

(11)

7/22

```
|-----|
| Holtec HISTAR 100 MPC-24
| ANSYS 5.5
| BJK - started 3/18/02 - last modified 11/1/02
|
|   btf.inp (was mpc24-12.inp)  -- HOLTEC HISTAR 100 MPC-24
|   fire thermal analysis for MPC
|   Units: btu, inch, hour, F, lbm
|
```

```
| Required macros and files:
|   btf-20m.inp - main input deck (this file)
|   mpc24-20.des - description file with geometry and material specs
|   boral.mac   - boral 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
| *afun,deg $/filn,mpc24
| /config,nproc,2
| /config,fsplit,1900
| /config,nres,10000
| /prep7
| !/out,build,out
| *get,t_start,active,,time,wall
| immed,0 $/pnum,kp,1 $/pnum,line,1 $/pnum,area,1
| /plop,info,auto
|
```

```
|-----|
| Input the MPC in overpack description file
| Normal transport - transient fire load - cooldown
|-----|
```

```
| /input,mpc24-20,des
|
```

```
|-----|
| Define element types
|-----|
```

```
| et,1,plane55,1
| et,2,link31
|
```

```
|-----|
| Define mesh element size factors
|-----|
```

```

|
| esf=1.5                | Fuel region default element size
| edefsiz=2              | Default element size of unit cell
| engg=2                 | Elements across gas gap in unit cell
| enrcth=2               | Elements across radial channel thickness
|
|-----|
| 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 boron 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 boron plate
| vertcut(7)=tk1+(gtube_i+wd6)/2 | right side narrow boron 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 boron 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 boron plate/air gap combo thickness
| vertcut(15)=tk1+gtube_i+tk1a+(tk4+2*gp1)+tk3 | left boron 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
lsl,,loc,y,yoff1 $cm,linedrag,line
alls
adrag,linedrag,,,,,_do+vertnum+1,_do+vertnum+2,_do+vertnum+3,_do+vertnum+4,_do+vertnum+5
lsl,,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
lsl,,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
lsl,,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
!
! 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
!
! borai 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
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 and basket supports ---
!-----

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
csys,21
lssel,,,,_do,_do+99 $lssel,r,loc,y,0,90 $al,all
lssel,,,,_do,_do+99 $lssel,r,loc,y,90,180 $al,all
lssel,,,,_do,_do+99 $lssel,r,loc,y,180,270 $al,all
lssel,,,,_do,_do+99 $lssel,r,loc,y,270,360 $al,all
asel,,,,_do,_do+99
cm,mpcshell,area
aatt,11,,1
!
!--- create basket supports 9A,9B,9C (x4 total) ---
!
! 9B #1
!
alls
local,22,0,centx,centy,,(ang_9B_1+90)
do=30100 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do,,-rinner+wd2-bro
circle,_do,bro $circle,_do,bri
lssel,r,,,,_do,_do+99
wplane,-1,defa $wpcsys,-1,22 $wpoff,,-rinner+wd2-bro $wprot,,90
wprot,,,ang2/2 $lsbw,all
wprot,,,ang2 $lsbw,all
lssel,r,loc,y,-10000,-rinner+wd2-bro
ldel,all,,,1
lssel,,,,_do,_do+99
k,_do+30,kx(_do+14)-wd2*sin(ang2/2),ky(_do+14)-wd2*cos(ang2/2)
k,_do+31,kx(_do+16)-wd2*sin(ang2/2),ky(_do+16)-wd2*cos(ang2/2)
k,_do+32,kx(_do+11)+wd2*sin(ang2/2),ky(_do+11)-wd2*cos(ang2/2)
k,_do+33,kx(_do+9)+wd2*sin(ang2/2),ky(_do+9)-wd2*cos(ang2/2)
l,_do+14,_do+30 $l,_do+16,_do+31 $l,_do+11,_do+32 $l,_do+9,_do+33
l,_do+30,_do+31 $l,_do+32,_do+33
lssel,,,,_do,_do+99
al,all
asel,,,,_do,_do+99
cm,bsup9b,area
cmsel,a,mpcshell
do2=30000 $numstr,kp,_do2 $numstr,line,_do2 $numstr,area,_do2
aovlap,all
csys,21
asel,r,loc,x,router,10000

```

```

adel,all,,,1
lssel,,,,do,do+99
asll $lsla $cm,bsup9b1,area
aatt,3,,1
asel,,,,do2,do2+99
cmsel,u,bsup9b1
cm,mpcshell,area
! 9B #2
alls
csys,0
local,22,0,centx,centy,,(ang_9B_2+90)
do=30200 $numstr,kp,do $numstr,line,do $numstr,area,do
k,do,,--rinner+wd2--bro
circle,do,bro $circle,do,bri
lssel,r,,,do,do+99
wplane,-1,defa $wpcsys,-1,22 $wpoff,,--rinner+wd2--bro $wprot,,90
wprot,,,ang2/2 $lsbw,all
wprot,,,--ang2 $lsbw,all
lssel,r,loc,y,-10000,--rinner+wd2--bro
ldel,all,,,1
lssel,,,,do,do+99
k,_do+30,kx(_do+13)-wd2*sin(ang2/2),ky(_do+13)-wd2*cos(ang2/2)
k,_do+31,kx(_do+15)-wd2*sin(ang2/2),ky(_do+15)-wd2*cos(ang2/2)
k,_do+32,kx(_do+12)+wd2*sin(ang2/2),ky(_do+12)-wd2*cos(ang2/2)
k,_do+33,kx(_do+10)+wd2*sin(ang2/2),ky(_do+10)-wd2*cos(ang2/2)
l,_do+13,_do+30 $l,_do+15,_do+31 $l,_do+12,_do+32 $l,_do+10,_do+33
l,_do+30,_do+31 $l,_do+32,_do+33
lssel,,,,do,do+99
al,all
asel,,,,do,do+99
cm,bsup9b,area
cmsel,a,mpcshell
do2=30000 $numstr,kp,do2 $numstr,line,do2 $numstr,area,do2
aovlap,all
csys,21
asel,r,loc,x,router,10000
adel,all,,,1
lssel,,,,do,do+99
asll $lsla $cm,bsup9b2,area
aatt,3,,1
asel,,,,do2,do2+99
cmsel,u,bsup9b1
cmsel,u,bsup9b2
cm,mpcshell,area
! 9A
alls
csys,0
local,22,0,centx,centy,,(ang_9A+90)
do=30300 $numstr,kp,do $numstr,line,do $numstr,area,do
k,do,,--rinner+wd2_9A--bro

```



```

circle,_do,bro $circle,_do,bri
lsl,r,,,do,_do+99
wplane,-1,defa $wpcsys,-1,22 $wpoff,, -rinner+wd2_9A-bro $wprot,,90
wprot,,,ang2/2 $lsbw,all
wprot,,, -ang2 $lsbw,all
lsl,r,loc,y,-10000,-rinner+wd2_9A-bro
ldel,all,,,1
lsl,,,,do,_do+99
k,_do+30,kx(_do+13)-wd2_9A*sin(ang2/2),ky(_do+13)-wd2_9A*cos(ang2/2)
k,_do+31,kx(_do+15)-wd2_9A*sin(ang2/2),ky(_do+15)-wd2_9A*cos(ang2/2)
k,_do+32,kx(_do+11)+wd2_9A*sin(ang2/2),ky(_do+11)-wd2_9A*cos(ang2/2)
k,_do+33,kx(_do+9)+wd2_9A*sin(ang2/2),ky(_do+9)-wd2_9A*cos(ang2/2)
l,_do+13,_do+30 $l,_do+15,_do+31 $l,_do+11,_do+32 $l,_do+9,_do+33
l,_do+30,_do+31 $l,_do+32,_do+33
lsl,,,,do,_do+99
al,all
asel,,,,do,_do+99
cm,bsup9A,area
cmsel,a,mpcshell
_do2=30000 $numstr,kp,_do2 $numstr,line,_do2 $numstr,area,_do2
aovlap,all
csys,21
asel,r,loc,x,router,10000
adel,all,,,1
lsl,,,,do,_do+99
asll $lsla $cm,bsup9A,area
aatt,3,,1
asel,,,,do2,_do2+99
cmsel,u,bsup9b1
cmsel,u,bsup9b2
cmsel,u,bsup9A
cm,mpcshell,area
! 9C
alls
csys,0
local,22,0,centx,centy,,(ang_9C+90)
_do=30400 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do,, -rinner+wd2_9C-bro
circle,_do,bro $circle,_do,bri
lsl,r,,,do,_do+99
wplane,-1,defa $wpcsys,-1,22 $wpoff,, -rinner+wd2_9C-bro $wprot,,90
wprot,,,ang2/2 $lsbw,all
wprot,,, -ang2 $lsbw,all
lsl,r,loc,y,-10000,-rinner+wd2_9C-bro
ldel,all,,,1
lsl,,,,do,_do+99
k,_do+30,kx(_do+14)-wd2_9C*sin(ang2/2),ky(_do+14)-wd2_9C*cos(ang2/2)
k,_do+31,kx(_do+16)-wd2_9C*sin(ang2/2),ky(_do+16)-wd2_9C*cos(ang2/2)
k,_do+32,kx(_do+12)+wd2_9C*sin(ang2/2),ky(_do+12)-wd2_9C*cos(ang2/2)
k,_do+33,kx(_do+10)+wd2_9C*sin(ang2/2),ky(_do+10)-wd2_9C*cos(ang2/2)

