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**Civilian Radioactive Waste Management System  
Management and Operating Contractor**

**Selection of MCNP Cross Section Libraries**

**Revision 00**

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## File 'INSTALL.FIX'

c <<<<< makemcnp changes for MCNP4B2 >>>>> loddatt 09/22/97

c

c For each fix, enter five integer parameters on one line in free  
c format, ip(1)-ip(5) described below, followed by the appropriate  
c number of new lines.

c

c ip(1) = The applicable computer system number or 0 for all systems.

c ip(2) = The file number:

c 1 = patchf

c 2 = makemcnp

c 3 = patchc

c ip(3) = The applicable line number to edit-see the MCSETUP source.

c ip(4) = The alter code:

c 1 = insert the following ip(5) line(s) before line ip(3)

c 2 = replace line ip(3) with the following ip(5) line(s)

c 3 = insert the following line after entry ip(5) of line ip(3).

c 4 = delete lines ip(3) through ip(5)

c ip(5) = The number of new line(s) if ip(4)=1,2

c The entry number if ip(4)=3

c The last line number to delete if ip(4)=4

c

c The number of new lines that follow ip(1)-ip(5) is given by:

c = ip(5) if ip(4)=1,2

c = 1 if ip(4)=3

c = 0 if ip(4)=4

c\*\*\*\*\* FIXES FOR SYSTEM 1 (Cray UNICOS) \*\*\*\*\*

c

c Add the \*define t3d for the Cray T3D.

c 1 1 2 1 1

c \*define t3d

c

c Provide links to the T3D compilers and linker. XTM:GWM-95-128

c Change the CFT77 compile line.

c 1 2 18 1 4

c export TARGET; TARGET=CRAY-T3D

c ln -s /mpp/bin/cc cc

c ln -s /mpp/bin/cft77 cft77  
c ln -s /mpp/bin/mppldr segldr  
c Provide links to the T3D compilers and linker. XTM:GWM-95-128  
c 1 2 26 2 1  
c cft77 compile  
c  
c Add CFTLIB library on UNICOS for profile timing. 06/30/95 (GWM)  
c 1 2 28 3 10  
c -L/usr/local/lib -lprof

c\*\*\*\*\* FIXES FOR SYSTEM 2 (Sun SunOS )\*\*\*\*\*

c Add a second X-window include path for some SunOS systems.  
c 2 2 18 3 4  
c -I/usr/openwin/include/X11  
  
c Add a link to the ANSI C library (libansi.a) on some SunOS systems.  
c 2 2 29 3 10  
c -L/home -lansi

c\*\*\*\*\* FIXES FOR SYSTEM 3 (IBM AIX )\*\*\*\*\*

c  
c PVM libraries must go first for pvm version at some installations.  
c 3 2 30 2 1  
c xlf -o mcnp \*.o -L/usr/lanl/pvm3.3/lib -lfpvm3 -lpvm3 -L/usr/lib -lX11

c\*\*\*\*\* FIXES FOR SYSTEM 4 (HP HPUX )\*\*\*\*\*

c  
c Add a link to the C math library (libM.a) on some HP systems.  
c 4 2 29 3 6  
c -lM

c\*\*\*\*\* FIXES FOR SYSTEM 5 (VAX VMS )\*\*\*\*\*

c  
c Add an additional \*define keyword for PRPR on a VAX VMS system.  
c 5 1 2 1 1  
c \*define disscgs

c\*\*\*\*\* FIXES FOR SYSTEM 6 (DEC Unix and PC LINUX)\*\*\*\*\*

c  
c The following 7 lines enable GNU F77 compilation on LINUX.

```
c Tim Goorley, jgoorley@mit.edu XTM-RN(U97-028) 7/21/97
c 6 1 2 1 1
c *define linux
c 6 2 2 7 3 1
c -O0
c 6 2 2 8 4 2 8
c 6 3 2 1 1
c *define linux
```

```
c***** FIXES FOR SYSTEM 7 (PC DOS ) *****
```

```
c
c The following 9 lines enable LAHEY F90 compilation on DOS/WINDOWS.
c Also uncomment the 2 lines in TTYINT below [call break()].
c 7 2 8 2 1
c lf90 prpr.for
c 7 2 9 4 9
c 7 2 1 7 2 1
c lf90 makxsf.for
c 7 2 1 8 4 1 8
c 7 2 4 3 2 1
c lf90 mcnp.for
c 7 2 5 0 4 5 0
```

```
c***** FIXES FOR SYSTEM 8 (Sun Sol. ) *****
```

```
c***** FIXES FOR SYSTEM 9 (SGI IRIX ) *****
```

```
c***** FIXES FOR THE MCNP FORTRAN SOURCE (PATCHF FILE) *****
```

```
0 1 1 1 2
```

```
*/ Integrate your patch with the following. If your patch makes changes
*/ to the ZC, VV, CM, GS, MB, or BD decks, contact MCNP@LANL.GOV for
*/ details on including your patch via the INSTALL.FIX file. When
*/ integrating your patch, be sure the order of the changes (increasing
*/ in line number) is preserved to avoid a PRPR error. See Appendix
*/ C, page C-8 in the MCNP manual for more details.
```

```
*/
```

```
*/ ----- ttyint
```

```
*ident tt4b2
```

```
*/ Uncomment (delete 1st 3 columns) of next 2 lines to enable LAHEY F90
```

```

*/ compilation on DOS/WINDOWS.                07/07/97 (GWM/GWM)
*/ *d,t4a.28                                  <1014>
*/ call break(lockl)
*/
*/ ----- msgcon
*/ Fix a print bug. Wrong number of arguments. 07/07/97 (GWM/GWM)
*ident me4b2
*d,me4b.195                                    <20311>
  call errprn(0,j,1,one*max(1,ntasks),zero,'ntk','');
*/ Force PVM to free some buffers.            07/07/97 (GWM/GWM)
*/ $20 awarded to Dudley A. Raine, III, ORNL (XTM:JSH-97-176) (GWM/GWM)
*i,me4b.311                                    <20498>
c
c free the receive buffers.
  do 582 nt=1,ntasks
  582 call mfbuff(ib(nt),i)
*/
*/ ----- startp
*ident sp4b2
*/ Wrong index. Affects var. reduction and tracking. 07/07/97 (GWM/GWM)
*d,sp4b.8,sp4b.10                             <21159-21161>
  if(wc1(i).ge.0.)go to 85
  wcs1tc(i)=-wc1(i)*wgt
  wcs2tc(i)=-wc2(i)*wgt
*/
*/ ----- level
*ident ll4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montieth (INEEL) XTM:JSH-97-208
*d,ll4b.25                                     <22232>
  jsu=-abs(jsu)
  if(1.gt.ll+1.and.lat(llat+1,icl).ne.0)call findel(icl)
  jsu=abs(jsu)
*/
*/ ----- ypbssp
*ident yp4b2
*/ Wrong index. Affects var. reduction and tracking. 07/07/97 (GWM/GWM)
*d,yp4b.2,yp4b.4                             <22590-22592>
  if(wc1(i).ge.0.)go to 45
  wcs1tc(i)=-wc1(i)*wgt
  wcs2tc(i)=-wc2(i)*wgt

```

```

*/
*/ ----- wtwndo
*ident we4b2
*/ Fix a print bug. Wrong number of arguments. 07/23/97 (GWM/GWM)
*d,we4b.145 <23152>
200 call errprn(1,nwsg(3),-1,1,icl,zero,'icl',
*/
*/ ----- track
*ident tr4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,tr4b.18 <23651>
if(dl(i)+coincd.lt.dl(levp))go to 445
*/
*/ ----- findel
*ident fn4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,fn.6 <24481>
dimension ii(3),jx(14,2)
*i,fn.7 after equivalence <24482>
data jx/1,1,2,2,3,3,1,1,2,2,2,2,3,3,
1 1,-1,1,-1,1,-1,1,-1,1,-1,1,-1/
*d,fn.10 n= <24485>
*d,fn4b.5,fn4b.16 ii(i)= thru label 10 <24493-24504>
10 ii(i)=nint(a)
*d,fn.22,fn.52 <24510-24550>
c
c correct for coincident surfaces and hexagonal prism lattices.
c check if new location completely inside lattice element.
jc=0
30 jc=jc+1
if(jc.gt.10)go to 70
do 60 jk=lca(lca+ic),abs(lca(lca+ic+1))-1
j=abs(lja(lja+jk))
k=kst(lkst+j)
l=lsc(llsc+j)
if(k.eq.1)t4=scf(l+1)*xxx+scf(l+2)*yyy+scf(l+3)*zzz-scf(l+4)
if(k.ne.1)t4=gpbpcm(k-1)-scf(l+1)
if(jsu.ge.0)go to 40
if(ksc(lksc-jsu).ne.ksc(lksc+j))go to 40

```



```

if(k.eq.1)t5=scf(l+1)*uuu+scf(l+2)*vvv+scf(l+3)*www
if(k.ne.1)t5=gpblcm(k+2)
if(abs(t4).le.coincd*abs(t5))t4=t5
40 if(lja(llja+jk)*t4.gt.0)go to 60

```

c

c location coincident with or beyond surface j, index ix.

```

j1=jk-lca(llca+ic)+6*lat(llat+1,ic)-5
ix=jx(j1,1)
iy=jx(j1,2)
50 ii(ix)=ii(ix)+iy
xxx=xxx-iy*vcl(lvcl+1,ix,m)
yyy=yyy-iy*vcl(lvcl+2,ix,m)
zzz=zzz-iy*vcl(lvcl+3,ix,m)

```

c

c if on or beyond hex side 3, increment sides 1 and 2.

```

if(ix.ne.2.or.j1.lt.1.1)go to 30
iii=iii-iy
xxx=xxx+iy*vcl(lvcl+1,1,m)
yyy=yyy+iy*vcl(lvcl+2,1,m)
zzz=zzz+iy*vcl(lvcl+3,1,m)
go to 30
60 continue
return
70 kdb=1

```

\*/

\*/ ----- findlv

\*ident fv4b2

\*/ Silent wrong answers for near-coincident lattices. 08/25/97

\*/ \$20 to Lee Montierth (INEEL) XTM:JSH-97-208

\*d,fv.35 &lt;24587&gt;

```

60 jsu=-abs(jsu)
if(lat(llat+1,icl).ne.0)call findel(icl)
jsu=abs(jsu)

```

\*/

\*/ ----- chkcel

\*ident cc4b2

\*/ Silent wrong answers for near-coincident lattices. 08/25/97

\*/ \$20 to Lee Montierth (INEEL) XTM:JSH-97-208

\*d,cc4b.4 &lt;24700&gt;

```

t5=scf(i)*uuu+scf(i+1)*vvv+scf(i+2)*www
if(abs(t4).le.coincd*abs(t5))t4=t5

```

```
*d,cc4b.9 <24705>
  if(abs(t4).le.coincd*abs(gpblcm(k+2)))t4=gpblcm(k+2)
*/
*/----- mfbuf
*ident mf4b2
*/ Force PVM to free some buffers. 07/07/97 (GWM/GWM)
*/ $20 awarded to Dudley A. Raine, III, ORNL (XTM:JSH-97-176) (GWM/GWM)
*i,mf4b.83 <41720>
  subroutine mfbuff(ib,in)
c   perform function 'free message buffer'.
*call mb
*if def,pvm,1
  call pvmffreebuf(ib,in)
  return
  end
*/
*/----- getidt
*ident gi4b2
*/ Provide cleaner separation of LINUX and DEC. 06/04/97 (GWM/GWM)
*d,gi4b.1 <42208>
*if def,linux,3
*d,gi4b.5 <42212>
*i,gi4a.1 <42213>
*if -def,linux,3
```

## INSTALLATION OF MCNP4B2 ON PC

The READMAAG file for the code installation and the README file for cross section installation are the same as for the HP installation. Installation differences are limited to platform dependencies which include directories, scripts, and platform software. Installation documentation peculiar to the PC desktop computers is given in this section. Installation of the MCNP4B2 code is performed through use of an "install.bat" script which sets up the source correction files, updates the MCNP4B2 source, and calls the compiler and linker modules. The installation verification cases were run separately following successful installation of the code. The utility program "mcsetup" which builds the "makemcnp.bat" file is configured for the Lahey f77 compiler as obtained from the transmittal CD. This program was modified to use the Lahey lf90 compiler for the MCNP4B2 installation. This modification was restricted to changing the data block in the "mcsetup" source from f77 commands to lf90 commands. The revised source for the program "mcsetup" is included as part of this documentation. Installation on PC platforms which have RAM of 32 meg or less will require the MCNP4B2 source code to be split into parts for compilation. A fortran routine "fsplit" was written and used in this installation which copied the MCNP4B2 compilation source to three parts. The "install.bat", "install.fix", "makemcnp.bat", "mcsetup.for", "fsplit.for", and "answer" files used for the installation are listed below. The "answer" file may be used with the "install.bat" script to duplicate the installation.

Two versions of the MCNP4B2 program were install on the WPO desktop PCs differing only in the size of the volatile memory controlled by the parameter "MDAS" defined during the installation setup. One version was installed with a standard sized "MDAS" parameter of 4,000,000 bytes which will run on any of the WPO desktop PCs. A second version with a large "MDAS" parameter of 9,600,000 bytes was also installed on WPO desktop PCs with 64 Meg of RAM. The large version will not run on all WPO PCs because of memory requirements.

### Install.bat file for PC desktop computer

```

echo off
echo *
echo *****
echo *
echo *           Time          *
echo * Run the SETUP program ... (1-2 min.) *
echo *
echo *****
for %%f in (inp01 inp02 inp03 inp04 inp05) do if exist %%f del %%f
for %%f in (inp06 inp07 inp08 inp09 inp10) do if exist %%f del %%f
for %%f in (inp11 inp12 inp13 inp14 inp15) do if exist %%f del %%f
for %%f in (inp16 inp17 inp18 inp19 inp20) do if exist %%f del %%f

```

```
for %%f in (inp21 inp22 inp23 inp24 inp25) do if exist %%f del %%f
for %%f in (inp01o inp02o inp03o inp04o inp05o) do if exist %%f del %%f
for %%f in (inp06o inp07o inp08o inp09o inp10o) do if exist %%f del %%f
for %%f in (inp11o inp12o inp13o inp14o inp15o) do if exist %%f del %%f
for %%f in (inp16o inp17o inp18o inp19o inp20o) do if exist %%f del %%f
for %%f in (inp21o inp22o inp23o inp24o inp25o) do if exist %%f del %%f
for %%f in (mctl01 mctl02 mctl03 mctl04 mctl05) do if exist %%f del %%f
for %%f in (mctl06 mctl07 mctl08 mctl09 mctl10) do if exist %%f del %%f
for %%f in (mctl11 mctl12 mctl13 mctl14 mctl15) do if exist %%f del %%f
for %%f in (mctl16 mctl17 mctl18 mctl19 mctl20) do if exist %%f del %%f
for %%f in (mctl21 mctl22 mctl23 mctl24 mctl25) do if exist %%f del %%f
for %%f in (outp01 outp02 outp03 outp04 outp05) do if exist %%f del %%f
for %%f in (outp06 outp07 outp08 outp09 outp10) do if exist %%f del %%f
for %%f in (outp11 outp12 outp13 outp14 outp15) do if exist %%f del %%f
for %%f in (outp16 outp17 outp18 outp19 outp20) do if exist %%f del %%f
for %%f in (outp21 outp22 outp23 outp24 outp25) do if exist %%f del %%f
if exist patchc del patchc
if exist patchf del patchf
if exist makemcnp.bat del makemcnp.bat
if exist codef del codef
if exist mcnp.for del mcnp.for
if exist mcnp.obj del mcnp.obj
if exist mcnp4b2.exe del mcnp4b2.exe
if exist install.log del install.log
rem f7713 mcsetup.for >> install.log
rem 386link -nomap mcsetup >> install.log
echo *****
echo *
echo * Call LF90 for mcsetup *
echo *
echo *****
c:\lf9035\bin\lf90 mcsetup -fix -tp -nwin -bind >> install.log
del mcsetup.obj
rem del mcsetup.sld
if "%1" == "" mcsetup
if not "%1" == "" mcsetup < %1
if not exist makemcnp.bat goto err1
if exist answer del answer
rename install.ans answer
echo *
echo *****
```

```
echo *
echo *           Time *
echo * Run the MAKEMCNP script ... (15-30 min.) *
echo *
echo *****
rem command /c makemcnp > > install.log
call makemcnp > > install.log
if not exist D:\MCNP4B\EXE\mcnp4b2.exe goto err2
rem if not exist runprob.dos goto err3
if not exist runprob.bat goto err3
goto end
echo *
echo *****
echo *           Time *
echo * Run the test problems ... (20-40 min.) *
echo *
echo *****
rem pkxarc -rx testinp.dos > > install.log
rem pkxarc -rx testmctl.dos > > install.log
rem pkxarc -rx testoutp.dos > > install.log
inpdos > > install.log
mctldos > > install.log
outpdos > > install.log
rem copy runprob.dos runprob.bat > > install.log
rem command /c runprob > > install.log
goto end
call runprob > > install.log
for %%f in (inp01m inp02m inp03m inp04m inp05m) do if not exist %%f goto err4
for %%f in (inp06m inp07m inp08m inp09m inp10m) do if not exist %%f goto err4
for %%f in (inp11m inp12m inp13m inp14m inp15m) do if not exist %%f goto err4
for %%f in (inp16m inp17m inp18m inp19m inp20m) do if not exist %%f goto err4
for %%f in (inp21m inp22m inp23m inp24m inp25m) do if not exist %%f goto err4
echo *
echo *****
echo *
echo * Installation complete - see Readme file. *
echo *
echo *****
goto end
:err1
echo *
echo *****
```

```

echo *
echo * SETUP ERROR OR USER ABORT. *
echo *
echo *****
goto end
:err2
echo *
echo *****
echo *
echo * COMPILATION ERROR - see INSTALL.LOG file. *
echo *
echo *****
goto end
:err3
echo *
echo *****
echo *
echo * VERIFICATION ERROR - missing RUNPROB file. *
echo *
echo *****
goto end
:err4
echo *
echo *****
echo *
echo * VERIFICATION ERROR - see INSTALL.LOG file. *
echo *
echo *****
:end

