-----
!
!---- create air gap between canister and overpack ----
!
!   Difficult to mesh this with quads since I did not line up the
!   mesh on inside and outside, so just free mesh with tri's.
!
!-----
!
alls
_do=41000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
csys,21 $lssel,,loc,x,router $lssel,a,loc,x,ri_opack
ksll $ksel,r,loc,y,0 $k111=kpnext(0) $k222=kpnext(k111) $1,k111,k222
ksll $ksel,r,loc,y,90 $k333=kpnext(0) $k444=kpnext(k333) $1,k333,k444
ksll $ksel,r,loc,y,180 $k555=kpnext(0) $k666=kpnext(k555) $1,k555,k666
ksll $ksel,r,loc,y,270 $k777=kpnext(0) $k888=kpnext(k777) $1,k777,k888
lsel,,loc,x,router,ri_opack $lssel,r,loc,y,0,90 $al,all
lsel,,loc,x,router,ri_opack $lssel,r,loc,y,90,180 $al,all
lsel,,loc,x,router,ri_opack $lssel,r,loc,y,180,270 $al,all
lsel,,loc,x,router,ri_opack $lssel,r,loc,y,270,360 $al,all
asel,,,_do,_do+999
mshkey,2
mshape,1,2D
aatt,6,1
amesh,all
!
!-----
!
!---- Establish radiation conductors ----
!
!-----
!
rad_key=1

```

```
*if,rad_key,eq,1,then
```

```
!-----
!
!--- Radiation between fuel and basket for the 24 cells ---
!
!   Uses aux12 to generate elements. Each pair uses different
!   element number to keep things separate
!-----
```

```
!
!_dol=401           ! element number designation
matr1=31           ! emissivity for first defined material
matr2=32           ! emissivity for second defined material
et,_dol,link31     ! defines link31 element
alls              ! select all
*do,i,1,24
  _do=i*1000 $_do2=600+i
  asel,,,,_do,_do+999
  esla $esel,r,mat,,5 $nsle $nsel,r,ext $esln $esel,r,mat,,1
  type,_dol $mat,matr1 $esurf
  esla $esel,r,mat,,5 $nsle $nsel,r,ext $esln $esel,r,mat,,2
  mat,matr2 $esurf
  esel,s,type,,_dol $nsle
  /aux12
  emis,matr1,efuel
  emis,matr2,esst1
  stef,sbc
  geom,1,0
  vtype,0,zne1
  write,radmat%i%,sub
  fini
  /prep7
  et,_do2,matrix50,1
  type,_do2 $mat,_do2
  se,radmat%i%,sub
  esel,,type,,_dol
  edel,all
*enddo
```

```
!-----
!
!--- Radiation between guide tube and basket plates for the 24 cells ---
!
!   Uses aux12 to generate elements. Each pair uses different
!   element number to keep things separate. Uses only 1 emissivity
!   for these volumes.
!-----
```

```
!
!_dol=401           ! element number designation
matr2=32           ! emissivity for second defined material
et,_dol,link31     ! defines link31 element
alls              ! select all
*do,i,1,24
  _do=i*1000 $_do2=600+24+i
  asel,,,,_do,_do+999
  esla $esel,r,mat,,7 $nsle $nsel,r,ext $esln $esel,u,mat,,7
  type,_dol $mat,matr2 $esurf
  esel,s,type,,_dol $nsle
  /aux12
  emis,matr2,esst1
  stef,sbc
  geom,1,0
  vtype,0,zne2
  write,radmat%24+i%,sub
  fini
  /prep7
  et,_do2,matrix50,1
```

```

type,_do2 $mat,_do2
se,radmat%24+i%,sub
esel,,type,,_do1
edel,all
*enddo

```

```

!----- Radiation within supports 9A/9B/9C (4) -----

```

```

! Uses aux12 to generate elements. Each pair uses different
! element number to keep things separate.

```

```

!_do1=401          ! element number designation
matr1=42           ! emissivity for second defined material
matr2=52           ! emissivity for second defined material
et,_do1,link31     ! defines link31 element
alls              ! select all

```

```

! Basket support 9A

```

```

!_do2=649
cmsel,,air_9a
esla $nsle $nsel,r,ext $esln $esel,r,mat,,3,17,14
type,_do1 $mat,matr1 $esurf
esla $nsle $nsel,r,ext $esln $esel,r,mat,,11
type,_do1 $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,esst1
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne4
write,radmat49,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat49,sub
esel,,type,,_do1
edel,all
alls

```