```

```

1,_do+14,_do+30 $1,_do+16,_do+31 $1,_do+12,_do+32 $1,_do+10,_do+33
1,_do+30,_do+31 $1,_do+32,_do+33
lsel,,,,_do,_do+99
al,all
asel,,,,_do,_do+99
cm,bsup9C,area
cmsel,a,mpcshell
_do2=30000 $numstr,kp,_do2 $numstr,line,_do2 $numstr,area,_do2
aovlap,all
csys,21
asel,r,loc,x,router,10000
adel,all,,,1
lsel,,,,_do,_do+99
asll $lsla $cm,bsup9C,area
aatt,3,,1
asel,,,,_do2,_do2+99
cmsel,u,bsup9B1
cmsel,u,bsup9B2
cmsel,u,bsup9A
cmsel,u,bsup9C
cm,mpcshell,area
!
!---- create basket supports 5C (x4) ----
!
! cut the MPC shell
alls
csys,0 $local,22,0,centx,centy,,ang_5C_1
cmsel,,mpcshell
_do=30000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd8/2 $asbw,all
wpoff,,,wd8 $asbw,all
! cut the MPC shell
ang_5C_2=90
csys,0 $local,22,0,centx,centy,,ang_5C_2
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd8/2 $asbw,all
wpoff,,,wd8 $asbw,all
cm,mpcshell,area
! 5c #1
_do=30510 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
local,23,0,centx,centy $lsel,r,loc,y,-wd8/2,wd8/2 $lsel,r,loc,x,0,10000
k1_5c=kp(rinner,-wd8/2,0) $k2_5c=kp(rinner,wd8/2,0) $k3_5c=kp(rinner,0,0)
ksel,,,,k1_5c $ksel,a,,,k2_5c $ksel,a,,,k3_5c $lslk,,1
k,_do,rinner-wd7,-wd8/2 $k,_do+1,rinner-wd7,wd8/2 $k,_do+2,rinner-wd7,0
l,k1_5c,_do $l,k2_5c,_do+1 $l,k3_5c,_do+2
l,_do,_do+2 $l,_do+1,_do+2
ksel,,,,k2_5c $ksel,a,,,k3_5c $ksel,a,,,_do+1,_do+2 $lslk,,1 $al,all

```

```

ksel,,,k1_5c $ksel,a,,,k3_5c $ksel,a,,,_do+0,_do+2,2 $slsk,,1 $al,all
asel,,,_do,_do+9 $aatt,3,,1 $cm,bsup5c1,area
! 5c #2
_do=30520 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $slsa $ksll
csys,21 $lsel,r,loc,x,rinner
local,23,0,centx,centy $lsel,r,loc,x,-wd8/2,wd8/2 $lsel,r,loc,y,0,10000
k1_5c=kp(-wd8/2,rinner,0) $k2_5c=kp(wd8/2,rinner,0) $k3_5c=kp(0,rinner,0)
ksel,,,k1_5c $ksel,a,,,k2_5c $ksel,a,,,k3_5c $slsk,,1
k,_do,-wd8/2,rinner-wd7 $k,_do+1,wd8/2,rinner-wd7 $k,_do+2,0,rinner-wd7
l,k1_5c,_do $l,k2_5c,_do+1 $l,k3_5c,_do+2
l,_do,_do+2 $l,_do+1,_do+2
ksel,,,k2_5c $ksel,a,,,k3_5c $ksel,a,,,_do+1,_do+2 $slsk,,1 $al,all
ksel,,,k1_5c $ksel,a,,,k3_5c $ksel,a,,,_do+0,_do+2,2 $slsk,,1 $al,all
asel,,,_do,_do+9 $aatt,3,,1 $cm,bsup5c2,area
! 5c #3
_do=30530 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $slsa $ksll
csys,21 $lsel,r,loc,x,rinner
local,23,0,centx,centy $lsel,r,loc,y,-wd8/2,wd8/2 $lsel,r,loc,x,-10000,0
k1_5c=kp(-rinner,-wd8/2,0) $k2_5c=kp(-rinner,wd8/2,0) $k3_5c=kp(-rinner,0,0)
ksel,,,k1_5c $ksel,a,,,k2_5c $ksel,a,,,k3_5c $slsk,,1
k,_do,-rinner+wd7,-wd8/2 $k,_do+1,-rinner+wd7,wd8/2 $k,_do+2,-rinner+wd7,0
l,k1_5c,_do $l,k2_5c,_do+1 $l,k3_5c,_do+2
l,_do,_do+2 $l,_do+1,_do+2
ksel,,,k2_5c $ksel,a,,,k3_5c $ksel,a,,,_do+1,_do+2 $slsk,,1 $al,all
ksel,,,k1_5c $ksel,a,,,k3_5c $ksel,a,,,_do+0,_do+2,2 $slsk,,1 $al,all
asel,,,_do,_do+9 $aatt,3,,1 $cm,bsup5c3,area
! 5c #4
_do=30540 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $slsa $ksll
csys,21 $lsel,r,loc,x,rinner
local,23,0,centx,centy $lsel,r,loc,x,-wd8/2,wd8/2 $lsel,r,loc,y,-10000,0
k1_5c=kp(-wd8/2,-rinner,0) $k2_5c=kp(wd8/2,-rinner,0) $k3_5c=kp(0,-rinner,0)
ksel,,,k1_5c $ksel,a,,,k2_5c $ksel,a,,,k3_5c $slsk,,1
k,_do,-wd8/2,-rinner+wd7 $k,_do+1,wd8/2,-rinner+wd7 $k,_do+2,0,-rinner+wd7
l,k1_5c,_do $l,k2_5c,_do+1 $l,k3_5c,_do+2
l,_do,_do+2 $l,_do+1,_do+2
ksel,,,k2_5c $ksel,a,,,k3_5c $ksel,a,,,_do+1,_do+2 $slsk,,1 $al,all
ksel,,,k1_5c $ksel,a,,,k3_5c $ksel,a,,,_do+0,_do+2,2 $slsk,,1 $al,all
asel,,,_do,_do+9 $aatt,3,,1 $cm,bsup5c4,area
cmsel,a,bsup5c1
cmsel,a,bsup5c2
cmsel,a,bsup5c3
cm,bsup5c,area
!
!--- create basket supports 5E (x4) ---
!
! cut the MPC shell
alls

```

```

cmsel,,mpcshell
csys,21 $asel,r,loc,y,ang_5E_1-45,ang_5E_1+45
csys,0 $local,22,0,centx,centy,,ang_5E_1
_do=30000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd10/2 $asbw,all
wpoff,,,wd10 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5E_2-45,ang_5E_2+45
csys,0 $local,22,0,centx,centy,,ang_5E_2
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd10/2 $asbw,all
wpoff,,,wd10 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5E_3-45,ang_5E_3+45
csys,0 $local,22,0,centx,centy,,ang_5E_3
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd10/2 $asbw,all
wpoff,,,wd10 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5E_4-45,ang_5E_4+45
csys,0 $local,22,0,centx,centy,,ang_5E_4
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd10/2 $asbw,all
wpoff,,,wd10 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! 5E #1
_do=30610 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5E_1
lsel,r,loc,y,-wd10/2,wd10/2 $lsel,r,loc,x,0,10000
k1_5e=kp(rinner,-wd10/2,0) $k2_5e=kp(rinner,wd10/2,0)
ksel,,,k1_5e $ksel,a,,,k2_5e $lslk,,1
k,_do,rinner-wd9,-wd10/2 $k,_do+1,rinner-wd9,wd10/2
l,k1_5e,_do $l,_do,_do+1 $l,_do+1,k2_5e
al,all $asel,,,do,_do+9 $aatt,3,,1 $cm,bsup5e1,area
! 5E #2
_do=30620 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5E_2
lsel,r,loc,y,-wd10/2,wd10/2 $lsel,r,loc,x,0,10000
k1_5e=kp(rinner,-wd10/2,0) $k2_5e=kp(rinner,wd10/2,0)
ksel,,,k1_5e $ksel,a,,,k2_5e $lslk,,1
k,_do,rinner-wd9,-wd10/2 $k,_do+1,rinner-wd9,wd10/2
l,k1_5e,_do $l,_do,_do+1 $l,_do+1,k2_5e