```

#### Install.fix file for PC desktop computer

```

c <<<<< makemcnp changes for MCNP4B2 >>>>> loddatt 09/22/97
c M&O WPO new loddatt = 03/31/98
c File install.fix.std
c File install.fix.x for the large memory version differs only in the value
c assigned to MDAS
c
c For each fix, enter five integer parameters on one line in free
c format, ip(1)-ip(5) described below, followed by the appropriate
c number of new lines.

```

c  
c ip(1) = The applicable computer system number or 0 for all systems.  
c ip(2) = The file number:  
c 1 = patchf  
c 2 = makemcnp  
c 3 = patchc  
c ip(3) = The applicable line number to edit-see the MCSETUP source.  
c ip(4) = The alter code:  
c 1 = insert the following ip(5) line(s) before line ip(3)  
c 2 = replace line ip(3) with the following ip(5) line(s)  
c 3 = insert the following line after entry ip(5) of line ip(3)  
c 4 = delete lines ip(3) through ip(5)  
c ip(5) = The number of new line(s) if ip(4)=1,2  
c The entry number if ip(4)=3  
c The last line number to delete if ip(4)=4  
c  
c The number of new lines that follow ip(1)-ip(5) is given by:  
c = ip(5) if ip(4)=1,2  
c = 1 if ip(4)=3  
c = 0 if ip(4)=4

c\*\*\*\*\* FIXES FOR SYSTEM 1 (Cray UNICOS) \*\*\*\*\*

c  
c Add the \*define t3d for the Cray T3D.  
c 1 1 2 1 1  
c \*define t3d  
c  
c Provide links to the T3D compilers and linker. XTM:GWM-95-128  
c Change the CFT77 compile line.  
c 1 2 18 1 4  
c export TARGET; TARGET=CRAY-T3D  
c ln -s /mpp/bin/cc cc  
c ln -s /mpp/bin/cft77 cft77  
c ln -s /mpp/bin/mppldr segldr  
c Provide links to the T3D compilers and linker. XTM:GWM-95-128  
c 1 2 26 2 1  
c cft77 compile  
c  
c Add CFTLIB library on UNICOS for profile timing. 06/30/95 (GWM)  
c 1 2 28 3 10  
c -L/usr/local/lib -lprof

**c\*\*\*\*\* FIXES FOR SYSTEM 2 (Sun SunOS ) \*\*\*\*\*****c Add a second X-window include path for some SunOS systems.****c 2 2 18 3 4****c -I/usr/openwin/include/X11****c Add a link to the ANSI C library (libansi.a) on some SunOS systems.****c 2 2 29 3 10****c -L/home -lansi****c\*\*\*\*\* FIXES FOR SYSTEM 3 (IBM AIX ) \*\*\*\*\*****c****c PVM libraries must go first for pvm version at some installations.****c 3 2 30 2 1****c xlf -o mcnp \*.o -L/usr/lanl/pvm3.3/lib -lfpvm3 -lpvm3 -L/usr/lib -lX11****c\*\*\*\*\* FIXES FOR SYSTEM 4 (HP HPUX ) \*\*\*\*\*****c****c Add a link to the C math library (libM.a) on some HP systems.****c 4 2 29 3 6****c -lM****c\*\*\*\*\* FIXES FOR SYSTEM 5 (VAX VMS ) \*\*\*\*\*****c****c Add an additional \*define keyword for PRPR on a VAX VMS system.****c 5 1 2 1 1****c \*define disscgs****c\*\*\*\*\* FIXES FOR SYSTEM 6 (DEC UNIX and PC LINUX) \*\*\*\*\*****c****c The following 7 lines enable GNU F77 compilation on LINUX.****c Tim Goorley, jgoorley@mit.edu XTM-RN(U97-028) 7/21/97****c 6 1 2 1 1****c \*define linux****c 6 2 27 3 1****c -O0****c 6 2 28 4 28****c 6 3 2 1 1****c \*define linux**



c\*\*\*\*\* FIXES FOR SYSTEM 7 (PC DOS ) \*\*\*\*\*

c

c The following 9 lines enable LAHEY F90 compilation on DOS/WINDOWS.

c Also uncomment the 2 lines in TTYINT below [call break()].

c 7 2 8 2 1

c lf90 prpr.for

c 7 2 9 4 9

c 7 2 17 2 1

c lf90 makxf.for

c 7 2 18 4 18

c 7 2 43 2 1

c lf90 mcnp.for

c 7 2 50 4 50

c\*\*\*\*\* FIXES FOR SYSTEM 8 (Sun Sol. ) \*\*\*\*\*

c\*\*\*\*\* FIXES FOR SYSTEM 9 (SGI IRIX ) \*\*\*\*\*

c\*\*\*\*\* FIXES FOR THE MCNP FORTRAN SOURCE (PATCHF FILE) \*\*\*\*\*

0 1 2 2 0

\*/ Integrate your patch with the following. If your patch makes changes

\*/ to the ZC, VV, CM, GS, MB, or BD decks, contact MCNP@LANL.GOV for

\*/ details on including your patch via the INSTALL.FIX file. When

\*/ integrating your patch, be sure the order of the changes (increasing

\*/ in line number) is preserved to avoid a PRPR error. See Appendix

\*/ C, page C-8 in the MCNP manual for more details.

\*/

\*/ \_\_\_\_\_ ttyint

\*ident tt4b2v

\*/

\*/ comdeck zc

\*/ change version and date

\*/

\*d,zc4b.1

parameter (kod='mcnp',ver='4b2')

\*d,zc4b.4

parameter (mdas=4000000)

\*d,bd4b.3

3 hsd/'sequential', 'direct', /, ibin/'fdusmcet', /, loddatt/'03/31/98', /,

```

*d,bd4b.4
  a hdpth/'d:\mcp4b'/,
*ident tt4b2
*/
*/ Uncomment (delete 1st 3 columns) of next 2 lines to enable LAHEY F90
*/ compilation on DOS/WINDOWS.                07/07/97 (GWM/GWM)
*/ undelete next two lines                    03/31/98 (WPO/JAM)
*d,tt4a.28                                     <1014>
  call break(lockl)
*/
*/ ----- msgcon
*/ Fix a print bug. Wrong number of arguments. 07/07/97 (GWM/GWM)
*ident me4b2
*d,me4b.195                                     <20311>
  call errprn(0,j,1,one*max(1,ntasks),zero,'ntk',' ');
*/ Force PVM to free some buffers.            07/07/97 (GWM/GWM)
*/ $20 awarded to Dudley A. Raine, III, ORNL (XTM:JSH-97-176) (GWM/GWM)
*i,me4b.311                                     <20498>
c
c   free the receive buffers.
  do 582 nt=1,ntasks
  582 call mdbuf(ib(nt),i)
*/
*/ ----- startp
*ident sp4b2
*/ Wrong index. Affects var. reduction and tracking. 07/07/97 (GWM/GWM)
*d,sp4b.8,sp4b.10                             <21159-21161>
  if(wc1(i).ge.0.)go to 85
  wcs1tc(i)=-wc1(i)*wgt
  wcs2tc(i)=-wc2(i)*wgt
*/
*/ ----- levcel
*ident ll4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,ll4b.25                                     <22232>
  jsu=-abs(jsu)
  if(l.gt.ll+1.and.lat(llat+1,icl).ne.0)call findel(icl)
  jsu=abs(jsu)
*/
*/ ----- ypbssp

```

```

*ident yp4b2
*/ Wrong index. Affects var. reduction and tracking. 07/07/97 (GWM/GWM)
*d,yp4b.2,yp4b.4 <22590-22592>
  if(wc1(i).ge.0.)go to 45
  wcs1tc(i)=-wc1(i)*wgt
  wcs2tc(i)=-wc2(i)*wgt
*/
*/ ----- wtwndo
*ident we4b2
*/ Fix a print bug. Wrong number of arguments. 07/23/97 (GWM/GWM)
*d,we4b.145 <23152>
  200 call errprn(1,nwsg(3),-1,1,icl,zero,'icl',
*/
*/ ----- track
*ident tr4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,tr4b.18 <23651>
  if(dl(i)+coincd.lt.dl(levp))go to 445
*/
*/ ----- findel
*ident fn4b2
*/ Silent wrong answers for near-coincident lattices. 08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,fn.6 <24481>
  dimension ii(3),jx(14,2)
*i,fn.7 after equivalence <24482>
  data jx/1,1,2,2,3,3,1,1,2,2,2,2,3,3,
  1 1,-1,1,-1,1,-1,1,-1,1,-1,1,-1/
*d,fn.10 n= <24485>
*d,fn4b.5,fn4b.16 ii(i)= thru label 10 <24493-24504>
  10 ii(i)=nint(a)
*d,fn.22,fn.52 <24510-24550>
c
c correct for coincident surfaces and hexagonal prism lattices.
c check if new location completely inside lattice element.
  jc=0
  30 jc=jc+1
  if(jc.gt.10)go to 70
  do 60 jk=lca(llca+ic),abs(lca(llca+ic+1))-1
  j=abs(lja(llja+jk))

```

```

k=kst(lkst+j)
l=lsc(llsc+j)
if(k.eq.1)t4=scf(l+1)*xxx+scf(l+2)*yyy+scf(l+3)*zzz-scf(l+4)
if(k.ne.1)t4=gpblcm(k-1)-scf(l+1)
if(jsu.ge.0)go to 40
if(ksc(lksc-jsu).ne.ksc(lksc+j))go to 40
if(k.eq.1)t5=scf(l+1)*uuu+scf(l+2)*vvv+scf(l+3)*www
if(k.ne.1)t5=gpblcm(k+2)
if(abs(t4).le.coined*abs(t5))t4=t5
40 if(lja(llja+jk)*t4.gt.0)go to 60

```

c

c location coincident with or beyond surface j, index ix.

```

j1=jk-lca(llca+ic)+6*lat(llat+1,ic)-5
ix=jx(j1,1)
iy=jx(j1,2)
50 ii(ix)=ii(ix)+iy
xxx=xxx-iy*vcl(lvcl+1,ix,m)
yyy=yyy-iy*vcl(lvcl+2,ix,m)
zzz=zzz-iy*vcl(lvcl+3,ix,m)

```

c

c if on or beyond hex side 3, increment sides 1 and 2.

```

if(ix.ne.2.or.j1.lt.11)go to 30
iii=iii-iy
xxx=xxx+iy*vcl(lvcl+1,1,m)
yyy=yyy+iy*vcl(lvcl+2,1,m)
zzz=zzz+iy*vcl(lvcl+3,1,m)
go to 30
60 continue
return
70 kdb=1

```

\*/

\*/ \_\_\_\_\_ findlv

\*ident fv4b2

\*/ Silent wrong answers for near-coincident lattices. 08/25/97

\*/ \$20 to Lee Montierth (INEEL) XTM:JSH-97-208

\*d,fv.35 &lt;24587&gt;

```

60 jsu=-abs(jsu)
if(lat(llat+1,icl).ne.0)call findel(icl)
jsu=abs(jsu)

```

\*/

\*/ \_\_\_\_\_ chkcel

```

*ident cc4b2
*/ Silent wrong answers for near-coincident lattices.      08/25/97
*/ $20 to Lee Montierth (INEEL) XTM:JSH-97-208
*d,cc4b.4 <24700>
  t5=scf(i)*uuu+scf(i+1)*vvv+scf(i+2)*www
  if(abs(t4).le.coincd*abs(t5))t4=t5
*d,cc4b.9 <24705>
  if(abs(t4).le.coincd*abs(gpblcm(k+2)))t4=gpblcm(k+2)
*/
*/ ----- mdbuf
*ident mf4b2
*/ Force PVM to free some buffers,      07/07/97 (GWM/GWM)
*/ $20 awarded to Dudley A. Raine, III, ORNL (XTM:JSH-97-176) (GWM/GWM)
*i,mf4b.83 <41720>
  subroutine mdbuf(ib,in)
c    perform function 'free message buffer'.
*call mb
*if def,pvm,1
  call pvmffreebuf(ib,in)
  return
  end
*/
*/ ----- getidt
*ident gi4b2
*/ Provide cleaner separation of LINUX and DEC.  06/04/97 (GWM/GWM)
*d,gi4b.1 <42208>
*if def,linux,3
*d,gi4b.5 <42212>
*i,gi4a.1 <42213>
*if -def,linux,3

```

#### Makemcnp.bat file for PC desktop computer

```

rem Batch file to make MCNP 4A on the PC DOS.
rem Files needed: prpr.id,makxs.id,patchf,mcnpf.id.
rem change executable name to 'mcnp4b2x' for large version
echo on
rem
del compile
del newid
del patch

```

```
copy prpr.id prpr.for
rem f7713 prpr.for
rem 386link -nomap prpr
c:\f9035\bin\f90 prpr -fix -tp -nwin -bind >> install.log
del prpr.for
del prpr.obj
rem del prpr.sld
copy makxs.id codef
type patchf | find "*define" > patch
prpr
rename compile makxsf.for
rem f7713 makxsf.for
rem 386link -nomap makxsf
c:\f9035\bin\f90 makxsf -fix -tp -nwin -bind >> install.log
del makxsf.for
del makxsf.obj
rem del makxsf.sld
del codef
del patch
del newid
copy mcnp4b.id codef
copy patchf patch
prpr
del mcnp1.for
del mcnp2.for
del mcnp3.for
del codef
del patch
call fsplit
del newid
del compile
rem 386link -nomap -pack mcnp
move mcnp1.for c:\tmpspace
move mcnp2.for c:\tmpspace
move mcnp3.for c:\tmpspace
c:
cd ..
cd tmpspace
c:\f9035\bin\f90 mcnp1 -c -fix -tp -nwin -o0 >> d:\mcnp4b\install\install.log
c:\f9035\bin\f90 mcnp2 -c -fix -tp -nwin -o0 >> d:\mcnp4b\install\install.log
c:\f9035\bin\f90 mcnp3 -c -fix -tp -nwin -o0 >> d:\mcnp4b\install\install.log
```

```

c:\lf9035\bin\lf90 *.obj -bind -nomap -exe d:\mcnp4b\exe\mcnp4b2 >>d:\mcnp4b\install\install.log
rem -libp c:\lf9035\lib -l lf90
del mcnp1.for
del mcnp2.for
del mcnp3.for
del mcnp1.obj
del mcnp2.obj
del mcnp3.obj
d:
rem del mcnp.sld