```

! Basket support 9B-1

```

```

!_do2=650
cmsel,,air_9b1
esla $nsle $nsel,r,ext $esln $esel,r,mat,,3,17,14
type,_do1 $mat,matr1 $esurf
esla $nsle $nsel,r,ext $esln $esel,r,mat,,11
type,_do1 $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,esst1
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne4
write,radmat50,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat50,sub
esel,,type,,_do1

```

```

edel,all
alls
!
! Basket support 9B-2
!
_do2=651
cmsel,,air_9b2
esla $nsle $nsel,r,ext $esln $esel,r,mat,,3,17,14
type,_do1 $mat,matr1 $esurf
esla $nsle $nsel,r,ext $esln $esel,r,mat,,11
type,_do1 $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,esst1
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne4
write,radmat51,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat51,sub
esel,,type,,_do1
edel,all
alls
!
! Basket support 9C
!
_do2=652
cmsel,,air_9c
esla $nsle $nsel,r,ext $esln $esel,r,mat,,3,17,14
type,_do1 $mat,matr1 $esurf
esla $nsle $nsel,r,ext $esln $esel,r,mat,,11
type,_do1 $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,esst1
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne4
write,radmat52,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat52,sub
esel,,type,,_do1
edel,all
alls
!
!-----
!--- Radiation between basket, supports, and shell (16) ---
!
! Uses aux12 to generate elements. Each pair uses different
! element number to keep things separate.
!-----
!
!_do1=401           ! element number designation
matr1=32           ! emissivity for second defined material
matr2=42           ! emissivity for second defined material
matr3=52           ! emissivity for second defined material
!matr4=62          ! emissivity for second defined material
et,_do1,link31     ! defines link31 element

```

```

alls          ! select all
*do,i,1,16
  _do2=600+52+i
  cmsel,,mpcair%i%
  esla $nsle $nsel,r,ext $esln $esel,r,mat,,2,4,2 $cm,tempe,elem
  esln $esel,r,mat,,9,10 $cmsel,a,tempe
  type,_do1 $mat,matr1 $esurf
  esla $nsle $nsel,r,ext $esln $esel,r,mat,,3 $cm,tempe,elem
  esln $esel,r,mat,,17,19 $cmsel,a,tempe
  mat,matr2 $esurf
  esla $nsle $nsel,r,ext $esln $esel,r,mat,,11
  mat,matr3 $esurf
  esel,s,type,,_do1 $nsle
  /aux12
  emis,matr1,esst1
  emis,matr2,esst1
  emis,matr3,est12
  stef,sbc
  geom,1,0
  vtype,0,zne3
  write,radmat%52+i%,sub
  fini
  /prep7
  et,_do2,matrix50,1
  type,_do2 $mat,_do2
  se,radmat%52+i%,sub
  esel,,type,,_do1
  edel,all
  alls
*enddo

```

```

!-----
!---- Radiation between MPC and overpack ----
!

```

```

!   Uses aux12 to generate elements. Each pair uses different
!   element number to keep things separate.
!-----
!

```

```

!_do1=401          ! element number designation
matr1=52           ! emissivity for second defined material
matr2=52           ! emissivity for second defined material
et,_do1,link31     ! defines link31 element
alls              ! select all
!
! area 1
!
_do2=669
asel,, ,41000 $lsla $csys,21 $lsel,r,loc,x,router $nsll,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
ls la $csys,21 $lsel,r,loc,x,ri_opack $nsll,,1
esln $esel,r,mat,,20 $type,_do1, $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,est12
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne5
write,radmat%_do2-600%,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat%_do2-600%,sub
esel,,type,,_do1
edel,all

```

```

alls
!
! area 2
!
_do2=670
asel,,,,41001 $lsla $csys,21 $lsl,r,loc,x,router $nsl1,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
lsla $csys,21 $lsl,r,loc,x,ri_opack $nsl1,,1
esln $esel,r,mat,,20 $type,_do1, $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,est12
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne5
write,radmat%_do2-600%,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat%_do2-600%,sub
esel,,type,,_do1
edel,all
alls
!
! area 3
!
_do2=671
asel,,,,41002 $lsla $csys,21 $lsl,r,loc,x,router $nsl1,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
lsla $csys,21 $lsl,r,loc,x,ri_opack $nsl1,,1
esln $esel,r,mat,,20 $type,_do1, $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,est12
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne5
write,radmat%_do2-600%,sub
fini
/prep7
et,_do2,matrix50,1
type,_do2 $mat,_do2
se,radmat%_do2-600%,sub
esel,,type,,_do1
edel,all
alls
!
! area 4
!
_do2=672
asel,,,,41003 $lsla $csys,21 $lsl,r,loc,x,router $nsl1,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
lsla $csys,21 $lsl,r,loc,x,ri_opack $nsl1,,1
esln $esel,r,mat,,20 $type,_do1, $mat,matr2 $esurf
esel,s,type,,_do1 $nsle
/aux12
emis,matr1,est12
emis,matr2,est12
stef,sbc
geom,1,0
vtype,0,zne5
write,radmat%_do2-600%,sub
fini
/prep7
et,_do2,matrix50,1

```