```

```

al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5e2,area
! 5E #3
_do=30630 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5E_3
lsel,r,loc,y,-wd10/2,wd10/2 $lsel,r,loc,x,0,10000
k1_5e=kp(rinner,-wd10/2,0) $k2_5e=kp(rinner,wd10/2,0)
ksel,,,,k1_5e $ksel,a,,,k2_5e $lslk,,1
k,_do,rinner-wd9,-wd10/2 $k,_do+1,rinner-wd9,wd10/2
l,k1_5e,_do $l,_do,_do+1 $l,_do+1,k2_5e
al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5e3,area
! 5E #4
_do=30640 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5E_4
lsel,r,loc,y,-wd10/2,wd10/2 $lsel,r,loc,x,0,10000
k1_5e=kp(rinner,-wd10/2,0) $k2_5e=kp(rinner,wd10/2,0)
ksel,,,,k1_5e $ksel,a,,,k2_5e $lslk,,1
k,_do,rinner-wd9,-wd10/2 $k,_do+1,rinner-wd9,wd10/2
l,k1_5e,_do $l,_do,_do+1 $l,_do+1,k2_5e
al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5e4,area
cmsel,a,bsup5e1
cmsel,a,bsup5e2
cmsel,a,bsup5e3
cm,bsup5e,area
!
!--- create basket supports 5D (x4) ---
!
! cut the MPC shell
alls
cmsel,,mpcshell
csys,21 $asel,r,loc,y,ang_5D_1-45,ang_5D_1+45
csys,0 $local,22,0,centx,centy,,ang_5D_1
_do=30000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd12/2 $asbw,all
wpoff,,,wd12 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5D_2-45,ang_5D_2+45
csys,0 $local,22,0,centx,centy,,ang_5D_2
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd12/2 $asbw,all
wpoff,,,wd12 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5D_3-45,ang_5D_3+45
csys,0 $local,22,0,centx,centy,,ang_5D_3

```

```

wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd12/2 $asbw,all
wpoff,,,wd12 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! cut the MPC shell
csys,21 $asel,r,loc,y,ang_5D_4-45,ang_5D_4+45
csys,0 $local,22,0,centx,centy,,ang_5D_4
wplane,-1,defa $wpcsys,-1,22 $wprot,,90
wpoff,,,wd12/2 $asbw,all
wpoff,,,wd12 $asbw,all
cmsel,a,mpcshell $cm,mpcshell,area
! 5D #1
_do=30710 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5D_1
lsel,r,loc,y,-wd12/2,wd12/2 $lsel,r,loc,x,0,10000
k1_5D=kp(rinner,-wd12/2,0) $k2_5D=kp(rinner,wd12/2,0)
ksel,,,k1_5D $ksel,a,,,k2_5D $lslk,,1
k,_do,rinner-wd11,-wd12/2 $k,_do+1,rinner-wd11,wd12/2
l,k1_5D,_do $l,_do,_do+1 $l,_do+1,k2_5D
al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5D1,area
! 5D #2
_do=30720 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5D_2
lsel,r,loc,y,-wd12/2,wd12/2 $lsel,r,loc,x,0,10000
k1_5D=kp(rinner,-wd12/2,0) $k2_5D=kp(rinner,wd12/2,0)
ksel,,,k1_5D $ksel,a,,,k2_5D $lslk,,1
k,_do,rinner-wd11,-wd12/2 $k,_do+1,rinner-wd11,wd12/2
l,k1_5D,_do $l,_do,_do+1 $l,_do+1,k2_5D
al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5D2,area
! 5D #3
_do=30730 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5D_3
lsel,r,loc,y,-wd12/2,wd12/2 $lsel,r,loc,x,0,10000
k1_5D=kp(rinner,-wd12/2,0) $k2_5D=kp(rinner,wd12/2,0)
ksel,,,k1_5D $ksel,a,,,k2_5D $lslk,,1
k,_do,rinner-wd11,-wd12/2 $k,_do+1,rinner-wd11,wd12/2
l,k1_5D,_do $l,_do,_do+1 $l,_do+1,k2_5D
al,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5D3,area
! 5D #4
_do=30740 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,mpcshell $lsla $ksll
csys,21 $lsel,r,loc,x,rinner
csys,0 $local,23,0,centx,centy,,ang_5D_4
lsel,r,loc,y,-wd12/2,wd12/2 $lsel,r,loc,x,0,10000

```

```

k1_5D=kp(rinner,-wd12/2,0) $k2_5D=kp(rinner,wd12/2,0)
ksel,,,,k1_5D $ksel,a,,,k2_5D $lslk,,1
k,_do,rinner-wd11,-wd12/2 $k,_do+1,rinner-wd11,wd12/2
l,k1_5D,_do $l,_do,_do+1 $l,_do+1,k2_5D
a1,all $asel,,,,_do,_do+9 $aatt,3,,1 $cm,bsup5D4,area
cmsel,a,bsup5D1
cmsel,a,bsup5D2
cmsel,a,bsup5D3
cm,bsup5D,area
!
!--- cut basket supports at inner radius of canister ---
!--- (to change material type to lower conductivity to simulate weld) ---
!
alls
_do=31000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
csys,0 $k,_do,1,1 $circle,30000,rinner-cutbac,,_do,360,4
lsl,,,,_do,_do+99 $cm,cutter,line
_do=30100 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup9b1 $asbl,all,cutter,,DELE,KEEP $cm,bsup9b1,area
_do=30200 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup9b2 $asbl,all,cutter,,DELE,KEEP $cm,bsup9b2,area
_do=30300 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup9a $asbl,all,cutter,,DELE,KEEP $cm,bsup9a,area
_do=30400 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup9c $asbl,all,cutter,,DELE,KEEP $cm,bsup9c,area
ldel,cutter,,1
_do=31000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
csys,0 $k,_do,1,1 $circle,30000,rinner-cutbac,,360,4
lsl,,,,_do,_do+99 $cm,cutter,line
_do=30500 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup5c1 $asbl,all,cutter,,DELE,KEEP $cm,bsup5c1,area
cmsel,,bsup5c2 $asbl,all,cutter,,DELE,KEEP $cm,bsup5c2,area
cmsel,,bsup5c3 $asbl,all,cutter,,DELE,KEEP $cm,bsup5c3,area
cmsel,,bsup5c4 $asbl,all,cutter,,DELE,KEEP $cm,bsup5c4,area
_do=30600 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup5e1 $asbl,all,cutter,,DELE,KEEP $cm,bsup5e1,area
cmsel,,bsup5e2 $asbl,all,cutter,,DELE,KEEP $cm,bsup5e2,area
cmsel,,bsup5e3 $asbl,all,cutter,,DELE,KEEP $cm,bsup5e3,area
cmsel,,bsup5e4 $asbl,all,cutter,,DELE,KEEP $cm,bsup5e4,area
_do=30700 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
cmsel,,bsup5d1 $asbl,all,cutter,,DELE,KEEP $cm,bsup5d1,area
cmsel,,bsup5d2 $asbl,all,cutter,,DELE,KEEP $cm,bsup5d2,area
cmsel,,bsup5d3 $asbl,all,cutter,,DELE,KEEP $cm,bsup5d3,area
cmsel,,bsup5d4 $asbl,all,cutter,,DELE,KEEP $cm,bsup5d4,area
cmsel,,cutter $cmdel,cutter $ldel,all,,1
!
!-----
!--- generate the 24 basket cells ---
!-----
!
```

```

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
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

```

```

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

```

```

alls
cmdel,gen_cell $cmdel,gen_fuel $cmdel,gen_airf $cmdel,gen_guid
cmdel,platel $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 $slsl $ksll
*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_cell1
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_cell1
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_cell1 $slsl $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 $slsl
kmod,all,,offy1+horizcut(15)+platdrag
amesh,all
! add keypoint to outside of stringer plate
cmsel,a,a_cell1 $cm,a_cell1,area
asel,r,loc,y,offy1+horizcut(14),offy1+horizcut(15)+platdrag
asel,r,loc,x,offx1+vertcut(15),offx1+vertcut(16)
aclear,all $slsl $ksll
k111=kp(-10000,-10000,0)
k222=kp(-10000,10000,0)
k333=kp(10000,-10000,0)
k444=kp(10000,10000,0)