```

### Mcsetup source file for Lahey lf90 compiler

```

C   Last change: JAM  1 Apr 98  2:07 pm
    program mcsetup
c
c   program updates to compilr with Lahey lf90 compiler, version 3.5
c   december 18, 1997
c
c   hsymb(4,i) = Linker library symbol(s). (comment)
c
c   data statements for lf90
c   data (hmake(j,7),j=1,mxnl)/
c   1 'rem Batch file to make MCNP 4A on the PC DOS.',
c   2 'rem Files needed: prpr.id,makxs.id,patchf,mcnpf.id.',
c   3 'echo on','del compile','del newid','del patch',
c   7 'copy prpr.id prpr.for',
c   8 'rem f7713 prpr.for','rem 386link -nomap prpr',
c   9 'lf90 prpr -fix -tp -nwin >> install.log',
c   1 'del prpr.for','del prpr.obj','rem del prpr.sld',
c   3 'copy makxs.id codef','type patchf | find "*define" > patch',
c   5 'prpr','rename compile makxsf.for','rem f7713 makxsf.for',
c   8 'rem 386link -nomap makxsf',
c   6 'lf90 makxsf -fix -tp -nwin >> install.log',
c   7 'del makxsf.for','del makxsf.obj',
c   1 'rem del makxsf.sld','del codef','del patch','del newid',
c   5 'copy mcnpf.id codef','copy patchf patch',
c   7 'prpr','rename compile mcnp.for','del codef','del patch',
c   1 'del newid','rem f7713 mcnp.for','rem 386link -nomap -pack mcnp',
c   2 'lf90 mcnp -fix -tp -nwin -nomap -g -lib plot.lib >> install.log',

```

```

c 4 'rem del mcnp.sld',13*' '/'
c
c Setup the proper files on each computer system.
c
c IUO = PATCHC, PATCHF, and MAKEMCNP output files.
c IUF = INSTALL.FIX input file.
c IUS = Internal scratch fix file.
c IUW = INSTALL.ANS answer file.
c MXND = Maximum number of parameter distributions.
c MXNE = Maximum number of entries per main menu section.
c MXNF = Maximum number of internal fixes per system.
c MXNI = Maximum number of instruction messages.
c MXNL = Maximum number of lines per patch or make file.
c MXNO = Maximum number of options per main menu entry - note
c this is also the maximum number of supported systems.
c MXNU = Maximum number of unavailable options per system.
c NCOL = Number of main menu columns.
c NSEC = Number of main menu sections.
c
c parameter (iuo=31,iuf=32,ius=33,iuw=34,mxnd=20,mxne=3,mxnf=7,
1 mxni=3,mxnl=70,mxno=10,mxnu=10,ncol=4,nsec=5)
c
c dimension ib(5),ichk(mxne,nsec),idef(mxne,nsec,mxno),
1 ifix(4,mxnf,mxno),ifxl(2,5),iopt(4,mxnu,mxno),
2 ipar(3,mxno,mxne,nsec),ipms(mxnd),nepms(nsec)
c
c character h*3,hfmt*10,hname(mxno,3)*12,hsymb(4,mxno)*7
c character*20 hmenu(ncol,mxne,nsec),hoptn(mxno,ncol-1,mxne,nsec),hp
c character*41 ha,hb,hparm(mxno,mxnd)
c character*80 hc,hmsg(20),htitl(nsec)
c character*120 hd,hf,hfixs(mxnf),hmake(mxnl,mxno),hpatc(mxnl),
1 hpatf(mxnl)
c
c logical lv
c
c Main menu titles.
c data htitl/'COMPUTER SYSTEM DESCRIPTION','GENERAL OPTIONS',
1 'GRAPHICS OPTIONS','CROSS-SECTION OPTIONS',
2 'MULTIPROCESSING OPTIONS'/
c
c Option data - Section 1 (Computer System Description).

```



```

data (((hoptn(i,j,k,1),i=1,mxno),j=1,ncol-1),k=1,mxne)/
1 'Cray Unicos','Sun SunOS','IBM RS/6000 AIX','HP-9000 HPUX',
1 'VAX VMS','DEC UNIX','PC DOS','Sun Solaris','SGI IRIX',' ',
2 'cray,unicos','sun','aix','hpux','vms','dec,lp64','pcdos',
2 'sun','dec,lp64',' ',
3 10*'off',
1 30*' ',
1 30*' '/

```

c

c Option data - Section 2 (General Options).

```

data (((hoptn(i,j,k,2),i=1,mxno),j=1,ncol-1),k=1,mxne)/
1 'Unix System','Unix System',8*' ',
2 'unix','*****',8*' ',
3 'on','off',8*' ',
1 '32-Bit System','32-Bit System',8*' ',
2 'cheap','*****',8*' ',
3 'on','off',8*' ',
1 'Dynamic Memory','Dynamic Memory',8*' ',
2 'pointer','*****',8*' ',
3 'on','off',8*' '/

```

c

c Option data - Section 3 (Graphics Options).

```

data (((hoptn(i,j,k,3),i=1,mxno),j=1,ncol-1),k=1,mxne)/
1 'Geometry Plotter','Geometry Plotter',8*' ',
2 'plot','*****',8*' ',
3 'on','off',8*' ',
1 'Tally Plotter','Tally Plotter',8*' ',
2 'mcplot','*****',8*' ',
3 'on','off',8*' ',
1 'X-Window Library','CGS Library','GKS Library','DISSPLA Library',
1 'LAHEY Library',5*' ',
2 'gkssim,xlib','gkssim,cgs','*****','gkssim,disspla',
2 'gkssim,lahey',5*' ',
3 10*'on'/

```

c

c Option data - Section 4 (Cross-Section Options).

```

data (((hoptn(i,j,k,4),i=1,mxno),j=1,ncol-1),k=1,mxne)/
1 'Data Path',9*' ',
2 '*****',9*' ',
3 'on',9*' ',
1 '64-Bit Data','64-Bit Data',8*' ',

```

```

2 'xs-64','*****',8* ' ',
3 'on','off',8* ' ',
1 30* ' /

```

c

c Option data - Section 5 (Multiprocessing Options).

```

data (((hoptn(i,j,k,5),i=1,mxno),j=1,ncol-1),k=1,mxne)/
1 'Multiprocessing','Distributed Memory','Common Memory',7* ' ',
2 '*****','multp,pvm','multt',7* ' ',
3 'off','on','on',7* ' ',
1 30* ' ',
1 30* ' /

```

c

c For each distribution, provide system dependent parameters.

```

data ((hparm(i,j),i=1,mxno),j=1,10)/

```

c

c Distribution 1 - compiler versions.

```

1 'CFT77 6.0.4.1','F77 4.0','XLF 3.02.5.3','F77 9.16',
2 'FORTRAN 5.9','F77 3.2','F77L-EM/32 5.2','F77 4.0',
3 'F77 4.0.2',' ',

```

c

c Distribution 2 - fixed memory allocation.

```

1 10*'mdas=4000000',

```

c

c Distribution 3 - graphics library paths.

```

1 '/usr/lib','/usr/openwin/lib',2*'/usr/lib',
2 'gsys:[graphics.lib]','/usr/lib','c: f77l3 lib',3*'/usr/lib',

```

c

c Distribution 4 - X-Window graphics library.

```

1 10*'libX11.a',

```

c

c Distribution 5 - X-Window include path.

```

1 '/usr/include','/usr/openwin/include',2*'/usr/include',
2 'gsys:[graphics.include]','/usr/include','c:xwin',
3 3*'/usr/include',

```

c

c Distribution 6 - CGS graphics library.

```

1 10*'libcgs.a',

```

c

c Distribution 7 - GKS graphics library.

```

1 10*'libgks.a',

```

c

INFORMATION ONLY

c Distribution 8 - DISSPLA graphics library.  
1 4\*'libdis66.a','dislib66.olb,cgsfor.olb',5\*'libdis66.a',  
c  
c Distribution 9 - LAHEY graphics library.  
1 6\*' ','graph3.lib',3\*' ',  
c  
c Distribution 10 - DATAPATH path.  
1 4\*'/usr/local/udata/mcnp','gsys:[user.local.udata.mcnp]','  
2 '/usr/local/udata/mcnp','c: mcnp xs',  
3 3\*'/usr/local/udata/mcnp'/  
data ((hparm(i,j),i=1,mxno),j=11,mxnd)/  
c  
c Distribution 11 - PVM library path.  
1 4\*'/usr/lib',' ','/usr/lib',' ',3\*'/usr/lib',  
c  
c Distribution 12 - PVM library.  
1 4\*'libfpvm3.a,libpvm3.a',' ','libfpvm3.a,libpvm3.a',' ',  
2 3\*'libfpvm3.a,libpvm3.a',  
c  
c Distributions 13-20 - unused.  
1 80\*' '/  
c  
c Common messages.  
data hmesg/  
1 'FATAL. This option is not available with the ',  
2 'WARNING. This option degrades performance with the ',  
3 'WARNING. This option has not been tested with the ',  
4 'Enter length of MCNP DAS array (typically 1-4 Mwords), <CR> for  
4default:',  
5 'Enter graphics library path (max. 40 characters), <CR> for defau  
5lt:',  
6 'Enter graphics library name, <CR> for default:',  
7 'Enter X-Window include path (max. 40 characters), <CR> for defau  
7lt:',  
8 'Enter cross-section data path (max. 40 characters), <CR> for def  
8ault:',  
9 'Enter PVM library path (max. 40 characters), <CR> for default:',  
1 'Enter PVM library name, <CR> for default:',  
2 10\*' '/

c

- c Special symbols for the ith computer system:
- c hsymb(1,i) = Directory path symbol.
- c hsymb(2,i) = Compiler include symbol(s).
- c hsymb(3,i) = Linker library path symbol(s).
- c hsymb(4,i) = Linker library symbol(s).

```

data hsymb/
1 '/' '-I' '-L' '-I',
2 '/' '-I' '-L' '-I',
3 '/' '-I' '-L' '-I',
4 '/' '-I' '-L' '-I',
5 ' ' ' ' ' ' /',
6 '/' '-I' '-L' '-I',
7 ' ' ' ' -libp' '-I',
8 '/' '-I' '-L' '-I',
9 '/' '-I' '-L' '-I',
1 '/' '-I' '-L' '-I' /

```

- c
- c Output file names for each computer system.

```

data hname/10*'patchf',
1 4*'makemcnp', 'makemcnp.com', 'makemcnp', 'makemcnp.bat',
2 3*'makemcnp',
3 10*'patchc' /

```

- c
- c Template for the PATCHF file (the same for all systems).
- c Note at about label 10 that hpatf(10) has been initialized.

```

data hpatf/
1 '*define',
2 '*ident fixf',
3 '*/',
4 '*/ _____ comdeck zc',
5 '*d,zc4b.4',
6 ' parameter (mdas=4000000)',
7 '*/',
8 '*/ _____ block data',
9 '*d,bd4b.4',
1 ' ',
1 '*/,59*' /

```

- c
- c Template for the MAKEMCNP file for each computer system.

```

data (hmake(j,1),j=1,mxnl)/
1 '#!/bin/sh', '# Script file to make MCNP 4B on the Cray UNICOS.',

```

```

3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex', 'rm -f compile newid patch', 'cp prpr.id prpr.f',
7 'cf77 -o prpr prpr.f', 'cp makxs.id codef',
9 'grep *define patchc > patch', 'prpr', 'mv compile makxsf.f',
2 'cf77 -o makxsf makxsf.f', 'rm -f newid *.f *.o',
4 'cp mcnpc.id codef', 'cp patchc patch', 'prpr',
7 'mv compile mcnpc.c', 'cc -c -dz mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef', 'cp patchf patch', 'prpr',
3 'rm -f codef patch',
4 'mkdir flib', 'mkdir olib',
6 'cft77 -ez -a stack compile',
7 'mv compile *.c flib',
8 'segldr -o mcnp *.o',
9 'mv *.o olib',41*' '/'

```

c

```

data (hmake(j,2),j=1,mxnl)/
1 '#!/bin/sh', '# Script file to make MCNP 4B on the Sun SunOS.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex', 'rm -f compile newid patch', 'cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f', 'cp makxs.id codef',
9 'grep *define patchc > patch', 'prpr', 'mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f', 'rm -f newid *.f *.o',
4 'cp mcnpc.id codef', 'cp patchc patch', 'prpr',
7 'mv compile mcnpc.c', 'cc -dalign -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef', 'cp patchf patch', 'prpr',
3 'fsplit compile > clog', 'rm -f compile codef patch newid clog',
5 'mkdir flib', 'mkdir olib',
7 'f77 -O3 -Nn6000 -Nq6000 -Ns6000 -Nx2000 -dalign -c *.f',
8 'mv *.f *.c flib',
9 'f77 -o mcnp -Bstatic *.o',
1 'mv *.o olib',40*' '/'

```

c

```

data (hmake(j,3),j=1,mxnl)/
1 '#!/bin/sh', '# Script file to make MCNP 4B on the IBM AIX.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex', 'rm -f compile newid patch', 'cp prpr.id prpr.f',
7 'xlf -o prpr prpr.f', 'cp makxs.id codef',
9 'grep *define patchc > patch', 'prpr', 'mv compile makxsf.f',
2 'xlf -o makxsf makxsf.f', 'rm -f newid *.f *.o',

```

```

4 'cp mcnpc.id codef','cp patchc patch','prpr',
7 'mv compile mcnpc.c','cc -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef','cp patchf patch','prpr',
3 'fsplit compile > clog','rm -f compile codef patch newid clog',
5 'mkdir flib','mkdir olib',
7 'xlf -O -NQ20000 -NA16384 -c *.f',
8 'xlf -NQ20000 -NA16384 -c brang.f tallyp.f nextit.f',
9 'mv *.f *.c flib',
1 'xlf -o mcnp *.o',
1 'mv *.o olib',39*' '/'

```

c

```

data (hmake(j,4),j=1,mxn1)/
1 '#!/bin/sh','# Script file to make MCNP 4B on the HP9000 HPUX.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex','rm -f compile newid patch','cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f','cp makxs.id codef',
9 'grep *define patchc > patch','prpr','mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f','rm -f newid *.f *.o',
4 'cp mcnpc.id codef','cp patchc patch','prpr',
7 'mv compile mcnpc.c','cc -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef','cp patchf patch','prpr',
3 'fsplit compile > clog','rm -f compile codef patch newid clog',
5 'mkdir flib','mkdir olib',
7 'f77 +T +E1 -O -c *.f',
8 'mv *.f *.c flib',
9 'fort77 -o mcnp *.o',
1 'mv *.o olib',40*' '/'

```

c

```

data (hmake(j,5),j=1,mxn1)/
1 '$ ! COM file to make MCNP 4B on the VAX VMS.',
2 '$ ! Files needed: prpr.id,makxs.id,patchf.dat,mcnpf.id.',
3 '$ set verify','$ set noon',
5 '$ del compile.dat;,newid.dat;,patch.dat;',
6 '$ copy prpr.id prpr.for','$ fortran prpr','$ link prpr',
9 '$ del prpr.for;,prpr.obj;','$ copy makxs.id codef.dat',
1 '$ search patchf.dat *define /output=patch.dat','$ run prpr',
3 '$ rename compile.dat makxsf.for',
4 '$ fortran /g_floating makxsf','$ link makxsf',
6 '$ del codef.dat;,patch.dat;,newid.dat;,makxsf.for;,makxsf.obj;',

```

```

7 '$ copy mcnpf.id codef.dat', '$ copy patchf.dat patch.dat',
9 '$ run prpr', '$ del codef.dat;,patch.dat;,newid.dat;',
1 '$ rename compile.dat mcnp.for',
2 '$ fortran /g_ floating mcnp',
3 '$ link mcnp',47*' '/'