```

type,_do2 $mat,_do2
se,radmat%_do2-600%,sub
esel,,type,,_do1
edel,all
alls
*endif
!
!-----
!
!--- Create surface effect elements ---
!-----
!
!
! Solar radiation (done as heat generation on surface)
!
et,10,151
keyo,10,3,0
keyo,10,4,1
keyo,10,5,0
keyo,10,6,0
keyo,10,8,0
keyo,10,9,0
r,110,,sbc
rmore,thik_sol,thik_sol
!
! Radiation/convection from overpack to surroundings (ambient, fire,
cooldown)
!
et,11,151
keyo,11,3,0
keyo,11,4,1
keyo,11,5,1
keyo,11,6,0
keyo,11,8,5
keyo,11,9,1
mp,emis,111,emis_amb          ! apply ambient emissivity material
props
r,111,view_amb,sbc           ! apply ambient real constants
!
! Create surface elements
!
alls
nsel,r,ext $cm,extnode,node
_do=42000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
n,_do+11,50,2 $spac_nod=_do+11
type,10 $mat,110 $real,110 $esurf
type,11 $mat,111 $real,111 $esurf,spac_nod
esel,,type,,10 $cm,elem_sol,elem
esel,,type,,11 $cm,elem_sur,elem
alls
!
!-----
!
!--- Solution ---
!-----
!
!
*get,t_build,active,,time,wall
alls
csys,21
wsort,all,0
save
save,go_solve,db
/solu
!/out,solu,out
!
! First load step - time integration off (i.e. static) to obtain

```

```

! initial conditions
!
antype,transient,new
solcon,on
nropt,full,,off
trnopt,full
timint,off
kbc,0
outres,all,last
time,1e-4
nsub,5,100,1
bfe,el_fuel,hgen,,qfuel      ! apply heat generation to fuel
d,spac_nod,temp,temp_amb     ! make space node ambient
temperature
sfe,elem_sur,1,conv,0,film_amb ! apply ambient convection
coefficient
bfe,elem_sol,hgen,,rate_sol/thik_sol ! apply solar loading (surface heat
generation)
solve
save
!
! Second load step - transient to simulate fire conditions
!
timint,on
kbc,1
outres,all,all
time,time_fir
delt,.05/60,.01/60,30/60
d,spac_nod,temp,temp_fir     ! make space node fire temperature
sfe,elem_sur,1,conv,0,film_fir ! apply fire convection coefficient
mp,emis,111,emis_fir        ! apply fire emissivity material
props
r,111,view_fir,sbc          ! apply fire real constants
bfe,elem_sol,hgen,,0.0      ! remove solar loading (surface
heat generation)
esel,,mat,,21              ! change carbon steel shells with
gaps
mpchg,28,all               ! to intimate contact for
conservatism
alls
mp,kxx,24,1.0/fti
mp,kxx,25,1.0/fti
solve
save
!
! Third load step - transient to simulate cooldown after fire
!
time,time_fir+time_am2
delt,.05/60,.01/60,60/60
d,spac_nod,temp,temp_am2     ! make space node ambient cooldown
temperature
sfe,elem_sur,1,conv,0,film_am2 ! apply ambient cooldown convection
coefficient
mp,emis,111,emis_am2        ! apply ambient cooldown emissivity
material props
r,111,view_am2,sbc          ! apply ambient cooldown real
constants
esel,,mat,,24,25           ! change Holtite A and foam to air
to
mpchg,26,all               ! simulate degradation due to
fire
esel,,mat,,28              ! change carbon steel shells in
intimate contact
mpchg,21,all               ! to shells with gaps for
conservatism
alls
solve
save

```

```
fini
*get,t_solve,active,,time,wall
!
!-----
!
!--- Post Processing ---
!-----
!
!
/post1
!/out,post,out
wpstyl
/triad,lbot
set,last
plns,temp

*msg,ui,(t_build-t_start)*60,(t_solve-t_build)*60
The model took %I minutes to build%&
and %I minutes to solve
/eof
```