```

```

a000=arnext(1)
lset,r,loc,y,offy1+horizcut(15)+platdrag-.01,offy1+horizcut(15)+platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell1 $cm,a_cell1,area
!
!--- cell #2 ---
!
alls
asel,,,2000,2999 $cm,a_cell2,area $sls1a $ks11
*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_cell2
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_cell2
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_cell2
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_cell2
asel,r,loc,x,offx2+horizcut(13),10000
asel,r,loc,y,offy2+vertcut(8),offy2+vertcut(9)
aclear,all $aatt,2,,1 $amesh,all
! remove air on top right
cmsel,,a_cell2
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_cell2
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 $lsla $ksll
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 $lsla
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 $lsla $ksll $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-tk1/2
kmod,all,offx2+celptch-tk1
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
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)
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 $lsla $ksll
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+vertcut(2)
aclear,all $lsla
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 $lsla $ksll $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
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_cell7
amesh,all
cmsel,a,a_cell7 $cm,a_cell7,area
!
!--- cell #12 ---
!
alls
asel,,,,12000,12999 $cm,a_cell12,area $lsla $ksll
*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 $lsla $ksll
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 $lsla
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
aclear,all
aatt,2,,1
asel,r,loc,y,offy12+horizcut(15),offy12+celptch
asel,r,loc,x,offx12+vertcut(6),offx12+vertcut(8)
aatt,7,,1
asel,r,loc,y,offy12+horizcut(16),offy12+celptch
asel,r,loc,x,offx12+vertcut(7),offx12+vertcut(8)
aatt,2,,1
cmsel,,a_cell12
asel,r,loc,y,offy12+celptch,offy12+celptch+tk1
asel,r,loc,x,offx12+vertcut(8),offx12+vertcut(9)
adel,all,,,1
cmsel,,a_cell12 $lsla $ksll $cm,kp_work,kp
cmsel,,kp_work
ksel,r,loc,y,offy12+horizcut(16)
ksel,r,loc,x,offx12+vertcut(7),offx12+vertcut(9)
kmod,all,,offy12+celptch-tk1
cmsel,,kp_work
ksel,r,loc,y,offy12+horizcut(17)
ksel,r,loc,x,offx12+vertcut(7),offx12+vertcut(9)
kmod,all,,offy12+celptch-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offx12+horizcut(7)-.01,offx12+horizcut(7)+.01
ksel,r,loc,y,offy12+celptch-tk1,offy12+celptch+vertcut(1)
kmod,all,offx12+horizcut(8)-tk1
cmsel,,kp_work
ksel,r,loc,x,offx12+horizcut(9)-.01,offx12+horizcut(9)+.01
ksel,r,loc,y,offy12+celptch-tk1
kmod,all,,offy12+celptch-tk1-tk1/2
cmsel,,kp_work
ksel,r,loc,x,offx12+horizcut(9)-.01,offx12+horizcut(9)+.01
ksel,r,loc,y,offy12+celptch-tk1/2
kmod,all,,offy12+celptch-tk1
cmsel,,kp_work
ksel,r,loc,x,offx12+horizcut(9)-.01,offx12+horizcut(9)+.01
ksel,r,loc,y,offy12+celptch
kmod,all,,offy12+celptch-tk1/2
!cmsel,,kp_work
!ksel,r,loc,y,offy12+celptch+tk1
!ksel,r,loc,x,offx12+horizcut(8)-.01,offx12+horizcut(8)+.01

```

```

!kmod,all,offx12+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,offx13,kp,,mxloc,x $offx13=offx13-celptch
*get,offy13,kp,,mxloc,y $offy13=offy13-celptch
! shorten the boral on the side
cmsel,,a_cell13
asel,r,loc,x,offx13-celptch+horizcut(16),offx13
asel,r,loc,y,offy13+vertcut(3),offy13+vertcut(10)
asel,u,loc,y,offy13+vertcut(6),offy13+vertcut(7)
aclear,all $aatt,7,,1 $amesh,all
! add the stringer plate
cmsel,,a_cell13
asel,r,loc,x,offx13-celptch+horizcut(16),offx13-celptch+horizcut(17)
asel,r,loc,y,offy13+vertcut(12),offy13+celptch
aclear,all $aatt,2,,1 $amesh,all
cmsel,,a_cell13
asel,r,loc,x,offx13-celptch+horizcut(17),offx13
asel,r,loc,y,offy13+vertcut(12),offy13+celptch
aclear,all $aatt,2,,1 $amesh,all
! fix air on bottom left
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 $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,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 $sls $ksll
*get,offx18,kp,,mnloc,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 $sls $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 $sls
kmod,all,offx18+horizcut(15)+platdrag
amesh,all

```

```

! add keypoint to outside of stringer plate
cmsel,a,a_cell18 $cm,a_cell18,area
asel,r,loc,y,offy18+horizcut(15),offy18+horizcut(16)
asel,r,loc,x,offx18+horizcut(14),offx18+horizcut(14)+platdrag
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,x,offx18+horizcut(15)+platdrag-.01,offx18+horizcut(15)+platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell18 $cm,a_cell18,area
!
!--- cell #19 ---
!
alls
asel,,,19000,19999 $cm,a_cell19,area $sls $ksll
*get,offx19,kp,,mxloc,x $offx19=offx19-celptch
*get,offy19,kp,,mxloc,y $offy19=offy19-celptch
! fix air on bottom left
cmsel,,a_cell19
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_cell19
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_cell19
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_cell22,area $sls $ksll
*get,offx22,kp,,mxloc,x
*get,offy22,kp,,mxloc,y $offy22=offy22-celptch
! remove the outer boral on the side
cmsel,,a_cell22
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_cell22
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_cell22
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 $lsla $ksll
*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) $lsla $ksll $aclear,all
ksel,r,loc,y,offy23-.0001,offy23+.0001
kpcur=kpnex(0) $kmod,all,,ky(kpcur)+kpfixer $lsla $ksll $amesh,all
cmsel,a,a_cell23 $cm,a_cell23,area
cmsel,,a_cell23
asel,r,loc,y,-10000,offy23 $lsla $ksll
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 $lsla $ksll
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 $lsla
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 $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,y,offy23k-celptch+horizcut(16)-platdrag-.01,offy23k-celptch+horizcut(16)-platdrag+.01
ldiv,all
amap,a000,k111,k222,k444,k333
cmsel,a,a_cell23 $cm,a_cell23,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_cell24
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_cell24 $cm,a_cell24,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_cell124
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 $ls1a $ks11 $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

```

```

!-----
!--- Remove helium elements external to basket ---
!

```

```

! This clears the areas and elements on the outer boundary
! of the basket so they can be meshed with the rest of the helium
! in this region.
!

```

```

!
alls
nsle $nsel,r,ext
esln,r $esel,r,mat,,7 $nsle $ksln $lslk,,1 $asll,,1 $asel,r,mat,,7
aclear,all $adel,all,,1
alls
nsle $nsel,r,ext
esln,r $esel,r,mat,,7 $nsle $ksln $lslk,,1 $asll,,1 $asel,r,mat,,7
aclear,all $adel,all,,1

```

```

!-----
!--- create the air gaps inside the mpc shell ---
!

```

```

! This section creates the helium gaps between the basket and the
! MPC shell. First, the helium in the basket supports 9A/9B/9C are
! created. Then the helium in the gaps between each support and
! basket are made into an area. These areas will be used for radiation
! matrix calculations.
!

```

```

!
!--- create the areas inside the basket supports---
!

```

```

alls
_do=35000 $nums,area,_do $nums,kp,_do $nums,line,_do
! inside basket support 9C
lsel,,,30076 $lsel,a,,30401 $lsel,a,,30406,30408 $lsel,a,,30412
lsel,a,,30414,30415 $al,all $asll,,1 $cm,air_9c,area $aatt,8,,1
! inside basket support 9B1
lsel,,,30044 $lsel,a,,30202,30204,2 $lsel,a,,30207,30208
lsel,a,,30212 $lsel,a,,30214,30215 $al,all $asll,,1 $cm,air_9b1,area $aatt,8,,1
! inside basket support 9A

```

```

lsel,,,30060 $lsel,a,,,30303,30305 $lsel,a,,,30309
lsel,a,,,30312,30313 $lsel,a,,,30315 $al,all $asll,,1 $cm,air_9a,area $aatt,8,,1
! inside basket support 9B2
lsel,,,30028 $lsel,a,,,30105,30106 $lsel,a,,,30113 $lsel,a,,,30152,30158,6
lsel,a,,,30161,30163,2 $al,all $asll,,1 $cm,air_9b2,area $aatt,8,,1
!
!--- generate lines at each support and make areas ---
!
alls
_do=36000 $nums,area,_do $nums,kp,_do $nums,line,_do
asel,,,30000,35999
cm,mpc_area,area
lsla $lsel,r,ext $csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
lsla $lsel,r,ext $csys,21 $lsel,r,loc,x,router $cm,mpc_out,line
alls
asel,,,1,29999
lsla $lsel,r,ext
cm,bask_out,line
csys,0
! Create line to basket support 5C-1
_do=36100 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
csys,0
cmsel,mpc_in $cmsel,bsup5c1 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
! Create line to basket support 5E-1
_do=36200 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_5E_1,90 $wpcsys,-1,23
cmsel,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,bsup5e1 $asbw,all $cm,bsup5e1,area
csys,0 $lsla $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,_do+50-100 $ksll $cmsel,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,_do+50 $ksll $cmsel,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,_do+50-100 $ksll $cmsel,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,_do+50 $ksll $cmsel,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair1,area
! Create line to basket support 9C
_do=36300 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_9C,90 $wpcsys,-1,23
cmsel,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell

```

```

cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup9C $asbw,all $cm,bsup9c,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair2,area
! Create line to basket support 5E-2
_do=36400 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_5E 2,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup5e2 $asbw,all $cm,bsup5e2,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair3,area
! Create line to basket support 5C-2
_do=36500 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
csys,0
cmsel,,mpc_in $cmsel,,bsup5c2 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
csys,21
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair4,area
! Create line to basket support 5D-1
_do=36600 $nums,area,_do $nums,kp,_do $nums,line,_do

```

```

alls
local,23,0,,,ang_5d 1,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc in $cmsel,,bsup5d1 $asbw,all $cm,bsup5d1,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair5,area
! Create line to basket support 9B-2
_do=36700 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_9b 2,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc in $cmsel,,bsup9b2 $asbw,all $cm,bsup9b2,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair6,area
! Create line to basket support 5E-3
_do=36800 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_5E 3,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc in $cmsel,,bsup5e3 $asbw,all $cm,bsup5e3,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y

```

```

lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair7,area
! Create line to basket support 5C-3
_do=36900 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
csys,0
cmsel,,mpc_in $cmsel,,bsup5c3 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
csys,21
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
kploc2=kploc2+360
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair8,area
! Create line to basket support 5D-2
_do=37000 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,,ang_5d 2,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup5d2 $asbw,all $cm,bsup5d2,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
kploc2=kploc2+360
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
kploc1=kploc1+360 $kploc2=kploc2+360
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair9,area
! Create line to basket support 9A
_do=37100 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,,ang_9a,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup9a $asbw,all $cm,bsup9a,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)

```

```

cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%),ky(k%_do%),0)
ksel,all $nnums,line,_do+50 $l,k%_do%,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,, _do+50-100, _do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair10,area
! Create line to basket support 5D-3
_do=37200 $nnums,area,_do $nnums,kp,_do $nnums,line,_do
alls
local,23,0,,,,ang_5d 3,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup5d3 $asbw,all $cm,bsup5d3,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%),ky(k%_do%),0)
ksel,all $nnums,line,_do+50 $l,k%_do%,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,, _do+50-100, _do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair11,area
! Create line to basket support 5C-4
_do=37300 $nnums,area,_do $nnums,kp,_do $nnums,line,_do
alls
csys,0
cmsel,,mpc_area $cmsel,a,bsup5e1 $cm,mpc_area,area
lsla $lsel,r,ext $csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,mpc_in $cmsel,,bsup5c4 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%),ky(k%_do%),0)
ksel,all $nnums,line,_do+50 $l,k%_do%,k%_do%b
csys,21
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,, _do+50-100, _do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair12,area
! Create line to basket support 5E-4
_do=37400 $nnums,area,_do $nnums,kp,_do $nnums,line,_do
alls

```

```

local,23,0,,,ang_5E_4,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup5e4 $asbw,all $cm,bsup5e4,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair13,area
! Create line to basket support 9B-1
_do=37500 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_9b_1,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup9b1 $asbw,all $cm,bsup9b1,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100,_do+50,100 $ksll $csys,21
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,,_do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,,_do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,_do+50-100,_do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair14,area
! Create line to basket support 5D-4
_do=37600 $nums,area,_do $nums,kp,_do $nums,line,_do
alls
local,23,0,,,ang_5d_4,90 $wpcsys,-1,23
cmsel,,mpcshell $asel,r,loc,x,30,100 $asbw,all $cmsel,a,mpcshell
cm,mpcshell,area $cmsel,a,mpc_area $cm,mpc_area,area
cmsel,,mpc_in $cmsel,,bsup5d4 $asbw,all $cm,bsup5d4,area
csys,0 $lsla,r $ksll $k%_do%a=kp(0,0,0)
cmsel,,mpc_area $cmsel,a,bsup5d4 $cm,mpc_area,area
cmsel,a,mpc_area $cm,mpc_area,area $lsla $lsel,r,ext
csys,21 $lsel,u,loc,x,router $cm,mpc_in,line
cmsel,,bask_out $ksll $k%_do%b=kp(kx(k%_do%a),ky(k%_do%a),0)
ksel,all $nums,line,_do+50 $l,k%_do%a,k%_do%b
lsel,,,,_do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y

```

```

lsel,,,do+50 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,do+50 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,do+50-100,do+50,100 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair15,area
! Create area between basket supports 5E-1 and 5C-1
do=37700 $nums,area, do $nums,kp, do $nums,line, do
lsel,,,do+50-100 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,do+50-1600 $ksll $cmsel,,mpc_in $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold1,line
lsel,,,do+50-100 $ksll $cmsel,,bask_out $ksll,r $*get,kploc1,kp,kpnext(1),loc,y
lsel,,,do+50-1600 $ksll $cmsel,,bask_out $ksll,r $*get,kploc2,kp,kpnext(1),loc,y
lsel,r,loc,y,kploc1,kploc2 $cm,airhold2,line
cmsel,a,airhold1 $lsel,a,,,do+50-100 $lsel,a,,,do+50-1600 $al,all $asll,,1 $aatt,8,,1 $cm,mpcair16,area

```

```

!-----
!--- Mesh the MPC shell, supports, and helium gaps
!-----

```

```

!
!--- mesh the shell and supports ---
!
alls
mshkey,1
mshape,0,2D
! mesh the shell
esize,.55
cmsel,,mpcshell $aatt,11,,1
amesh,mpcshell
! mesh the supports 5C, 5E, 5D
cmsel,,bsup5c1 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,18,,1
cmsel,,bsup5c1 $amesh,bsup5c1
cmsel,,bsup5c2 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,18,,1
cmsel,,bsup5c2 $amesh,bsup5c2
cmsel,,bsup5c3 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,18,,1
cmsel,,bsup5c3 $amesh,bsup5c3
cmsel,,bsup5c4 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,18,,1
cmsel,,bsup5c4 $amesh,bsup5c4
cmsel,,bsup5e1 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5e1 $amesh,bsup5e1
cmsel,,bsup5e2 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5e2 $amesh,bsup5e2
cmsel,,bsup5e3 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5e3 $amesh,bsup5e3
cmsel,,bsup5e4 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5e4 $amesh,bsup5e4
cmsel,,bsup5d1 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5d1 $amesh,bsup5d1
cmsel,,bsup5d2 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1

```



```

cmsel,,bsup5d2 $amesh,bsup5d2
cmsel,,bsup5d3 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5d3 $amesh,bsup5d3
cmsel,,bsup5d4 $aatt,3,,1 $asel,r,loc,x,rinner-cutbac,rinner $aatt,19,,1
cmsel,,bsup5d4 $amesh,bsup5d4
! mesh support 9a
cmsel,,bsup9a $csys,21 $asel,r,loc,x,rinner-cutbac,rinner $aatt,17,,1 $amesh,all $asel,inve
cmsel,r,bsup9a $a111=arnext(0) $a222=arnext(a111)
asel,,,a111 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9a-.01,ang_9a+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a111,k111,k222,k333,k444
asel,,,a222 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9a-.01,ang_9a+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a222,k111,k222,k333,k444
! mesh support 9b1
cmsel,,bsup9b1 $csys,21 $asel,r,loc,x,rinner-cutbac,rinner $aatt,17,,1 $amesh,all $asel,inve
cmsel,r,bsup9b1 $a111=arnext(0) $a222=arnext(a111)
asel,,,a111 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9b1-.01,ang_9b1+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a111,k111,k222,k333,k444
asel,,,a222 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9b1-.01,ang_9b1+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a222,k111,k222,k333,k444
! mesh support 9b2
cmsel,,bsup9b2 $csys,21 $asel,r,loc,x,rinner-cutbac,rinner $aatt,17,,1 $amesh,all $asel,inve
cmsel,r,bsup9b2 $a111=arnext(0) $a222=arnext(a111)
asel,,,a111 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9b2-.01,ang_9b2+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a111,k111,k222,k333,k444
asel,,,a222 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9b2-.01,ang_9b2+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a222,k111,k222,k333,k444
! mesh support 9c
cmsel,,bsup9c $csys,21 $asel,r,loc,x,rinner-cutbac,rinner $aatt,17,,1 $amesh,all $asel,inve
cmsel,r,bsup9c $a111=arnext(0) $a222=arnext(a111)
asel,,,a111 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9c-.01,ang_9c+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a111,k111,k222,k333,k444
asel,,,a222 $ls1a $ks11 $ksel,r,loc,x,rinner-cutbac $k111=kpnex(0) $k222=kpnex(k111)
ks11 $ksel,r,loc,y,ang_9c-.01,ang_9c+.01 $k333=kpnex(0) $k444=kpnex(k333)
aatt,3,,1 $ls1a $amap,a222,k111,k222,k333,k444
!
! rotate the reduced conductivity elements into proper element coordinate system
!
alls
csys,21
esel,,mat,,17 $emod,all,esys,21
esel,,mat,,18 $emod,all,esys,21
esel,,mat,,19 $emod,all,esys,21
!