```

c

```

data (hmake(j,6),j=1,mxn1)/
1 '#!/bin/sh', '# Script file to make MCNP 4B on the DEC UNIX.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex', 'rm -f compile newid patch', 'cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f', 'cp makxs.id codef',
9 'grep *define patchc > patch', 'prpr', 'mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f', 'rm -f newid *.f *.o',
4 'cp mcnpc.id codef', 'cp patchc patch', 'prpr',
7 'mv compile mcnpc.c', 'cc -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef', 'cp patchf patch', 'prpr',
3 'fsplit compile > clog', 'rm -f compile codef patch newid clog',
5 'mkdir flib', 'mkdir olib',
7 'f77 -c *.f',
8 'f77 -O1 -fpel -c itally.f getxs.f gmgww.f',
9 'mv *.f *.c flib',
1 'f77 -o mcnp *.o',
1 'mv *.o olib',39*' '/'

```

c

```

c data (hmake(j,7),j=1,43)/
c 1 'rem Batch file to make MCNP 4B on the PC DOS.',
c 2 'rem Files needed: prpr.id,makxs.id,patchf,mcnpf.id.',
c 3 'echo on', 'del compile', 'del newid', 'del patch',
c 7 'copy prpr.id prpr.for', 'f7713 prpr.for', '386link prpr -nomap',
c 1 'del prpr.for', 'del prpr.obj', 'del prpr.sld',
c 3 'copy makxs.id codef', 'type patchf | find "*define" > patch',
c 5 'prpr', 'rename compile makxsf.for', 'f7713 makxsf.for',
c 8 '386link makxsf -nomap', 'del makxsf.for', 'del makxsf.obj',
c 1 'del makxsf.sld', 'del codef', 'del patch', 'del newid',
c 5 'type patchf | find "*define pcdos" | find "xlib"',
c 6 'if errorlevel 1 goto next', 'if exist mcnpc.c del mcnpc.c',
c 8 'copy mcnpc.id codef', 'copy patchc patch', 'prpr',
c 1 'rename compile mcnpc.c', 'del codef', 'del patch', 'del newid',
c 5 'hc386 -f387 -DMSDOS -Hoff=protection -I\dx\include -c mcnpc.c',
c 6 ':next', 'copy mcnpf.id codef', 'copy patchf patch',

```

```

c 9 'prpr', 'rename compile mcnp.for', 'del codef', 'del patch',
c 3 'f7713 mcnp.for /Q1'/
c data (hmake(j,7),j=44,mxn)/
c 4 'type patchf | find "*define pcdos" | find "xlib"',
c 5 'if errorlevel 1 goto lahey',
c 6 'set lib=\f7713\lib;\hc33\small;\dvx\lib\hc387',
c 7 '386link mcnp \f7713\lib\hc320 mcnpc -l hc386,hc387,hcna,x11,sys
c 7 -nomap -stub runb',
c 8 'goto end', ':lahey',
c 1 '386link mcnp -nomap -nopack -stub runb',
c 1 ':end', 'del mcnp.sld', 'echo off', '17*' '/'
c
data (hmake(j,7),j=1,mxn)/
1 'rem Batch file to make MCNP 4A on the PC DOS.',
2 'rem Files needed: prpr.id,makxs.id,patchf,mcnpf.id.',
3 'echo on', 'rem',
5 'del compile', 'del newid', 'del patch',
8 'copy prpr.id prpr.for',
9 'rem f7713 prpr.for', 'rem 386link -nomap prpr',
1 'c:\f9035\bin\f90 prpr -fix -tp -nwin -bind >> install.log',
2 'del prpr.for', 'del prpr.obj', 'rem del prpr.sld',
5 'copy makxs.id codef', 'type patchf | find "*define" > patch',
7 'prpr', 'rename compile makxsf.for', 'rem f7713 makxsf.for',
* 'rem 386link -nomap makxsf',
1 'c:\f9035\bin\f90 makxsf -fix -tp -nwin -bind >> install.log',
2 'del makxsf.for', 'del makxsf.obj',
4 'rem del makxsf.sld', 'del codef', 'del patch', 'del newid',
8 'copy mcnp4b.id codef', 'copy patchf patch',
* 'prpr', 'del mcnp1.for', 'del mcnp2.for', 'del mcnp3.for',
4 'del codef', 'del patch', 'call fsplit', 'rem del newid',
8 'del compile', 'rem 386link -nomap -pack mcnp',
* 'move mcnp1.for c:\tmpspace', 'move mcnp2.for c:\tmpspace',
2 'move mcnp3.for c:\tmpspace', 'c:', 'cd ..', 'cd tmpspace',
6 'c:\f9035\bin\f90 mcnp1 -c -fix -tp -nwin -o0 >> d:\mcnp4b\insta
All\install.log',
7 'c:\f9035\bin\f90 mcnp2 -c -fix -tp -nwin -o0 >> d:\mcnp4b\insta
All\install.log',
8 'c:\f9035\bin\f90 mcnp3 -c -fix -tp -nwin -o0 >> d:\mcnp4b\insta
All\install.log',
9 'c:\f9035\bin\f90 *.obj -bind -nomap -exe d:\mcnp4b\exe\mcnp4b2
Ax >> d:\mcnp4b\install\install.log', 'rem',

```



```

1 'del mcnp1.for','del mcnp2.for','del mcnp3.for',
4 'del mcnp1.obj','del mcnp2.obj','del mcnp3.obj','d:',
8 'rem del mcnp.sld',12*' '/

```

c

c

```

data (hmake(j,8),j=1,mxnl)/
1 '#!/bin/sh','# Script file to make MCNP 4B on the Sun Solaris.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex','rm -f compile newid patch','cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f','cp makxs.id codef',
9 'grep *define patchc > patch','prpr','mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f','rm -f newid *.f *.o',
4 'cp mcnpc.id codef','cp patchc patch','prpr',
7 'mv compile mcnpc.c','cc -dalign -c mcnpc.c',
9 'rm -f codef patch newid',
* 'cp mcnpf.id codef','cp patchf patch','prpr',
3 'fsplit compile > clog','rm -f compile codef patch newid clog',
5 'mkdir flib','mkdir olib',
7 'f77 -O3 -Nn6000 -Nq6000 -Ns6000 -Nx2000 -dalign -c *.f',
8 'mv *.f *.c flib',
9 'f77 -o mcnp *.o',
* 'mv *.o olib',40*' '/

```

c

```

data (hmake(j,9),j=1,mxnl)/
1 '#!/bin/sh','# Script file to make MCNP 4B on the SGI ONYX.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex','rm -f compile newid patch','cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f','cp makxs.id codef',
9 'grep *define patchc > patch','prpr','mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f','rm -f newid *.f *.o',
4 'cp mcnpc.id codef','cp patchc patch','prpr',
7 'mv compile mcnpc.c','cc -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef','cp patchf patch','prpr',
3 'fsplit compile > clog','rm -f compile codef patch newid clog',
5 'mkdir flib','mkdir olib',
7 'f77 -O1 -TARG:madd=OFF -c *.f',
8 'f77 -c sing.f mapmaz.f',
9 'mv *.f *.c flib',
1 'f77 -o mcnp *.o',
1 'mv *.o olib',39*' '/

```

c

```

data (hmake(j,10),j=1,mxnl)/
1 '#!/bin/sh', '# Script file to make MCNP 4B on the Sun SunOS.',
3 '# Files needed: prpr.id,makxs.id,patch?,mcnpc.id,mcnpf.id.',
4 'set -ex', 'rm -f compile newid patch', 'cp prpr.id prpr.f',
7 'f77 -o prpr prpr.f', 'cp makxs.id codef',
9 'grep *define patchc > patch', 'prpr', 'mv compile makxsf.f',
2 'f77 -o makxsf makxsf.f', 'rm -f newid *.f *.o',
4 'cp mcnpc.id codef', 'cp patchc patch', 'prpr',
7 'mv compile mcnpc.c', 'cc -dalign -c mcnpc.c',
9 'rm -f codef patch newid',
1 'cp mcnpf.id codef', 'cp patchf patch', 'prpr',
3 'fsplit compile > clog', 'rm -f compile codef patch newid clog',
5 'mkdir flib', 'mkdir olib',
7 'f77 -O3 -Nn6000 -Nq6000 -Ns6000 -Nx2000 -dalign -c *.f',
8 'mv *.f *.c flib',
9 'f77 -o mcnp -Bstatic *.o',
1 'mv *.o olib',40*' '/'

```

c

c Template for the PATCHC file (the same for all systems).

```

data hpatc/
1 '*define',
2 '*ident fixc',
3 '*/',
4 '*/ _____ c routines',
5 '*/',65*' '/'

```

c

c Default options for the ith computer system:

c idef(1,n,i) = Default option for entry 1 of section n.

c idef(2,n,i) = Default option for entry 2 of section n.

c idef(3,n,i) = Default option for entry 3 of section n.

data idef/

```

1 1,0,0, 2,2,1, 1,1,1, 1,2,0, 1,0,0,
2 2,0,0, 1,1,2, 1,1,1, 1,2,0, 1,0,0,
3 3,0,0, 1,1,1, 1,1,1, 1,2,0, 1,0,0,
4 4,0,0, 1,1,1, 1,1,1, 1,2,0, 1,0,0,
5 5,0,0, 2,1,2, 1,1,4, 1,2,0, 1,0,0,
6 6,0,0, 1,1,1, 1,1,1, 1,2,0, 1,0,0,
7 7,0,0, 2,1,2, 1,1,5, 1,2,0, 1,0,0,
8 8,0,0, 1,1,2, 1,1,1, 1,2,0, 1,0,0,
9 9,0,0, 1,1,1, 1,1,1, 1,2,0, 1,0,0,

```

```

1 10,0,0, 1,1,2, 1,1,1, 1,2,0, 1,0,0/
c
c   Fix parameters for the nth fix of the ith computer system:
c   ifix(1,n,i) = File to fix: 1=patchf, 2=make script, 3=patchc.
c   ifix(2,n,i) = Relevant line number of fix file.
c   ifix(3,n,i) = Alter code:
c       1 = Insert new line(s) before line ifix(2,n)
c       2 = Replace line ifix(2,n) with new line(s)
c       3 = Add new text after entry ifix(4,n) of line ifix(2,n)
c   ifix(4,n,i) = Number of new lines, entry number if ifix(3..)=3.
data ifix/
1 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,3, 4*0,    2,28,3,4, 3,1,2,1,
2 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,3, 2,27,3,2, 2,29,3,5, 3,1,2,1,
3 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,2, 4*0,    2,30,3,4, 3,1,2,1,
4 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,2, 4*0,    2,29,3,4, 3,1,2,1,
5 1,1,2,1, 1,6,2,1,1,10,2,1, 8*0,          2,23,3,3, 3,1,2,1,
6 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,2, 4*0,    2,30,3,5, 3,1,2,1,
7 1,1,2,1, 1,6,2,1,1,10,2,1, 8*0,          2,50,3,6, 3,1,2,1,
8 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,3, 2,27,3,2, 2,29,3,4, 3,1,2,1,
9 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,2, 4*0,    2,30,3,4, 3,1,2,1,
1 1,1,2,1, 1,6,2,1,1,10,2,1, 2,18,3,3, 2,27,3,2, 2,29,3,5, 3,1,2,1/
c
c   Limits on external fix parameters within INSTALL.FIX:
c   ifxl(1-2,1) = Lower and upper limits of the system number.
c   ifxl(1-2,2) = Lower and upper limits of the file number.
c   ifxl(1-2,3) = Lower and upper limits of the line number.
c   ifxl(1-2,4) = Lower and upper limits of the alter code.
c   ifxl(1-2,5) = Lower and upper limits of the number of lines.
data ifxl/0,mxno, 1,3, 0,mxnl, 1,4, 0,1000000/
c
c   Unavailable options for the ith computer system (n <= mxnu):
c   iopt(1,n,i) = Section number of unavailable option n.
c   iopt(2,n,i) = Entry number of unavailable option n.
c   iopt(3,n,i) = Option number of unavailable option n.
c   iopt(4,n,i) = Message number of unavailable option n.
data iopt/
1 2,1,1,1, 2,2,1,1, 3,3,5,1, 4,2,1,1, 24*0,
2 2,1,2,1, 2,2,2,-3, 2,3,1,-2, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 16*0,
3 2,1,2,1, 2,2,2,-3, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 20*0,
4 2,1,2,1, 2,2,2,-3, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 20*0,
5 2,1,1,1, 2,2,2,-3, 2,3,1,1, 3,3,1,-3, 3,3,5,1, 5,1,2,1, 16*0,

```

6 2,1,2,1, 2,2,2,-3, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 20\*0,  
 7 2,1,1,1, 2,2,2,-3, 2,3,1,1, 3,3,1,-3, 3,3,2,1, 3,3,4,-3,  
 7 5,1,2,1, 5,1,3,1, 8\*0,  
 8 2,1,2,1, 2,2,2,-3, 2,3,1,-2, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 16\*0,  
 9 2,1,2,1, 2,2,2,-3, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 20\*0,  
 1 2,1,2,1, 2,2,2,-3, 3,3,4,-3, 3,3,5,1, 5,1,3,1, 20\*0/

c

c Parameter distributions for option k of entry j of section i:

c ipar(1,k,j,i) = Distribution number for parameter 1.

c ipar(2,k,j,i) = Distribution number for parameter 2.

c ipar(3,k,j,i) = Distribution number for parameter 3.

data ipar/

c

c Parameter dist. - Section 1 (Computer System Description).

1 1,0,0, 1,0,0, 1,0,0, 1,0,0, 1,0,0, 1,0,0, 1,0,0, 1,0,0, 1,0,0,

1 1,0,0, 1,0,0,

2 30\*0,

3 30\*0;

c

c Parameter dist. - Section 2 (General Options).

1 30\*0,

2 30\*0,

3 0,0,0, 2,0,0, 24\*0,

c

c Parameter dist. - Section 3 (Graphics Options).

1 30\*0,

2 30\*0,

3 3,4,5, 3,6,0, 3,7,0, 3,8,0, 3,9,0, 15\*0,

c

c Parameter dist. - Section 4 (Cross-Section Options).

1 10,0,0, 27\*0,

2 30\*0,

3 30\*0,

c

c Parameter dist. - Section 5 (Multiprocessing Options).