```

```

!--- mesh the helium gaps ---
!
alls
mshkey,2
mshape,1,2D
amesh,mpcair1
amesh,mpcair2
amesh,mpcair3
amesh,mpcair4
amesh,mpcair5
amesh,mpcair6
amesh,mpcair7
amesh,mpcair8
amesh,mpcair9
amesh,mpcair10
amesh,mpcair11
amesh,mpcair12
amesh,mpcair13
amesh,mpcair14
amesh,mpcair15
amesh,mpcair16
amesh,air_9a
amesh,air_9b1
amesh,air_9b2
amesh,air_9c

!-----
!--- 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
cskip,23,0,_do+8,_do+18,30000
lgen,2,_do+6,...,fmtk
cskip,23,0,_do+21,_do+12,30000
lgen,2,_do+16,...,fmtk
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
al,_do+21,_do+35,_do+40,_do+42,_do+59 $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,1
amesh,40013
amesh,40014
amesh,40015
amesh,40016
lesize,_do+49,,,1
amesh,40017
lesize,_do+12,,,2
amap,40018,40024,40008,40010,40011
amesh,40019
! 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
! 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
! create the symmetric version of this section
asel,,,do,_do+99 $lsla $ksll,,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,numch,gen_opak,,,ch_angle*2
lsla $ksll
numm,node
numm,kp
!
! 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 $lsel,,loc,x,router $lsel,a,loc,x,ri_opack
ksll $ksel,r,loc,y,0 $k111=kpnex(k111) $k222=kpnex(k111) $1,k111,k222
ksll $ksel,r,loc,y,90 $k333=kpnex(k333) $k444=kpnex(k333) $1,k333,k444
ksll $ksel,r,loc,y,180 $k555=kpnex(k555) $k666=kpnex(k555) $1,k555,k666
ksll $ksel,r,loc,y,270 $k777=kpnex(k777) $k888=kpnex(k777) $1,k777,k888
lsel,,loc,x,router,ri_opack $lsel,r,loc,y,0,90 $al,all
lsel,,loc,x,router,ri_opack $lsel,r,loc,y,90,180 $al,all
lsel,,loc,x,router,ri_opack $lsel,r,loc,y,180,270 $al,all
lsel,,loc,x,router,ri_opack $lsel,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,,_do1
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,_do1,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,_do1 $mat,matr2 $esurf
  esel,s,type,,_do1 $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.
-----

```

```

_dol=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
et,_dol,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,_dol $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,,_dol $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,,_dol
  edel,all
  alls
*enddo

```

```

|-----
| --- Radiation between MPC and overpack ---
|

```

```

|   Uses aux12 to generate elements. Each pair uses different
|   element number to keep things seperate.
|-----
|

```

```

|_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
|lsla $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 $lsel,r,loc,x,router $nsll,,1
|esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
|lsla $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 3
!
_do2=671
asel,,,41002 $lsla $csys,21 $lssel,r,loc,x,router $nsll,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
lsla $csys,21 $lssel,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 4
!
_do2=672
asel,,,41003 $lsla $csys,21 $lssel,r,loc,x,router $nsll,,1
esln $esel,r,mat,,11 $type,_do1, $mat,matr1 $esurf
lsla $csys,21 $lssel,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
*endif

```

```

!-----
!--- Create the gusseted cradle ---
!-----

```

```

!
alls
_do=50000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
csys,0
lssel,,ext
ksll,,1
k,_do,, -ro_opack-23.375
k,_do+1,101/2, -ro_opack-23.375
k,_do+2,-101/2, -ro_opack-23.375
k,_do+3,101/2, -ro_opack-23.375+50.375
k,_do+4,-101/2, -ro_opack-23.375+50.375-.7616
l,_do,_do+1 $l,_do,_do+2 $l,_do+1,_do+3 $l,_do+2,_do+4
kleft=kp(-101/2+8, -ro_opack-23.375+50.375,0)
kright=kp(101/2-8, -ro_opack-23.375+50.375,0)
l,_do+4,kleft
l,_do+3,kright
lssel,r,loc,y,-1000, -ro_opack-23.375+50.375
al,all
type,1
mat,12
esize,4
mopt,trans,4
mopt,expnd,0.75
mshape,0,2D
amesh,_do
alls
lssel,,ext
cm,tunnelr,line

```

```

!-----
!--- Create the tunnel profile ---
!-----

```

```

!
_do=51000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
k,_do,, -ro_opack-23.375-24-14
k,_do+1,-27*12/2, -ro_opack-23.375-24-14

```

```

k,_do+2,27*12/2,-ro_opack-23.375-24-14
k,_do+3,-27*12/2,-ro_opack-23.375-24-14+(22-27/2)*12
k,_do+4,27*12/2,-ro_opack-23.375-24-14+(22-27/2)*12
k,_do+5,, -ro_opack-23.375-24-14+22*12
l,_do+1,_do ! order matters
l,_do,_do+2 ! order matters
l,_do+3,_do+1 ! order matters
l,_do+2,_do+4 ! order matters
larc,_do+5,_do+3,_do,27/2*12 ! order matters
larc,_do+4,_do+5,_do,27/2*12 ! order matters
lsel,,,,_do,_do+5
cm,tunnel,line

```

```

!-----
!--- Create surface effect elements ---
!-----
!

```

```

!
! Solar radiation (done as heat generation on surface for ambient)
!
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/cradle to surroundings (ambient)
!
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
!
! Convection from overpack/cradle to surroundings (fire)
!
et,12,151
keyo,12,3,0
keyo,12,4,1
keyo,12,5,1
keyo,12,6,0
keyo,12,7,0

```

```

keyo,12,8,5
keyo,12,9,0
r,112,,sbc          ! apply fire real constants top
et,13,151
keyo,13,3,0
keyo,13,4,1
keyo,13,5,1
keyo,13,6,0
keyo,13,7,0
keyo,13,8,5
keyo,13,9,0
r,113,,sbc          ! apply fire real constants side
et,14,151
keyo,14,3,0
keyo,14,4,1
keyo,14,5,1
keyo,14,6,0
keyo,14,7,0
keyo,14,8,5
keyo,14,9,0
r,114,,sbc          ! apply fire real constants bottom
!
! Create surface elements for ambient
!
alls
nset,r,ext $cm,extnode,node
  _do=52000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
n,_do+11,50,2 $spac_nod=_do+11
n,_do+12,50,3 $spac_nt=_do+12
n,_do+13,50,4 $spac_ns=_do+13
n,_do+14,50,5 $spac_nb=_do+14
type,11 $mat,111 $real,111 $esurf,spac_nod
! nset,u,loc,y,-ro opack-23.375
type,10 $mat,110 $real,110 $esurf
esel,,type,,10 $cm,elem_sol,elem
esel,,type,,11 $cm,elem_sur,elem
!
! Create surface elements for fire
!
alls
csys,0
cmset,,extnode
nset,r,loc,y,-ro opack-23.375
type,14 $mat,114 $real,114 $esurf,spac_nb
cmset,,extnode
csys,1 $nset,r,loc,y,30,150 $csys,0
type,12 $mat,112 $real,112 $esurf,spac_nt
esel,,type,,12,14,2 $nsle $cm,covered,node
esln $nsle $cmset,r,extnode $cmset,u,covered
esln $nsle $cmset,r,covered $cm,addnode,node