1 0,0,0, 11,12,0, 24\*0,

2 30\*0,

3 30\*0/

c

c Messages for each parameter distribution.

data ipms/0,4,5,6,7,6,6,6,6,8,9,10,8\*0/

```

c
c   Number of entries within each section.
data neps/1,3,3,2,1/
c
c   ***** START UP *****
c   *                               *
c   Get the backslash the hard way - end of line on some systems.
hsymb(1,7)=char(92)
hparm(7,3)(3:3)=char(92)
hparm(7,3)(9:9)=char(92)
hparm(7,10)(3:3)=char(92)
hparm(7,10)(8:8)=char(92)
write(hpatf(10),10)
10 format(42h39h   3 hdpth/'/usr/local/udata/mcnp'/,)
c
c   Initialize the default system.
isys=1
hoptn(idef(1,1,isys),3,1,1)='on'
do 20 i=1,nsec
do 20 j=1,neps(i)
20 ichk(j,i)=0
c
c   Set up the default main menu.
30 do 50 i=1,nsec
do 50 j=1,neps(i)
n=idef(j,i,isys)
do 40 k=1,ncol-1
40 hmenu(k,j,i)=hoptn(n,k,j,i)
hmenu(ncol,j,i)=' '
if(ipar(1,n,j,i).ne.0)hmenu(ncol,j,i)=hparm(isys,ipar(1,n,j,i))
if(hmenu(ncol,j,i)(18:20).ne.' ')hmenu(ncol,j,i)(18:20)='...'
50 continue
c
c >>>>> Print the main menu.
60 write(*,70)
70 format(/51h ***** MCNP SETUP MAIN MENU ,
1 29h***** ,///,34x,
2 38hKEYWORD(S) STATUS PARAMETER(S))
do 110 i=1,nsec
write(*,80)htitl(i)
80 format(1x,a79)

```

```

do 100 j=1,neps(i)
  l=leng(hmenu(2,j,i))
  write(hc,90)11-l/2,1,11-l+1/2
90 format(27h(4h  (,i1,1h.,i1,2h) ,a19.,,i2,3hx,a,i2,1h.,i2,
  1 12hx,a5,5x,a20))
100 write(*,hc)i,j,(hmenu(k,j,i),k=1,ncol)
110 write(*,'(1h )')
  write(*,120)
120 format(49h Enter section number to change [1.1], (P)rocess,,
  1 11h or (Q)uit:)
  read(*,'(a)')h
  if(index('Qq',h(1:1)).eq.0)go to 125
  write(*,122)
122 format(/47h WARNING. Do you really want to abort the MCNP,
  1 29h installation? [N]o or (Y)es:)
  read(*,'(a)')h
  if(index('Yy',h(1:1)).ne.0)go to 1130
  go to 60
125 if(index('Pp',h(1:1)).ne.0)go to 480
c
c   Check the selected entry.
  ns=1
  ne=1
  if(h.eq.' ')go to 150
  if(h(2:2).ne.' ')go to 130
  ns=index('123456789',h(1:1))
  ne=index('123456789',h(3:3))
  if(ns.eq.0.or.ns.gt.nsec)go to 130
  if(ne.gt.0.and.ne.le.neps(ns))go to 150
130 write(*,140)
140 format(/41h ILLEGAL OPTION. Press <CR> to continue.)
  read(*,'(a)')h
  go to 60
c
c >>>>> Modify the selected entry.
c
c   Print the options menu.
150 write(*,160)
160 format(53h ***** MCNP CHANGE OPTION MENU ,
  1 27h***** ,///,7h OPTION,27x,
  2 38hKEYWORD(S)  STATUS  PARAMETER(S))

```

```

n=isys
do 180 i=1,mxno
if(hoptn(i,1,ne,ns).eq.' ')go to 190
hp=' '
if(ns+ne.eq.2)n=i
if(ipar(1,i,ne,ns).ne.0)hp=hparm(n,ipar(1,i,ne,ns))
if(hp(18:20).ne.' ')hp(18:20)='...'
l=leng(hoptn(i,2,ne,ns))
write(hc,170)11-1/2,1,11-1+1/2
170 format(21h(/2h (,i2,1h),4x,a19,,i2,3hx,a,i2,1h,,i2,
1 12hx,a5,5x,a20))
180 write(*,hc)i,(hoptn(i,k,ne,ns),k=1,ncol-1),hp
i=mxno+1
190 write(*,200)idef(ne,ns,isys)
200 format(/30h Enter desired option number [,i2,14h] or (C)ancel:)
read(*,'(a)')h
if(index('Cc',h(1:1)).ne.0)go to 30

```

c

c Check the selected option.

```

no=idef(ne,ns,isys)
if(h(1:1).eq.' ')go to 230
if(h(2:2).eq.' ')read(h(1:1),'(i1)',err=210)no
if(h(2:2).ne.' ')read(h(1:2),'(i2)',err=210)no
if(no.gt.0.and.no.lt.i)go to 230
210 write(*,220)
220 format(/41h ILLEGAL OPTION. Press <CR> to continue.)
read(*,'(a)')h
go to 150
230 if(ns+ne.ne.2)go to 250
if(no.eq.isys)go to 30

```

c

c If a new system is chosen, reset the check option flags.

```

hoptn(idef(1,1,isys),3,1,1)='off'
isys=no
hoptn(idef(1,1,isys),3,1,1)='on'
do 240 i=1,nsec
do 240 j=1,neps(i)
240 ichk(j,i)=0
go to 30

```

c

c Check for system consistency and update the main menu.

```

250 do 280 i=1,mxnu
    if(iopt(1,i,isis).eq.0)go to 290
    if(ns.ne.iopt(1,i,isis).or.ne.ne.iopt(2,i,isis).or.
1 no.ne.iopt(3,i,isis))go to 280
    hc=hmesg(abs(iopt(4,i,isis)))
    hp=hmenu(1,1,1)
    write(*,260)hc(1:leng(hc)),hp(1:leng(hp))
260 format(/1h ,a,1x,a,8h system.)
    write(*,270)
270 format(/24h Press <CR> to continue.)
    read(*,'(a)')h
    if(iopt(4,i,isis).lt.0)go to 290
    go to 150
280 continue
290 idef(ne,ns,isis)=no
    ichk(ne,ns)=1
    if(ipar(1,no,ne,ns).eq.0)go to 30

```

c

c Print parameters associated with this option.

```

300 do 330 i=1,3
    if(ipar(i,no,ne,ns).eq.0)go to 340
    n=ipar(i,no,ne,ns)
    hc=hmesg(ipms(n))
    write(*,310)i,hparm(isis,n),hc(1:leng(hc))
310 format(/28h Default value of parameter ,i1,1h:,//1h ,a,//1h ,a)
    read(*,'(a)')hc
    ha=hc(1:40)
    if(hc(41:len(hc)).eq.' ')go to 330
    write(*,320)hparm(isis,n)
320 format(/53h FATAL. Input exceeds 40 characters - current value:,
1 //1h ,a,//30h Enter [R]etype or (C)ontinue:)
    go to 470
330 if(ha.ne.' ')hparm(isis,n)=ha

```

c

c Verify the option parameters.

```

340 hb=hparm(isis,n)
    go to(30,350,30,390,400,390,390,390,410,30,420)n
350 hparm(isis,n)='mdas=4000000'
    hc=hb
    do 360 i=1,leng(hb)
360 if(index('1234567890-+',hb(i:i)).ne.0)go to 370

```



```
go to 450
370 hfmt = '(i9)'
    l = index(hb(1:len(hb)), ' ') - 1
    if(l.lt.0) l = len(hb) - i + 1
    if(l.ge.10) go to 450
    write(hfmt(3:3), '(i1)') l
    read(hb(i:i+1-1), hfmt, err = 450) m
    if(m.le.0) go to 450
    write(hparm(isys, n), '(5hmdas = ,i10)') m
    if(m.ge.100000.and.m.le.800000) go to 30
    write(*, 380) hparm(isys, n)
380 format(/54h WARNING. MDAS parameter appears incorrect - current ,
    1 6hvalue: ,//1h ,a25, //30h Enter [R]etyp e or (C)ontinue:)
    go to 470
390 hc = hparm(isys, 3)
    ha = hc(1:leng(hc)) // hsymb(1, isys)(1:1)
    if(isys.eq.5) ha = hc(1:leng(hc))
    m = index(hb, ',')
    if(m.eq.0) m = index(hb(1:leng(hb)), ' ')
    if(m.gt.0) hb(m:leng(hb)) = ' '
    go to 430
400 ha = hb(1:leng(hb)) // hsymb(1, isys)(1:1)
    if(isys.eq.5) ha = hb(1:leng(hb))
    hb = 'X11' // hsymb(1, isys)(1:1) // 'Xlib.h'
    if(isys.eq.5) hb = 'Xlib.h'
    go to 430
410 ha = hb(1:leng(hb)) // hsymb(1, isys)(1:1)
    if(isys.eq.5) ha = hb(1:leng(hb))
    hb = 'xmdir'
    go to 430
420 ha = hparm(isys, 11)(1:leng(hparm(isys, 11))) // hsymb(1, isys)(1:1)
    if(isys.eq.5) ha = hparm(isys, 11)(1:leng(hparm(isys, 11)))
    m = index(hb, ',')
    if(m.eq.0) m = index(hb(1:leng(hb)), ' ')
    if(m.gt.0) hb(m:leng(hb)) = ' '
430 hc = ha(1:leng(ha)) // hb(1:leng(hb))
    inquire(file = hc(1:leng(hc)), exist = lv)
    if(.not.lv.and.hb.eq.'xmdir') inquire(file = hb(1:leng(hb)), exist = lv)
    if(.not.lv) go to 450
440 if(n.ne.5) go to 30
    n = 4
```

```

    go to 340
c
c   Recover from an invalid input.
450 write(*,460)hc(1:leng(hc))
460 format(/54h FATAL. Error verifying parameter(s) - current value:,
    1 //1h ,a,//30h Enter [R]etype or (C)ontinue:)
470 read(*,'(a)')h
    if(h.eq.' '.or.index('Rr',h(1:1)).ne.0)go to 300
    if(index('Cc',h(1:1)).ne.0)go to 440
    go to 450
c
c >>>>> Process the main menu data into system files.
c
c   Check parameters that haven't been altered.
480 write(*,490)
490 format(/32h Verifying option parameters ...)
    if(hmenu(3,1,3).eq.'off'.and.hmenu(3,2,3).eq.'off')ichk(3,3)=1
    do 690 ns=1,nsec
    do 690 ne=1,neps(ns)
    if(ne+ns.eq.2.or.ichk(ne,ns).ne.0)go to 690
    no=idef(ne,ns,isys)
    if(ipar(1,no,ne,ns).eq.0)go to 690
    ic=0
c
c   If necessary, print parameters associated with this option.
500 do 540 i=1,3
    if(ipar(i,no,ne,ns).eq.0)go to 550
    n=ipar(i,no,ne,ns)
    if(ic.eq.0)go to 540
    hc=hmesg(ipms(n))
    write(*,510)i,hparm(isys,n),hc(1:leng(hc))
510 format(/28h Default value of parameter ,i1,1h:,//1h ,a,//1h ,a)
    read(*,'(a)')hc
    ha=hc(1:40)
    if(hc(41:len(hc)).eq.' ')go to 530
    write(*,520)hparm(isys,n)
520 format(/53h FATAL. Input exceeds 40 characters - current value:,
    1 //1h ,a,//44h Enter [R]etypе, (C)ontinue, or (M)ain menu:)
    go to 680
530 if(ha.ne.' ')hparm(isys,n)=ha
540 continue

```

- c  
c Verify the option parameters.

```

550 hb = hparm(isys,n)
      go to(690,560,690,600,610,600,600,600,600,620,690,630)n
560 hparm(isys,n) = 'mdas=4000000'
      hc = hb
      do 570 i = 1, leng(hb)
570 if(index('1234567890-+',hb(i:i)).ne.0)go to 580
      go to 660
580 hfmt = '(i9)'
      l = index(hb(i:len(hb)),')'-1
      if(l.lt.0)l = len(hb)-i+1
      if(l.ge.10)go to 660
      write(hfmt(3:3),'(i1)')l
      read(hb(i:i+1-1),hfmt,err = 660)m
      if(m.le.0)go to 660
      write(hparm(isys,n),'(5hmdas = ,i10)')m
      if(m.ge.100000.and.m.le.800000)go to 690
      write(*,590)hparm(isys,n)
590 format(/54h WARNING. MDAS parameter appears incorrect - current ,
      1 6hvalue: ,/1h ,a25,
      2 //44h Enter [R]etype, (C)ontinue, or (M)ain menu:)
      go to 680
600 hc = hparm(isys,3)
      ha = hc(1:leng(hc))/hsymb(1,isys)(1:1)
      if(isys.eq.5)ha = hc(1:leng(hc))
      m = index(hb,',')
      if(m.eq.0)m = index(hb(1:leng(hb)),')
      if(m.gt.0)hb(m:leng(hb)) = ','
      go to 640
610 ha = hb(1:leng(hb))/hsymb(1,isys)(1:1)
      if(isys.eq.5)ha = hb(1:leng(hb))
      hb = 'X11'//hsymb(1,isys)(1:1)//'Xlib.h'
      if(isys.eq.5)hb = 'Xlib.h'
      go to 640
620 ha = hb(1:leng(hb))/hsymb(1,isys)(1:1)
      if(isys.eq.5)ha = hb(1:leng(hb))
      hb = 'xmdir'
      go to 640
630 ha = hparm(isys,11)(1:leng(hparm(isys,11)))/hsymb(1,isys)(1:1)
      if(isys.eq.5)ha = hparm(isys,11)(1:leng(hparm(isys,11)))

```

```

m=index(hb,',')
if(m.eq.0)m=index(hb(1:leng(hb)), ' ')
if(m.gt.0)hb(m:leng(hb))=' '
640 hc=ha(1:leng(ha))/hb(1:leng(hb))
inquire(file=hc(1:leng(hc)),exist=lv)
if(.not.lv.and.hb.eq.'xmdir')inquire(file=hb(1:leng(hb)),exist=lv)
if(.not.lv)go to 660
650 if(n.ne.5)ichk(ne,ns)=1
if(n.ne.5)go to 690
n=4
go to 550
c
c Recover from an invalid input.
660 write(*,670)hc(1:leng(hc))
670 format(/54h FATAL. Error verifying parameter(s) - current value:,
1 //1h ,a,//44h Enter [R]etype, (C)ontinue, or (M)ain menu:)
680 read(*,'(a)')h
ic=1
if(h.eq.' '.or.index('Rr',h(1:1)).ne.0)go to 500
if(index('Cc',h(1:1)).ne.0)go to 650
if(index('Mm',h(1:1)).ne.0)go to 30
go to 660
690 continue
c
c Create new lines for internal changes.
write(*,700)
700 format(/25h Writing system files ...)
do 850 i=1,mxnf
if(ifix(1,i,isys).eq.0)go to 850
go to(710,730,760,780,790,800,710)i
c
c Create the PATCHC and PATCHF *define line.
710 hd='*define'
if(hmenu(3,1,3).eq.'off'.and.hmenu(3,2,3).eq.'off')
1 hmenu(3,3,3)='off'
do 720 j=1,nsec
do 720 k=1,neps(j)
hf=hd
720 if(hmenu(2,k,j).ne.'*****'.and.hmenu(3,k,j).eq.'on')
1 hd=hf(1:leng(hf))//', '//hmenu(2,k,j)
hd(8:8)=' '

```

```
    go to 850
c
c   Create the PATCHF mdas= line.
730 hd= ' '
    if(idef(3,2,sys).ne.2)go to 850
    hf=hparm(sys,ipar(1,idef(3,2,sys),3,2))
    do 740 j=1,leng(hf)
740 if(index('1234567890',hf(j:j)).ne.0)go to 750
    j=1
    hf='4000000'
750 hd= '   parameter (mdas='//hf(j:leng(hf))//')'
    go to 850
c
c   Create the PATCHF DATAPATH line.
760 hd= ' '
    hf=hparm(sys,ipar(1,idef(1,4,sys),1,4))
    if(hf.eq.' ')go to 850
    write(h,770)
770 format(3h'/',)
    hd= '   3 hpath'//h(1:1)//hf(1:leng(hf))//h
    go to 850
c
c   Alter the MAKEMCNP.SYS C compile line.
780 hd= ' '
    if(idef(3,3,sys).ne.1)go to 850
    hf=hparm(sys,ipar(3,idef(3,3,sys),3,3))
    hd=hsymb(2,sys)(1:3)//hf(1:leng(hf))
    go to 850
c
c   Alter the MAKEMCNP.SYS FORTRAN compile line.
790 hd= ' '
    if(sys.eq.2.and.idef(3,2,sys).eq.1)hd= ' -O2'
    go to 850
c
c   Alter the MAKEMCNP.SYS FORTRAN link line.
c   Add the graphics and PVM libraries, if requested.
800 hd= ' '
    do 840 k=1,2
    if(k.eq.1.and.hmenu(3,3,3).eq.'off')go to 840
    if(k.eq.2.and.idef(1,5,sys).ne.2)go to 840
    ne=5-2*k
```

```

ns = 2*k + 1
ha = hparm(isys, ipar(1, idef(ne, ns, isys), ne, ns))
if(ha.eq. ' ') go to 840
hb = hparm(isys, ipar(2, idef(ne, ns, isys), ne, ns))
if(hb.eq. ' ') go to 840
hc = ' '
j = 1

```

- c c Loop over all libraries listed on this parameter.

```

810 l = index(hb(j:leng(hb)), ' ')
if(l.eq.0) l = leng(hb) - j + 2
m = index(hb(j:leng(hb)), ':')
if(m.eq.0) m = leng(hb) - j + 2
n = min(l-1, m-1) + j - 1
if(isys.ne.5.and.isys.ne.7) j = j + 3
if(hc.ne. ' ') go to 820
hc = hsymb(4, isys)(1:3)//hb(j:n)
if(isys.eq.5) hc = hb(j:n)//hsymb(4, isys)(1:2)
if(isys.eq.7) hc = hsymb(4, isys)(1:4)//hb(j:n)
go to 830
820 if(isys.ne.5.and.isys.ne.7) hc = hc(1:leng(hc))//hsymb(4, isys)(1:3)
1 //hb(j:n)
if(isys.eq.5) hc = hc(1:leng(hc))//', '//hb(j:n)//hsymb(4, isys)(1:2)
if(isys.eq.7) hc = hc(1:leng(hc))//hsymb(4, isys)(1:4)//hb(j:n)
830 j = n + 1
if(l.lt.m) j = j + m + 1 - l
if(j.lt.leng(hb)) go to 810

```

- c c Combine the library paths and libraries.

```

j = 3
if(isys.eq.5) j = 1
if(isys.eq.7) j = 7
if(k.eq.1) hd = hsymb(3, isys)(1:j)//ha(1:leng(ha))//hc(1:leng(hc))
if(k.ne.1) hd = hd(1:leng(hd))//hsymb(3, isys)(1:j)//ha(1:leng(ha))
1 //hc(1:leng(hc))
840 continue
850 hfixs(i) = hd
c c Write the changes to an internal fix file.
c open(ius, status = 'scratch')
do 870 i = 1, mxnf

```

```
if(ifix(1,i,isys).eq.0)go to 870
write(ius,860)(ifix(j,i,isys),j=1,4)
860 format(4i5)
write(ius,'(a)')hfixs(i)
870 continue
```

c

c Add the external fix file if it exists.

```
inquire(file='install.fix',exist=lv)
if(.not.lv)go to 960
open(iuf,file='install.fix',status='old')
rewind(iuf)
880 read(iuf,'(a)',end=950)hd
if(hd.eq.' '.or.index('Cc',hd(1:1)).ne.0)go to 880
n=1
do 910 i=1,5
do 890 j=n,leng(hd)
890 if(index('0123456789+-',hd(j:j)).ne.0)go to 900
if(i.ne.5.or.ib(4).gt.2)go to 930
ib(5)=0
go to 910
900 hfmt='(i9)'
m=index(hd(j:len(hd)),')'-1
if(m.lt.0)m=len(hd)-j+1
if(m.ge.10)go to 930
write(hfmt(3:3),'(i1)')m
read(hd(j:j+m-1),hfmt,err=930)ib(i)
if(ib(i).lt.ifxl(1,i).or.ib(i).gt.ifxl(2,i))go to 930
910 n=j+m+1
if(ib(1).eq.0.or.ib(1).eq.isys)write(ius,860)(ib(k),k=2,5)
if(ib(4).eq.3)ib(5)=1
if(ib(4).eq.4)go to 880
if(ib(5).eq.0)ib(5)=1000000
do 920 i=1,ib(5)
read(iuf,'(a)',end=930)hd
if(ib(1).eq.0.or.ib(1).eq.isys)write(ius,'(a)')hd(1:leng(hd))
920 if(ib(5).eq.1000000.and.hd.eq.' ')go to 880
go to 880
930 if(ib(5).eq.1000000)go to 950
write(*,940)
940 format(/51h FATAL. Format error while reading the INSTALL.FIX,
1 6h file.)
```

```
    go to 1130
950 close(iuf)
c
c    Write the system files.
960 do 1050 i=1,3
    open(iuo,file=hname(isys,i),status='unknown')
    id=0
    do 1045 j=1,mxnl
    if(j.le.id)go to 1045
    if(i.eq.1)hd=hpatf(j)
    if(i.eq.2)hd=hmake(j,isys)
    if(i.eq.3)hd=hpatc(j)
    if(hd.eq.' ')go to 1050
    rewind(ius)
970 read(ius,860,end=1040)(ib(k),k=1,4)
    m=ib(3)
    if(ib(1).ne.i.or.ib(2).ne.j)m=0
    if(ib(3).lt.3.and.ib(4).eq.0)ib(4)=1000000
    go to(980,1000,1000,1020,1035)m+1
c
c    m=0 Wrong system or line number.
980 if(ib(3).eq.3)ib(4)=1
    if(ib(3).eq.4)go to 970
    do 990 k=1,ib(4)
    read(ius,'(a)',end=1040)hf
990 if(ib(4).eq.1000000.and.hf.eq.' ')go to 970
    go to 970
c
c    m=1,2 Insert lines or replace a line.
1000 do 1010 k=1,ib(4)
    read(ius,'(a)',end=1016)hf
    if(hf.eq.' ')go to 1010
    if(m.eq.2)hd=hf
    write(iuo,'(a)')hf(1:leng(hf))
1010 if(ib(4).eq.1000000.and.hf.eq.' ')go to 1014
    if(hf.eq.' ')go to 970
1014 if(m.eq.2)backspace(iuo)
    go to 970
1016 if(m.eq.2)backspace(iuo)
    go to 1040
```

c



```
c      m=3 Alter a line.
1020 read(ius,'(a)')hc
      if(hc.eq.' ')go to 970
      l=0
      do 1030 k=1,ib(4)
      l=min(l+1,leng(hd)+1)
1030 l=l+index(hd(1:leng(hd)+1),' ')-1
      if(ib(4).eq.0)hf=hc(1:leng(hc)+1)//hd(1:leng(hd))
      if(ib(4).ne.0)hf=hd(1:l-1)//hc(1:leng(hc))//
      l hd(min(l,leng(hd)+1):leng(hd)+1)
      hd=hf
      go to 970
```

```
c
c      m=4 Delete line(s).
1035 id=ib(4)
      go to 1045
1040 write(iuo,'(a)')hd(1:leng(hd))
1045 continue
1050 close(iuo)
```

```
c
c      Setup complete - write the answer file.
open(iuw,file='install.ans',status='unknown')
do 1110 ns=1,nsec
do 1110 ne=1,neps(ns)
write(iuw,'(i1,1h.,i1)')ns,ne
no=idef(ne,ns,isys)
if(no.lt.10)write(iuw,'(i1)')no
if(no.ge.10)write(iuw,'(i2)')no
if(ns+ne.eq.2)go to 1110
do 1060 i=1,mxnu
if(ns.ne.iopt(1,i,isys).or.ne.ne.iopt(2,i,isys).or.
1 no.ne.iopt(3,i,isys))go to 1060
write(iuw,'(1h)')
go to 1070
1060 continue
1070 do 1100 i=1,3
      n=ipar(i,no,ne,ns)
      if(n.eq.0)go to 1110
      write(iuw,'(a)')hparm(isys,n)
      if(n.ne.2)go to 1100
      hb=hparm(isys,n)
```

```

do 1080 j=1,len(hb)
1080 if(index('1234567890-+',hb(j:j)).ne.0)go to 1090
1090 hfmt='(i9)'
    l=index(hb(j:len(hb)),'-')-1
    if(l.lt.0)l=len(hb)-j+1
    write(hfmt(3:3),'(i1)')l
    read(hb(j:j+1-1),hfmt)m
    if(m.lt.100000.or.m.gt.8000000)write(iuw,'(1hc)')
1100 continue
1110 continue
    write(iuw,'(1hp)')
    write(*,1120)
1120 format(/16h Setup complete.)
1130 stop
    end
    function leng(h)
    character h*(*)
    do 10 leng=len(h),1,-1
10 if(h(leng:leng).ne.' ')return
    return
    end

```

Fsplit.for file for PC desktop computer

C Last change: JAM 5 Jan 98 11:05 am  
program fsplit

c

c fsplit separates a large fortran program into sections  
c incrementing the file name, respectively.

c

```

CHARACTER*80 card, blk
CHARACTER*9 outfil
CHARACTER*10 subnam
CHARACTER*6 NAME(5)

```

c

```

DATA outfil //'mcnp0.for'/
DATA name  /'xact ', 'kcalc ', 3* '  '/
DATA subnam /'subroutine'/
data blk  /'          '/

```

c

```

open (UNIT=15,FILE='compile',ACCESS='sequential', STATUS='old')

```

```
nfil = 1
write (outfil(5:5),'(i1)') nfil
open (UNIT=16,FILE=outfil,ACCESS='sequential',STATUS='new')
10 continue
read (UNIT=15,FMT=2001,END=1001) card
15 continue
IF (card .EQ. blnk) GO TO 1001
if (card(7:16) .ne. subnam) then
write (UNIT=16, FMT=2001) card
else
do 20 i = 1,5
if (card(18:23) .eq. NAME(i)) then
close (UNIT=16, STATUS='keep')
nfil = nfil + 1
write (outfil(5:5),'(i1)') nfil
open (UNIT=16,FILE=outfil,ACCESS='sequential',STATUS='new')
GO TO 25
end if
20 continue
25 write (UNIT=16, FMT=2001) card
end if
go to 10
c
1001 continue
close (UNIT=15,STATUS='keep')
close (UNIT=16,STATUS='keep')
c
2001 FORMAT (a80)
end program
```

**"ANSWER.std" file for PC desktop MCNP4B installation**

```
1.1
7
2.1
2
2.2
1
2.3
2
mdas= 4000000
```

3.1  
1  
3.2  
1  
3.3  
5  
c:\f9035\lib  
lf90.lib  
4.1  
1  
d:\mcp4b  
4.2  
2  
5.1  
1  
P

**"ANSWER.x" file for PC desktop MCNP4B installation**

1.1  
7  
2.1  
2  
2.2  
1  
2.3  
2  
mdas= 9600000  
c  
3.1  
1  
3.2  
1  
3.3  
5  
c:\f9035\lib  
lf90.lib  
4.1  
1  
d:\mcp4b  
4.2

2  
5.1  
1  
P

### **Attachment III: MCNP4B2 Directory And File Listing**

The following files are required for execution of the MCNP4B2 code system. These have been placed under the control of the appropriate systems administrator to provide write protection for these files.

#### **HP Workstations**

**MCNP4B2** - MCNP executable version 4B2 for the HP 9000 series workstations, 1458176 bytes, created on 03/30/98, located in the directory /opt/neut/MCNP4B.

#### **SUN Ultra-2 Workstation**

**MCNP4B2** - MCNP executable version 4B2 for the SUN Ultra-2 workstation, 2104584 bytes, created on 03/30/98, located in the directory /usr2/mcnp4b.

#### **PC's**

**MCNP4B2.EXE** - MCNP executable version 4B2 for the PC desktop computer, 18,130,471 bytes, 04/01/98

#### **PC's**

**MCNP4B2x.EXE** - MCNP executable version 4B2x for the PC desktop computer, 40,531,471 bytes, 04/01/98

**HP 9000 DIRECTORY LISTING**

This attachment contains actual listing of the MCNP4B2 executable and library files contained in subdirectories /opt/neut/MCNP4B and /opt/neut/MCNP4B/xslib on the QUICHE HP 9000 workstation. The list is created by invoking the Unix command "ls -la". These files were created during the installation process. Upon approval of this SQR all files other than those controlled by the systems administrator and selected test case input files will be removed after they have been electronically archived. This is done to conserve storage on the workstation.

**Directory listing of /opt/neut/MCNP4B**

```
total 5736
drwxr-xr-x  4 root    sys      1024 Mar 30 09:54 .
drwxr-xr-x 11 root    root     1024 Nov 25 15:20 ..
-rwxr-xr-x  1 root    sys     1458176 Dec 19 16:11 mcnp
drwxr-xr-x  7 root    sys      1024 May 21 1997 mcnp.Unix
-rwxr-xr-x  1 root    sys     1458176 Mar 30 09:54 mcnp4b2
drwxr-xr-x  2 root    sys      1024 Dec 17 16:29 xslib
```

**Directory listing of /opt/neut/MCNP4B/xslib**

```
total 189492
drwxr-xr-x  2 root    sys      1024 Dec 17 16:29 .
drwxr-xr-x  4 root    sys      1024 Dec 19 17:01 ..
-rw-r--r--  1 root    sys    3590144 Dec 17 16:18 100xs2
-rw-r--r--  1 root    sys    305152 Dec 17 16:21 531dos2
-rw-r--r--  1 root    sys    874496 Dec 17 16:21 532dos2
-rw-r--r--  1 root    sys    2680832 Dec 17 16:21 dre52
-rw-r--r--  1 root    sys    5093376 Dec 17 16:20 drmccs2
-rw-r--r--  1 root    sys     770048 Dec 17 16:21 e12
-rw-r--r--  1 root    sys    2846720 Dec 17 16:19 endf5mt2
-rw-r--r--  1 root    sys    5736448 Dec 17 16:16 endf5p2
-rw-r--r--  1 root    sys    5937152 Dec 17 16:17 endf5u2
-rw-r--r--  1 root    sys    36685824 Dec 17 16:14 endf602
-rw-r--r--  1 root    sys    5859328 Dec 17 16:19 endl852
-rw-r--r--  1 root    sys    1259520 Dec 17 16:17 kidman2
-rw-r--r--  1 root    sys    1687552 Dec 17 16:21 l1ldos2
-rw-r--r--  1 root    sys     577536 Dec 17 16:21 mcplib022
-rw-r--r--  1 root    sys     440320 Dec 17 16:21 mcplib2
-rw-r--r--  1 root    sys    1628160 Dec 17 16:21 mgxsnp2
-rw-r--r--  1 root    sys    3840000 Dec 17 16:17 misc5xs2
-rw-r--r--  1 root    sys    1812480 Dec 17 16:14 newxs2
-rw-r--r--  1 root    sys     716800 Dec 17 16:19 newxsd2
-rw-r--r--  1 root    sys     8196096 Dec 17 16:15 rmccs2
```

-rw-r--r--	1 root	sys	3532800	Dec 17 16:15	rmccsa2
-rw-r--r--	1 root	sys	90112	Dec 17 16:21	therxs2
-rw-r--r--	1 root	sys	2416640	Dec 17 16:21	tmccs2
-rw-r--r--	1 root	sys	146966	Dec 19 17:03	xmdir



**SUN Ultra-2 DIRECTORY LISTING**

This attachment contains actual listing of the MCNP4B2 executable and library files contained in subdirectories /usr2/mcnp4b and /usr2/mcnp4b/xslib on the OTIS SUN Ultra-2 workstation. The list is created by invoking the Unix command "ls -la". These files were created during the installation process. Upon approval of this SQR all files other than those controlled by the systems administrator and selected test case input files will be removed after they have been electronically archived. This is done to conserve storage on the workstation.