```

```

alls
nset,u,loc,y,-ro_opack-23.375 $csys,1 $nset,u,loc,y,30,150 $csys,0
cset,a,addnode
type,13 $mat,113 $real,113 $esurf,spac_ns
!
! create component names for cask/cradle nodes
!
alls
csys,0
esel,,type,,12 $cm,elem_surt,elem $*get,num_surt,elem,,count
esel,,type,,13 $cm,elem_surs,elem $*get,num_surs,elem,,count
esel,,type,,14 $cm,elem_surb,elem $*get,num_surb,elem,,count
esel,,type,,12,14 $cm,elem_fir,elem $*get,numfire,elem,,count
!
-----
!--- Create tunnel radiation elements ---
-----
!
*if,rad_key,eq,1,then
  _do=53000 $numstr,kp,_do $numstr,line,_do $numstr,area,_do
  _do1=701          ! element number designation
  _do2=702          ! element number designation
  matr1=70          ! emissivity for first defined material
  matr2=71          ! emissivity for second defined material
  et,_do1,link31    ! defines link31 element
  alls
  cset,,tunnel $type,_do1, $mat,matr1
  esize,8 $lmesh,all $nsll,,1 $cm,node_tun,node
  cset,,tunnelr $nsll,,1 $type,_do1, $mat,matr2 $esurf
  esel,s,type,,_do1 $nsle
  /aux12
  emis,matr1,emis_fir
  emis,matr2,emis_fir
  stef,sbc
  geom,1,0
  vtype,0,znet
  write,radmat$_do1$,sub
  fini
  /prep7
  et,_do2,matrix50,1
  type,_do2 $mat,_do2
  se,radmat$_do1$,sub
  esel,,type,,_do1
  cset,,tunnel
  lclear,all
  edel,all
*endif
alls
!
! create component names for tunnel nodes

```



```

1
cmsel,,node_tun $nsel,r,loc,y,50,10000 $cm,nd_firc,node
cmsel,,node_tun $nsel,r,loc,y,-ro opack-23.375-24-14 $cm,nd_firf,node
cmsel,,node_tun $cmsel,u,nd_firc $cmsel,u,nd_firf $cm,nd_firw,node

-----
|--- Read in NIST temperature and velocity time history data ---
|-----

alls
*dim,nistdata,array,3599,10
*vread,nistdata(1,1),nist-20m,dat,,JIK,10,3599
(F10.3,2F11.3,2F10.3,2F11.3,3F10.3)

-----
|--- Define look-up tables for air to determine convection coefficients ---
|-----

1=density, 2=Cp, 3=viscosity, 4=conductivity, 5=Pr
final units: BTU, in, hour, F, lbm

*dim,air_p,table,16,5
! 0 Temperature F
*set,air_p(1,0),0,32,100,200,300,400,500,600,700
*set,air_p(10,0),800,900,1000,1500,2000,2500,3000
! 1 Density lbm/ft^3 -> lbm/in^3
k=1/12**3
*set,air_p(0,1),1,.086*k,.081*k,.071*k,.060*k,.052*k,.046*k,.0412*k,.0373*k
*set,air_p(9,1),.0341*k,.0314*k,.0291*k,.0271*k,.0202*k,.0161*k,.0133*k,.0114*k
! 2 Cp Btu/lbm/F
*set,air_p(0,2),2,.239,.240,.240,.241,.243,.245,.247,.250
*set,air_p(9,2),.253,.256,.259,.262,.276,.286,.292,.297
! 3 Viscosity lbm/ft/s -> lbm/in/hr
k=3600/12
*set,air_p(0,3),3,1.110*k,1.165*k,1.285*k,1.440*k,1.610*k,1.750*k,1.890*k,2.000*k
*set,air_p(9,3),2.14*k,2.25*k,2.36*k,2.47*k,3.00*k,3.45*k,3.69*k,3.86*k
! 4 Conductivity Btu/hr/ft/F -> Btu/hr/in/F
k=1/12
*set,air_p(0,4),4,.0133*k,.0140*k,.0154*k,.0174*k,.0193*k,.0212*k,.0231*k,.0250*k
*set,air_p(9,4),.0268*k,.0286*k,.0303*k,.0319*k,.0400*k,.0471*k,.051*k,.054*k
! 5 Prandtl number
*set,air_p(0,5),5,.73,.72,.72,.72,.71,.689,.683,.685
*set,air_p(9,5),.690,.697,.705,.713,.739,.753,.763,.765

-----
|--- Solution ---
|-----

*get,t_build,active,,time,wall
alls
csys,21

```

```

wsort,all,0
save,go_solve
/solu
/out,solu,out
*cfopen,tmax,mntr
*vwrite,
('Time: ', 'Fuel Temp: ', 'Bskt Temp: ', 'Borl Temp: ', 'MPC Temp: ', 'CskI Temp: ', 'CskO Temp: ', 'Csk Skin: ')
!
! 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
d,spac_nod,temp,temp_amb
sfe,elem_sur,1,conv,0,film_amb
bfe,elem_sol,hgen,,rate_sol/thik_sol
sfe,elem_surt,1,conv,0,1e-9
sfe,elem_surs,1,conv,0,1e-9
sfe,elem_surb,1,conv,0,1e-9
d,spac_nt,temp,temp_amb
d,spac_ns,temp,temp_amb
d,spac_nb,temp,temp_amb
sf,nd_firc,hflux,0
sf,nd_firw,hflux,0
sf,nd_firf,hflux,0
solve
cmsel,,nd_firc
cmsel,a,nd_firw
cmsel,a,nd_firf
sfdel,all,hflux
alls
!
! Apply new convection coefficients based on steady state temps prior to fire transient
!
*dim,numloop,array,3
numloop(1)=num_surt
numloop(2)=num_surs
numloop(3)=num_surb
*dim,space_nd,array,3
*dim,e_hold1,array,numloop(1),2
*dim,e_hold2,array,numloop(2),2
*dim,e_hold3,array,numloop(3),2
! apply heat generation to fuel
! make space node ambient temperature
! apply ambient convection coefficient
! apply solar loading (surface heat generation)
! "deactivate" fire convection elements
! "deactivate" fire convection elements
! "deactivate" fire convection elements
! "deactivate" fire convection elements
! "deactivate" fire convection elements
! "deactivate" fire convection elements
! "deactivate" fire radiation matrix50
! "deactivate" fire radiation matrix50
! "deactivate" fire radiation

```

```

cl=305.875
fini
/post1
set,1
*do,k,1,3
  *if,k,eq,1,then
    cmsel,,elem_surt
    tfluid=nistdata(i,5)
    vfluid=nistdata(i,8)
    space_nd(1)=tfluid
    ! apply fire convection coefficient top
  *elseif,k,eq,2,then
    cmsel,,elem_surs
    tfluid=nistdata(i,6)
    vfluid=nistdata(i,9)
    space_nd(2)=tfluid
    ! apply fire convection coefficient side
  *elseif,k,eq,3,then
    cmsel,,elem_surb
    tfluid=nistdata(i,7)
    vfluid=nistdata(i,10)
    space_nd(3)=tfluid
    ! apply fire convection coefficient bottom
  *endif
*do,j,1,numloop(k)
  e_cur=elnext(0)
  *get,t_surf,elem,e_cur,nmisc,6
  *get,a_surf,elem,e_cur,nmisc,1
  tavg=(t_surf+tfluid)/2
  rho=air_p(tavg,1)
  usurf=air_p(t_surf,3)
  ufluid=air_p(tfluid,3)
  uavg=air_p(tavg,3)
  reyn=vfluid*rho*cl/uavg
  *if,reyn,ge,5e5,then
    ! turbulent
    h=a_surf*air_p(tavg,4)/cl*0.036*(reyn**0.8-23200)*air_p(tavg,5)**0.33*(ufluid/uwall)**.25
  *else
    ! laminar
    h=a_surf*air_p(tavg,4)/cl*0.664*reyn**0.5*air_p(tavg,5)**0.33
  *endif
  *set,e_hold%k%(j,1),e_cur
  *set,e_hold%k%(j,2),h
  esel,u,,,e_cur
*enddo
*enddo
alls
esel,,mat,,1 $nsle $nsort,temp,,0,0,1
*get,tfuelmax,sort,,max
esel,,mat,,2 $nsle $nsort,temp,,0,0,1
*get,tbsktmax,sort,,max
esel,,mat,,9,10,1 $nsle $nsort,temp,,0,0,1
*get,tborlmax,sort,,max
esel,,mat,,11 $nsle $nsort,temp,,0,0,1
*get,tmpcmax,sort,,max