**Directory listing of /usr2/mcnp4b**

```
total 6024
drwxr-xr-x  3 goluoglu users      512 Mar 31 15:25 ./
drwxr-xr-x  4 root      root      512 Feb 13 16:07 ../
-r--r--r--  1 goluoglu users    304084 Mar 30 13:34 libF77.so.3
-r--r--r--  1 goluoglu users    637768 Mar 30 13:32 libsunmath.so.1
lrwxrwxrwx  1 goluoglu users         7 Mar 30 13:33 mcnp -> mcnp4b2*
-r-xr-xr-x  1 goluoglu users   2104584 Mar 30 13:32 mcnp4b2*
drwxr-xr-x  2 root      sys      1024 Jan 14 10:34 xslib/
```

**Directory Listing of /usr2/mcnp4b/xslib**

```
total 190096
drwxr-xr-x  2 root      sys      1024 Jan 14 10:34 ./
drwxr-xr-x  3 goluoglu users      512 Mar 31 15:26 ../
-rwxr-xr-x  1 root      sys     3590144 Jan 14 10:03 100xs2*
-rwxr-xr-x  1 root      sys     305152 Jan 14 10:03 531dos2*
-rwxr-xr-x  1 root      sys     874496 Jan 14 10:03 532dos2*
-rwxr-xr-x  1 root      sys      9265 Jan 14 10:34 README*
-rwxr-xr-x  1 root      sys     20759 Jan 14 10:34 README_ENDF60*
-rwxr-xr-x  1 root      sys    2680832 Jan 14 10:04 dre52*
-rwxr-xr-x  1 root      sys    5093376 Jan 14 10:05 drmcgs2*
-rwxr-xr-x  1 root      sys     770048 Jan 14 10:05 el2*
-rwxr-xr-x  1 root      sys    2846720 Jan 14 10:06 endf5mt2*
-rwxr-xr-x  1 root      sys    5736448 Jan 14 10:07 endf5p2*
-rwxr-xr-x  1 root      sys    5937152 Jan 14 10:09 endf5u2*
-rwxr-xr-x  1 root      sys   36685824 Jan 14 10:22 endf602*
-rwxr-xr-x  1 root      sys    5859328 Jan 14 10:24 endl852*
-rwxr-xr-x  1 root      sys    1259520 Jan 14 10:24 kidman2*
-rwxr-xr-x  1 root      sys    1687552 Jan 14 10:25 lll1dos2*
-rwxr-xr-x  1 root      sys     577536 Jan 14 10:25 mcplib022*
-rwxr-xr-x  1 root      sys     440320 Jan 14 10:26 mcplib2*
-rwxr-xr-x  1 root      sys    1628160 Jan 14 10:26 mgxsnp2*
-rwxr-xr-x  1 root      sys    3840000 Jan 14 10:28 misc5xs2*
```

-IWXI-XI-X	1	root	sys	1812480	Jan 14	10:29	newxs2*
-IWXI-XI-X	1	root	sys	716800	Jan 14	10:29	newxsd2*
-IWXI-XI-X	1	root	sys	8196096	Jan 14	10:32	rmccs2*
-IWXI-XI-X	1	root	sys	3532800	Jan 14	10:33	rmccsa2*
-IWXI-XI-X	1	root	sys	523	Jan 14	10:33	specs*
-IWXI-XI-X	1	root	sys	90112	Jan 14	10:33	therxs2*
-IWXI-XI-X	1	root	sys	2416640	Jan 14	10:33	tmccs2*
-IWXI-XI-X	1	root	sys	5416	Jan 14	10:34	tprint*
-IWXI-XI-X	1	root	sys	146962	Feb 13	16:14	xmdir*
-IWXI-XI-X	1	root	sys	98714	Jan 14	10:34	xmdir1.org*
-IWXI-XI-X	1	root	sys	146934	Jan 14	10:34	xmdir2*

PC DESKTOP COMPUTER DIRECTORY LISTING

This attachment contains a listing of the MCNP4B2 executable and library files contained in subdirectories d:\mcnp4b\exe and d:\mcnp4b.xc on the GATEWAY2000 P5-166 PC desktop computer. These files were created during the installation process. Upon approval of this SQR all files other than those controlled by the systems administrator and selected test case input files will be removed after they have been electronically archived. This is done to conserve storage on the computer hard drive.

Directory for MCNP4B2

Volume in drive D has no label

Volume Serial Number is 2353-07C6

Directory of D:\MCNP4B

```

README TXT      1,313 01-15-98 11:32a readme.TXT
RUNMCNP BAT      1,500 04-10-98 9:51a runmcnp.bat
RUNMCNPX BAT     1,503 04-10-98 9:49a runmcnp.x.bat
XSDIR            129,390 01-07-98 11:41a xsdir

```

Volume in drive D has no label

Volume Serial Number is 2353-07C6

Directory of D:\MCNP4B\EXE

```

.      <DIR>      01-15-98 8:37a .
..     <DIR>      01-15-98 8:37a ..

MCNP4B2 EXE     18,130,741 04-01-98 1:11p MCNP4B2.EXE
MCNP4B2X EXE    40,530,741 04-01-98 2:19p MCNP4B2X.EXE
MCNPEXE DIR      0 04-10-98 8:56a mcnpexe.dir
README TXT      1,405 01-07-98 3:16p readme.TXT
RUNMCNP BAT      1,245 02-25-98 7:09a runmcnp.bat
SPECS           893 01-07-98 8:54a Specs
TPRINT DIF       100 01-07-98 10:40a tprint.dif
XSDIR1          100,581 01-02-98 2:19p Xsdir1

```

Volume in drive D has no label

Volume Serial Number is 2353-07C6

Directory of D:\MCNP4B\Install

```

.      <DIR>      03-31-98 9:51a .
..     <DIR>      03-31-98 9:51a ..
ANSWER STD      255 04-01-98 1:03p answer.std
ANSWER          258 04-01-98 2:12p answer

```

FIX4B2 TXT	10,452	03-27-98	3:40p	fix4b2.txt
FSPLIT BAK	1,399	01-05-98	10:54a	fsplit.BAK
FSPLIT EXE	291,381	01-05-98	11:08a	FSPLIT.EXE
FSPLIT FOR	1,401	01-05-98	11:05a	fsplit.for
GETFILES	923	02-10-97	10:20a	GETFILES
INSTALL LOG	1,162,009	04-01-98	2:19p	install.log
INSTALL BAT	5,486	03-31-98	11:18a	install.bat
INSTALL FIX	10,927	04-01-98	2:09p	install.fix
INSTAL~1 STD	1,162,008	04-01-98	1:11p	install.log.std
INSTAL~2 STD	10,883	04-01-98	1:01p	install.fix.std
MAKEMCNP BAK	948	12-19-97	10:15a	Makemcnp.BAK
MAKEMCNP BAT	1,391	04-01-98	2:12p	MAKEMCNP.BAT
MAKXS ID	51,585	12-19-97	11:17a	MAKXS.ID
MAKXSF MAP	20,474	04-01-98	2:12p	MAKXSF.MAP
MAKXSF EXE	318,293	04-01-98	2:12p	MAKXSF.EXE
MAKXSI~1 ORG	51,042	12-19-97	11:13a	Makxs.id.org
MCNP4B ORG	4,067,098	02-06-97	12:49p	mcnp4b.org
MCNP4B ID	4,110,365	03-31-98	4:17p	Mcnp4b.id
MCNPC ID	66,552	02-06-97	1:19p	MCNPC.ID
MCSETUP EXE	453,733	04-01-98	2:10p	MCSETUP.EXE
MCSETUP MAP	20,281	04-01-98	2:10p	MCSETUP.MAP
MCSETUP FOR	41,937	04-01-98	2:07p	Mcsetup.for
NEWID	4,110,757	04-01-98	2:12p	NEWID
PATCHC	131	04-01-98	2:12p	PATCHC
PATCHF	7,463	04-01-98	2:12p	PATCHF
PATCHF BAK	3,393	12-19-97	2:44p	Patchf.BAK
PLOT FOR	268	01-05-98	3:11p	plot.for
PRPR EXE	518,373	04-01-98	2:12p	PRPR.EXE
PRPR ID	8,443	12-18-97	4:49p	PRPR.ID
PRPR MAP	19,596	04-01-98	2:12p	PRPR.MAP
READMAAG	13,492	02-14-97	8:23a	READMAAG
README~1 TXT	15,166	03-27-98	3:39p	readme4b2.txt

Volume in drive D has no label  
Volume Serial Number is 2353-07C6  
Directory of D:\mcnp4b.xc

```

.<DIR> 01-15-98 8:37a .
..<DIR> 01-15-98 8:37a ..
100XS2 3,592,192 01-07-98 10:33a 100XS2
531DOS2 307,200 01-07-98 10:36a 531DOS2
532DOS2 876,544 01-07-98 10:36a 532DOS2
DRMCCS2 5,095,424 01-07-98 10:35a DRMCCS2
EL2 774,144 01-07-98 10:36a EL2
ENDF5MT2 2,848,768 01-07-98 10:34a ENDF5MT2
ENDF5P2 5,738,496 01-07-98 10:32a ENDF5P2
ENDF5U2 5,939,200 01-07-98 10:32a ENDF5U2

```

ENDF602	36,687,872	01-07-98 10:29a	ENDF602
ENDL852	5,861,376	01-07-98 10:34a	ENDL852
KIDMAN2	1,261,568	01-07-98 10:33a	KIDMAN2
LLLDOS2	1,689,600	01-07-98 10:36a	LLLDOS2
MCPLIB2	442,368	01-07-98 10:36a	MCPLIB2
MCPLIB22	579,584	01-07-98 10:36a	MCPLIB22
MGXSNP2	1,630,208	01-07-98 10:36a	MGXSNP2
MISC5XS2	3,842,048	01-07-98 10:33a	MISC5XS2
NEWXS2	1,814,528	01-07-98 10:29a	NEWXS2
NEWXSD2	718,848	01-07-98 10:34a	NEWXSD2
RMCCS2	8,198,144	01-07-98 10:30a	RMCCS2
RMCCSA2	3,534,848	01-07-98 10:31a	RMCCSA2
THERXS2	92,160	01-07-98 10:36a	THERXS2
TMCCS2	2,418,688	01-07-98 10:36a	TMCCS2

**Attachment IV: Table of Contents of Electronic Medias MOY-980421-19 (MI: 30056-M03-001), MOY-980421-18 (MI: 30057-M03-001), and MOY-980421-20 (MI: 30055-M72-001)**

The following is a list of the files that are used during installation verification and validation and included in the corresponding data tapes. Unix tapes are created using the Unix tar command. The files can be restored by entering:

```
tar -xvf <device> mcnp4b2.SYS
```

where <device> is the device name for the backup derive and SYS is the system name (e.g., spuds, opus, otis). The restored file is also a tar file which contains all files used and created on the corresponding system. All or parts of the mcnp4b2.SYS file can be restored depending on the need of the user. If the users system is identical to one of the systems used in this SQR, the user may only copy the executable under mcnp4b/exec directory along with the cross section libraries under mcnp4b/xslib. Note that the cross section libraries on otis are under mcnp4b/exec/xslib.

**Files from OPUS on HP backup tape MOY-980421-19 (MI: 30056-M03-001)**

Verification test problems are located in mcnp4b/exec . Criticality validation test problems are located in mcnp4b/ver-val/ndf5. Criticality validation test problems are located in mcnp4b/ver-val/ndf6. Shielding validation test problems are located in mcnp4b/ver-val/shield. Coincident planes verification test problem is located in mcnp4b/ver-val/4b2fix. .

```
rwxt-xt-x 229/20      0 Mar 31 16:45 1998 ./mcnp4b/
rwxt-xt-x 229/20      0 Dec 17 11:39 1997 ./mcnp4b/INSTALL/
r-xt-xt-x 229/20     3971 Dec 17 10:46 1997 ./mcnp4b/INSTALL/INSTALL
r-xt-xt-x 229/20     4523 Dec 17 10:46 1997 ./mcnp4b/INSTALL/INSTALL.VMS
r-xt-xt-x 229/20     51042 Dec 17 10:46 1997 ./mcnp4b/INSTALL/MAXXS.ID
r-xt-xt-x 229/20    4067098 Dec 17 10:47 1997 ./mcnp4b/INSTALL/MCNP4B.ID
r-xt-xt-x 229/20     8443 Dec 17 10:47 1997 ./mcnp4b/INSTALL/PRPR.ID
r-xt-xt-x 229/20     2918 Dec 17 10:46 1997 ./mcnp4b/INSTALL/INSTALL.FIX.old
r-xt-xt-x 229/20     66552 Dec 17 10:47 1997 ./mcnp4b/INSTALL/MCNP4B.ID
r-xt-xt-x 229/20     38920 Dec 17 10:47 1997 ./mcnp4b/INSTALL/MCSETUP.FOR
r-xt-xt-x 229/20     13492 Dec 17 10:47 1997 ./mcnp4b/INSTALL/READMAAG
r-xt-xt-x 229/20      923 Dec 17 10:46 1997 ./mcnp4b/INSTALL/GETFILES
rw-r--r-- 229/20     6603 Dec 17 11:38 1997 ./mcnp4b/INSTALL/INSTALL.FIX
rwxt-xt-x 229/20      0 Mar 31 15:49 1998 ./mcnp4b/exec/
rwxt-xt-x 229/20     6070 Mar 27 14:57 1998 ./mcnp4b/exec/RUNPROB.VMS
rwxt-xt-x 229/20    235520 Mar 27 14:57 1998 ./mcnp4b/exec/TESTMCTL.AIX
rwxt-xt-x 229/20    227840 Mar 27 14:57 1998 ./mcnp4b/exec/TESTMCTL.SUN
rwxt-xt-x 229/20    290304 Mar 27 14:57 1998 ./mcnp4b/exec/TESTMCTL.VMS
rwxt-xt-x 229/20    2048000 Mar 27 14:57 1998 ./mcnp4b/exec/TESTOUTP.AIX
rwxt-xt-x 229/20    2040320 Mar 27 14:57 1998 ./mcnp4b/exec/TESTOUTP.SUN
rwxt-xt-x 229/20    2354688 Mar 27 14:57 1998 ./mcnp4b/exec/TESTOUTP.VMS
rw-rw-rw- 229/20      230 Mar 27 15:28 1998 ./mcnp4b/exec/answer
rwxt-xt-x 229/20      923 Mar 27 14:57 1998 ./mcnp4b/exec/getfiles
rwxt-xt-x 229/20     66552 Mar 27 15:25 1998 ./mcnp4b/exec/mcnp4b.id
rw-r----- 229/20    10184 Mar 27 15:09 1998 ./mcnp4b/exec/install.fix
rwxt-xt-x 229/20    4067098 Mar 27 15:27 1998 ./mcnp4b/exec/mcnp4b.id
rwxrwxrwx 229/20      0 Mar 27 15:38 1998 ./mcnp4b/exec/flib/
rw-rw-rw- 229/20    32485 Mar 27 15:28 1998 ./mcnp4b/exec/flib/abvals.f
rw-rw-rw- 229/20    42851 Mar 27 15:28 1998 ./mcnp4b/exec/flib/acecas.f
```