```

```

esel,,mat,,20 $nsle $nsort,temp,,0,0,1
*get,tcskimax,sort,,max
esel,,mat,,21,28,7 $nsle $nsort,temp,,0,0,1
*get,tcskomax,sort,,max
esel,,mat,,22,23,1 $nsle $nsort,temp,,0,0,1
*get,tcskmax,sort,,max
*get,tfueltime,active,,set,time
*vwrite,tfueltime,tfuelmax,tbsktmax,tborlmax,tmprmax,tcskimax,tcskomax,tcskmax
(F7.3,F11.4,F11.4,F11.4,F11.4,F11.4,F11.4,F11.4)
alls
/solu
sfe,e_hold1(1:numloop(1),1),1,conv,0,e_hold1(1:numloop(1),2)
sfe,e_hold2(1:numloop(2),1),1,conv,0,e_hold2(1:numloop(2),2)
sfe,e_hold3(1:numloop(3),1),1,conv,0,e_hold3(1:numloop(3),2)
d,spac_nt,temp,space_nd(1)
d,spac_ns,temp,space_nd(2)
d,spac_nb,temp,space_nd(3)
!
! Second load step set - transient to simulate fire conditions using NIST data
!
ifsl=0
timint,on
kbc,1
outres,all,none
outres,nsol,last
nsubst,1,5,1
esel,,mat,,21
mpchg,28,all
alls
bfe,elem_sol,hgen,,0.0
sfe,elem_sur,1,conv,0,1e-9
mp,emis,111,1e-9
*do,i,1,3599
  antype,transient,restart
  *if,i,eq,1,then
    time,1e-3
  *else
    time,nistdata(i,1)
  *endif
  d,nd_firc,temp,nistdata(i,2)
  d,nd_firw,temp,nistdata(i,3)
  d,nd_firf,temp,nistdata(i,4)
  solve
  fini
/post1
set,i+1
plns,temp
*do,k,1,3
  *if,k,eq,1,then
    cmsel,,elem_surt

```

```

! change carbon steel shells with gaps
! to intimate contact for conservatism

```

```

! remove solar loading (surface heat generation)
! remove ambient convection
! remove ambient radiation

```

```

! time increment - step 1 only

```

```

! time increment - steps 2+

```

```

! apply tunnel wall temperature ceiling
! apply tunnel wall temperature wall
! apply tunnel wall temperature floor

```

```

! apply fire convection coefficient top

```

```

tfluid=nistdata(i,5)
vfluid=nistdata(i,8)
space_nd(1)=tfluid
*elseif,k,eq,2,then
  cmsel,,elem_surs
  tfluid=nistdata(i,6)
  vfluid=nistdata(i,9)
  space_nd(2)=tfluid
*elseif,k,eq,3,then
  cmsel,,elem_surb
  tfluid=nistdata(i,7)
  vfluid=nistdata(i,10)
  space_nd(3)=tfluid
*endif
*do,j,1,numloop(k)
  e_cur=elnext(0)
  *get,t_surf,elem,e_cur,nmisc,6
  *get,a_surf,elem,e_cur,nmisc,1
  tavg=(t_surf+tfluid)/2
  rho=air_p(tavg,1)
  usurf=air_p(t_surf,3)
  ufluid=air_p(tfluid,3)
  uavg=air_p(tavg,3)
  reyn=vfluid*rho*cl/uavg
  *if,reyn,ge,5e5,then
    h=a_surf*air_p(tavg,4)/cl*0.036*(reyn**0.8-23200)*air_p(tavg,5)**0.33*(ufluid/uwall)**.25
  *else
    h=a_surf*air_p(tavg,4)/cl*0.664*reyn**0.5*air_p(tavg,5)**0.33
  *endif
  *set,e_hold%k%(j,1),e_cur
  *set,e_hold%k%(j,2),h
  esel,u,,,e_cur
*enddo
*enddo
alls
esel,,mat,,1 $nsle $nsort,temp,,0,0,1
*get,tfuelmax,sort,,max
esel,,mat,,2 $nsle $nsort,temp,,0,0,1
*get,tbsktmax,sort,,max
esel,,mat,,9,10,1 $nsle $nsort,temp,,0,0,1
*get,tborlmax,sort,,max
esel,,mat,,11 $nsle $nsort,temp,,0,0,1
*get,tmpcmax,sort,,max
esel,,mat,,20 $nsle $nsort,temp,,0,0,1
*get,tcskimax,sort,,max
esel,,mat,,21,28,7 $nsle $nsort,temp,,0,0,1
*get,tcskomax,sort,,max
esel,,mat,,22,23,1 $nsle $nsort,temp,,0,0,1
*get,tcskmax,sort,,max
*get,tfueltime,active,,set,time

```

! apply fire convection coefficient side

! apply fire convection coefficient bottom

```

*vwrite,tfuel,tfuelmax,tbsktmax,tborlmax,tmpcmax,tcskimax,tcskomax,tcskmax
(F7.3,F11.4,F11.4,F11.4,F11.4,F11.4,F11.4,F11.4)
alls
/solu
sfe,e_hold1(1:numloop(1),1),1,conv,0,e_hold1(1:numloop(1),2)
sfe,e_hold2(1:numloop(2),1),1,conv,0,e_hold2(1:numloop(2),2)
sfe,e_hold3(1:numloop(3),1),1,conv,0,e_hold3(1:numloop(3),2)
d,spac_nt,temp,space_nd(1)
d,spac_ns,temp,space_nd(2)
d,spac_nb,temp,space_nd(3)
!-----
! change Holtite A to air after cessation of fire
  *if,ifs1,eq,0,then
    *if,i,ge,840,then
      esel,,mat,,24 $mpchg,124,all
      alls
      ifs1=1
    *endif
  *endif
!-----
*enddo
!
! Third load step set - transient with "steady" fire input to reach max fuel temp
!
! The fire temps for the fluid and tunnel walls are maintained at the last values
! from the NIST data. The convection coefficient still will vary due to changes of
! the cask temperature. Therefore, will still interrupt the analysis to recalculate
! the convection coefficients. This will be done for each hour after the last time
! on the NIST data.
!
delt,60/60,.01/60,60/60
outres,all,none
outres,nsol,last
auto,on
nisttime=nistdata(3599,1)
postnist=nint(nisttime+0.5)
inrem=0
*do,i,postnist,time_fir
  inrem=inrem+1
  antype,transient,restart
  time,i
  solve
  fini
  /post1
  set,3600+inrem
  plns,temp
  *do,k,1,3
    *if,k,eq,1,then
      cmsel,,elem_surt
      tfluid=nistdata(3599,5)
      ! apply fire convection coefficient top

```

```

vfluid=nistdata(3599,8)
*elseif,k,eq,2,then
  cmsel,,elem,surs                                ! apply fire convection coefficient side
  tfluid=nistdata(3599,6)
  vfluid=nistdata(3599,9)
*elseif,k,eq,3,then
  cmsel,,elem,surb                                ! apply fire convection coefficient bottom
  tfluid=nistdata(3599,7)
  vfluid=nistdata(3599,10)
*endif
*do,j,1,numloop(k)
  e_cur=elnext(0)
  *get,t_surf,elem,e_cur,nmisc,6
  *get,a_surf,elem,e_cur,nmisc,1
  tavg=(t_surf+tfluid)/2
  rho=air_p(tavg,1)
  usurf=air_p(t_surf,3)
  ufluid=air_p(tfluid,3)
  uavg=air_p(tavg,3)
  reyn=vfluid*rho*cl/uavg
  *if,reyn,ge,5e5,then                             ! turbulent
    h=a_surf*air_p(tavg,4)/cl*0.036*(reyn**0.8-23200)*air_p(tavg,5)**0.33*(ufluid/uwall)**.25
  *else                                             ! laminar
    h=a_surf*air_p(tavg,4)/cl*0.664*reyn**0.5*air_p(tavg,5)**0.33
  *endif
  *set,e_hold%k%(j,1),e_cur
  *set,e_hold%k%(j,2),h
  esel,u,,,e_cur
*enddo
*enddo
alls
esel,,mat,,1 $nsle $nsort,temp,,0,0,1
*get,tfuelmax,sort,,max
esel,,mat,,2 $nsle $nsort,temp,,0,0,1
*get,tbsktmax,sort,,max
esel,,mat,,9,10,1 $nsle $nsort,temp,,0,0,1
*get,tborlmax,sort,,max
esel,,mat,,11 $nsle $nsort,temp,,0,0,1
*get,tmpcmax,sort,,max
esel,,mat,,20 $nsle $nsort,temp,,0,0,1
*get,tcskimax,sort,,max
esel,,mat,,21,28,7 $nsle $nsort,temp,,0,0,1
*get,tcskomax,sort,,max
esel,,mat,,22,23,1 $nsle $nsort,temp,,0,0,1
*get,tcskmax,sort,,max
*get,tfueltim,active,,set,time
*vwrite,tfueltim,tfuelmax,tbsktmax,tborlmax,tmpcmax,tcskimax,tcskomax,tcskmax
(F7.3,F11.4,F11.4,F11.4,F11.4,F11.4,F11.4)
alls
/solu

```

```
sfe,e_hold1(1:numloop(1),1),1,conv,0,e_hold1(1:numloop(1),2)
sfe,e_hold2(1:numloop(2),1),1,conv,0,e_hold2(1:numloop(2),2)
sfe,e_hold3(1:numloop(3),1),1,conv,0,e_hold3(1:numloop(3),2)
*enddo
fini
*get,t_solve,active,,time,wall
save
/out,term
*cfclose

!
!-----
!--- Post Processing ---
!-----
!

/post1
wpstyl
/triad,lbot
set,last
plns,temp

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