rw-rw-rw-	229/20	35113	Mar 27 15:28 1998	./mcp4b/exec/flib/acecol.f
rw-rw-rw-	229/20	23506	Mar 27 15:28 1998	./mcp4b/exec/flib/acecos.f
rw-rw-rw-	229/20	26353	Mar 27 15:28 1998	./mcp4b/exec/flib/acecs6.f
rw-rw-rw-	229/20	24601	Mar 27 15:28 1998	./mcp4b/exec/flib/acefcn.f
rw-rw-rw-	229/20	24163	Mar 27 15:28 1998	./mcp4b/exec/flib/acefpt.f
rw-rw-rw-	229/20	38471	Mar 27 15:28 1998	./mcp4b/exec/flib/acegam.f
rw-rw-rw-	229/20	22265	Mar 27 15:28 1998	./mcp4b/exec/flib/acenu.f
rw-rw-rw-	229/20	23798	Mar 27 15:28 1998	./mcp4b/exec/flib/acetbl.f
rw-rw-rw-	229/20	34091	Mar 27 15:28 1998	./mcp4b/exec/flib/acetot.f
rw-rw-rw-	229/20	37084	Mar 27 15:28 1998	./mcp4b/exec/flib/action.f
rw-rw-rw-	229/20	29127	Mar 27 15:28 1998	./mcp4b/exec/flib/addtfc.f
rw-rw-rw-	229/20	21681	Mar 27 15:28 1998	./mcp4b/exec/flib/advijsk.f
rw-rw-rw-	229/20	28178	Mar 27 15:28 1998	./mcp4b/exec/flib/amatrx.f
rw-rw-rw-	229/20	29419	Mar 27 15:28 1998	./mcp4b/exec/flib/angl.f
rw-rw-rw-	229/20	1679	Mar 27 15:28 1998	./mcp4b/exec/flib/arbobv.f
rw-rw-rw-	229/20	33580	Mar 27 15:28 1998	./mcp4b/exec/flib/axis.f
rw-rw-rw-	229/20	26353	Mar 27 15:28 1998	./mcp4b/exec/flib/axlabl.f
rw-rw-rw-	229/20	22630	Mar 27 15:28 1998	./mcp4b/exec/flib/backup.f
rw-rw-rw-	229/20	29492	Mar 27 15:28 1998	./mcp4b/exec/flib/bankit.f
rw-rw-rw-	229/20	23506	Mar 27 15:28 1998	./mcp4b/exec/flib/barplt.f
rw-rw-rw-	229/20	21389	Mar 27 15:28 1998	./mcp4b/exec/flib/begone.f
rw-rw-rw-	229/20	34018	Mar 27 15:28 1998	./mcp4b/exec/flib/binlin.f
rw-rw-rw-	229/20	26353	Mar 27 15:28 1998	./mcp4b/exec/flib/binval.f
rw-rw-rw-	229/20	11607	Mar 27 15:28 1998	./mcp4b/exec/flib/blkdat.f
rw-rw-rw-	229/20	28397	Mar 27 15:28 1998	./mcp4b/exec/flib/brang.f
rw-rw-rw-	229/20	29054	Mar 27 15:28 1998	./mcp4b/exec/flib/brem.f
rw-rw-rw-	229/20	33872	Mar 27 15:28 1998	./mcp4b/exec/flib/brems.f
rw-rw-rw-	229/20	23871	Mar 27 15:28 1998	./mcp4b/exec/flib/broadn.f
rw-rw-rw-	229/20	49056	Mar 27 15:28 1998	./mcp4b/exec/flib/calcps.f
rw-rw-rw-	229/20	35770	Mar 27 15:28 1998	./mcp4b/exec/flib/calcva.f
rw-rw-rw-	229/20	36938	Mar 27 15:28 1998	./mcp4b/exec/flib/celnbr.f
rw-rw-rw-	229/20	29054	Mar 27 15:28 1998	./mcp4b/exec/flib/celpar.f
rw-rw-rw-	229/20	41756	Mar 27 15:28 1998	./mcp4b/exec/flib/celsrf.f
rw-rw-rw-	229/20	46136	Mar 27 15:28 1998	./mcp4b/exec/flib/chekcs.f
rw-rw-rw-	229/20	83950	Mar 27 15:28 1998	./mcp4b/exec/flib/chekit.f
rw-rw-rw-	229/20	1168	Mar 27 15:28 1998	./mcp4b/exec/flib/chgmem.f
rw-rw-rw-	229/20	30879	Mar 27 15:28 1998	./mcp4b/exec/flib/chkcel.f
rw-rw-rw-	229/20	28324	Mar 27 15:28 1998	./mcp4b/exec/flib/chkprb.f
rw-rw-rw-	229/20	25915	Mar 27 15:28 1998	./mcp4b/exec/flib/chksrc.f
rw-rw-rw-	229/20	51684	Mar 27 15:28 1998	./mcp4b/exec/flib/chkxss.f
rw-rw-rw-	229/20	23798	Mar 27 15:28 1998	./mcp4b/exec/flib/chqcel.f
rw-rw-rw-	229/20	949	Mar 27 15:28 1998	./mcp4b/exec/flib/chrhol.f
rw-rw-rw-	229/20	1095	Mar 27 15:28 1998	./mcp4b/exec/flib/ckchar.f
rw-rw-rw-	229/20	28105	Mar 27 15:28 1998	./mcp4b/exec/flib/colidk.f
rw-rw-rw-	229/20	36865	Mar 27 15:28 1998	./mcp4b/exec/flib/colidn.f
rw-rw-rw-	229/20	41391	Mar 27 15:28 1998	./mcp4b/exec/flib/colidp.f
rw-rw-rw-	229/20	36062	Mar 27 15:28 1998	./mcp4b/exec/flib/colinp.f
rw-rw-rw-	229/20	3577	Mar 27 15:28 1998	./mcp4b/exec/flib/confid.f
rw-rw-rw-	229/20	38106	Mar 27 15:28 1998	./mcp4b/exec/flib/contr.f
rw-rw-rw-	229/20	6132	Mar 27 15:28 1998	./mcp4b/exec/flib/covar.f
rw-rw-rw-	229/20	31901	Mar 27 15:28 1998	./mcp4b/exec/flib/cprinp.f
rw-rw-rw-	229/20	730	Mar 27 15:28 1998	./mcp4b/exec/flib/crspro.f
rw-rw-rw-	229/20	29054	Mar 27 15:28 1998	./mcp4b/exec/flib/crtcze.f
rw-rw-rw-	229/20	26937	Mar 27 15:28 1998	./mcp4b/exec/flib/dbmin.f
rw-rw-rw-	229/20	24674	Mar 27 15:28 1998	./mcp4b/exec/flib/dddet.f
rw-rw-rw-	229/20	25988	Mar 27 15:28 1998	./mcp4b/exec/flib/dddiag.f
rw-rw-rw-	229/20	22265	Mar 27 15:28 1998	./mcp4b/exec/flib/dddlev.f
rw-rw-rw-	229/20	23725	Mar 27 15:28 1998	./mcp4b/exec/flib/dosef.f
rw-rw-rw-	229/20	584	Mar 27 15:28 1998	./mcp4b/exec/flib/dotpro.f
rw-rw-rw-	229/20	25331	Mar 27 15:28 1998	./mcp4b/exec/flib/dotrc1.f
rw-rw-rw-	229/20	29711	Mar 27 15:28 1998	./mcp4b/exec/flib/dplinf.f
rw-rw-rw-	229/20	23214	Mar 27 15:28 1998	./mcp4b/exec/flib/dunlev.f
rw-rw-rw-	229/20	26353	Mar 27 15:28 1998	./mcp4b/exec/flib/dxdiag.f
rw-rw-rw-	229/20	37668	Mar 27 15:28 1998	./mcp4b/exec/flib/dxtran.f
rw-rw-rw-	229/20	24601	Mar 27 15:28 1998	./mcp4b/exec/flib/echkcl.f
rw-rw-rw-	229/20	27230	Mar 27 15:28 1998	./mcp4b/exec/flib/electr.f
rw-rw-rw-	229/20	38544	Mar 27 15:28 1998	./mcp4b/exec/flib/emaker.f
rw-rw-rw-	229/20	21754	Mar 27 15:28 1998	./mcp4b/exec/flib/entwwg.f
rw-rw-rw-	229/20	31901	Mar 27 15:28 1998	./mcp4b/exec/flib/eqpbbm.f
rw-rw-rw-	229/20	4891	Mar 27 15:28 1998	./mcp4b/exec/flib/erf2.f





FW-FW-FW	229/20	30441	Mar 27 15:28 1998	./mcp4b/exec/flib/inpert.f
FW-FW-FW	229/20	730	Mar 27 15:28 1998	./mcp4b/exec/flib/inquire.f
FW-FW-FW	229/20	38106	Mar 27 15:28 1998	./mcp4b/exec/flib/inter.f
FW-FW-FW	229/20	33507	Mar 27 15:28 1998	./mcp4b/exec/flib/intsec.f
FW-FW-FW	229/20	36938	Mar 27 15:28 1998	./mcp4b/exec/flib/ipbc.f
FW-FW-FW	229/20	23068	Mar 27 15:28 1998	./mcp4b/exec/flib/isheet.f
FW-FW-FW	229/20	3358	Mar 27 15:28 1998	./mcp4b/exec/flib/isos.f
FW-FW-FW	229/20	23871	Mar 27 15:28 1998	./mcp4b/exec/flib/isourc.f
FW-FW-FW	229/20	32047	Mar 27 15:28 1998	./mcp4b/exec/flib/issrc.f
FW-FW-FW	229/20	87892	Mar 27 15:28 1998	./mcp4b/exec/flib/italy.f
FW-FW-FW	229/20	38398	Mar 27 15:28 1998	./mcp4b/exec/flib/italpr.f
FW-FW-FW	229/20	30733	Mar 27 15:28 1998	./mcp4b/exec/flib/items.f
FW-FW-FW	229/20	30879	Mar 27 15:28 1998	./mcp4b/exec/flib/iwtwnd.f
FW-FW-FW	229/20	40734	Mar 27 15:28 1998	./mcp4b/exec/flib/ixmdir.f
FW-FW-FW	229/20	22922	Mar 27 15:28 1998	./mcp4b/exec/flib/jbin.f
FW-FW-FW	229/20	45260	Mar 27 15:28 1998	./mcp4b/exec/flib/jdecod.f
FW-FW-FW	229/20	44968	Mar 27 15:28 1998	./mcp4b/exec/flib/jsourc.f
FW-FW-FW	229/20	24236	Mar 27 15:28 1998	./mcp4b/exec/flib/jtskpt.f
FW-FW-FW	229/20	31171	Mar 27 15:28 1998	./mcp4b/exec/flib/kbatch.f
FW-FW-FW	229/20	34821	Mar 27 15:28 1998	./mcp4b/exec/flib/kcalc.f
FW-FW-FW	229/20	2336	Mar 27 15:28 1998	./mcp4b/exec/flib/kdarg.f
FW-FW-FW	229/20	2409	Mar 27 15:28 1998	./mcp4b/exec/flib/kdata.f
FW-FW-FW	229/20	3358	Mar 27 15:28 1998	./mcp4b/exec/flib/klein.f
FW-FW-FW	229/20	28470	Mar 27 15:28 1998	./mcp4b/exec/flib/knock.f
FW-FW-FW	229/20	41464	Mar 27 15:28 1998	./mcp4b/exec/flib/knorm.f
FW-FW-FW	229/20	43800	Mar 27 15:28 1998	./mcp4b/exec/flib/kprint.f
FW-FW-FW	229/20	35113	Mar 27 15:28 1998	./mcp4b/exec/flib/kskcyc.f
FW-FW-FW	229/20	23944	Mar 27 15:28 1998	./mcp4b/exec/flib/ksrctp.f
FW-FW-FW	229/20	24601	Mar 27 15:28 1998	./mcp4b/exec/flib/htable.f
FW-FW-FW	229/20	24601	Mar 27 15:28 1998	./mcp4b/exec/flib/kxray.f
FW-FW-FW	229/20	82928	Mar 27 15:28 1998	./mcp4b/exec/flib/landau.f
FW-FW-FW	229/20	51903	Mar 27 15:28 1998	./mcp4b/exec/flib/landct.f
FW-FW-FW	229/20	30952	Mar 27 15:28 1998	./mcp4b/exec/flib/latcon.f
FW-FW-FW	229/20	23433	Mar 27 15:28 1998	./mcp4b/exec/flib/lblocs.f
FW-FW-FW	229/20	657	Mar 27 15:28 1998	./mcp4b/exec/flib/leng.f
FW-FW-FW	229/20	28689	Mar 27 15:28 1998	./mcp4b/exec/flib/levcel.f
FW-FW-FW	229/20	31098	Mar 27 15:28 1998	./mcp4b/exec/flib/levchk.f
FW-FW-FW	229/20	2482	Mar 27 15:28 1998	./mcp4b/exec/flib/lgeval.f
FW-FW-FW	229/20	31317	Mar 27 15:28 1998	./mcp4b/exec/flib/likebt.f
FW-FW-FW	229/20	803	Mar 27 15:28 1998	./mcp4b/exec/flib/ljusti.f
FW-FW-FW	229/20	27667	Mar 27 15:28 1998	./mcp4b/exec/flib/mapmaz.f
FW-FW-FW	229/20	1679	Mar 27 15:28 1998	./mcp4b/exec/flib/matmpy.f
FW-FW-FW	229/20	35916	Mar 27 15:28 1998	./mcp4b/exec/flib/mcp.f
FW-FW-FW	229/20	32266	Mar 27 15:28 1998	./mcp4b/exec/flib/mcplot.f
FW-FW-FW	229/20	25915	Mar 27 15:28 1998	./mcp4b/exec/flib/mcrun.f
FW-FW-FW	229/20	40588	Mar 27 15:28 1998	./mcp4b/exec/flib/mctalr.f
FW-FW-FW	229/20	28397	Mar 27 15:28 1998	./mcp4b/exec/flib/mctalw.f
FW-FW-FW	229/20	61831	Mar 27 15:28 1998	./mcp4b/exec/flib/mdecod.f
FW-FW-FW	229/20	31974	Mar 27 15:28 1998	./mcp4b/exec/flib/mgacol.f
FW-FW-FW	229/20	36354	Mar 27 15:28 1998	./mcp4b/exec/flib/mgcoln.f
FW-FW-FW	229/20	26937	Mar 27 15:28 1998	./mcp4b/exec/flib/mgcolp.f
FW-FW-FW	229/20	39128	Mar 27 15:28 1998	./mcp4b/exec/flib/mgimps.f
FW-FW-FW	229/20	34894	Mar 27 15:28 1998	./mcp4b/exec/flib/mgxst.f
FW-FW-FW	229/20	25258	Mar 27 15:28 1998	./mcp4b/exec/flib/midpnt.f
FW-FW-FW	229/20	23068	Mar 27 15:28 1998	./mcp4b/exec/flib/movlat.f
FW-FW-FW	229/20	29127	Mar 27 15:28 1998	./mcp4b/exec/flib/mreset.f
FW-FW-FW	229/20	22630	Mar 27 15:28 1998	./mcp4b/exec/flib/namchg.f
FW-FW-FW	229/20	24163	Mar 27 15:28 1998	./mcp4b/exec/flib/namrad.f
FW-FW-FW	229/20	37522	Mar 27 15:28 1998	./mcp4b/exec/flib/newcd1.f
FW-FW-FW	229/20	36573	Mar 27 15:28 1998	./mcp4b/exec/flib/newcel.f
FW-FW-FW	229/20	50443	Mar 27 15:28 1998	./mcp4b/exec/flib/newcrd.f
FW-FW-FW	229/20	85702	Mar 27 15:28 1998	./mcp4b/exec/flib/nextit.f
FW-FW-FW	229/20	30003	Mar 27 15:28 1998	./mcp4b/exec/flib/norma.f
FW-FW-FW	229/20	31463	Mar 27 15:28 1998	./mcp4b/exec/flib/normh.f
FW-FW-FW	229/20	60371	Mar 27 15:28 1998	./mcp4b/exec/flib/nxtit1.f
FW-FW-FW	229/20	2409	Mar 27 15:28 1998	./mcp4b/exec/flib/nxtsym.f
FW-FW-FW	229/20	36865	Mar 27 15:28 1998	./mcp4b/exec/flib/oldcd1.f
FW-FW-FW	229/20	58254	Mar 27 15:28 1998	./mcp4b/exec/flib/oldcrd.f
FW-FW-FW	229/20	27083	Mar 27 15:28 1998	./mcp4b/exec/flib/output.f
FW-FW-FW	229/20	27375	Mar 27 15:28 1998	./mcp4b/exec/flib/outwgy.f

rw-rw-rw-	229/20	1241	Mar 27 15:28 1998	./mcnp4b/exec/flib/parato.f
rw-rw-rw-	229/20	27448	Mar 27 15:28 1998	./mcnp4b/exec/flib/pass1.f
rw-rw-rw-	229/20	25769	Mar 27 15:28 1998	./mcnp4b/exec/flib/photp.f
rw-rw-rw-	229/20	25769	Mar 27 15:28 1998	./mcnp4b/exec/flib/pathmz.f
rw-rw-rw-	229/20	4891	Mar 27 15:28 1998	./mcnp4b/exec/flib/pblat.f
rw-rw-rw-	229/20	23798	Mar 27 15:28 1998	./mcnp4b/exec/flib/pconst.f
rw-rw-rw-	229/20	25696	Mar 27 15:28 1998	./mcnp4b/exec/flib/pertub.f
rw-rw-rw-	229/20	25331	Mar 27 15:28 1998	./mcnp4b/exec/flib/photot.f
rw-rw-rw-	229/20	28397	Mar 27 15:28 1998	./mcnp4b/exec/flib/pieces.f
rw-rw-rw-	229/20	24893	Mar 27 15:28 1998	./mcnp4b/exec/flib/plin.f
rw-rw-rw-	229/20	29930	Mar 27 15:28 1998	./mcnp4b/exec/flib/plot2d.f
rw-rw-rw-	229/20	27886	Mar 27 15:28 1998	./mcnp4b/exec/flib/plotcn.f
rw-rw-rw-	229/20	33434	Mar 27 15:28 1998	./mcnp4b/exec/flib/plotg.f
rw-rw-rw-	229/20	31025	Mar 27 15:28 1998	./mcnp4b/exec/flib/pltdxt.f
rw-rw-rw-	229/20	26280	Mar 27 15:28 1998	./mcnp4b/exec/flib/pltit1.f
rw-rw-rw-	229/20	33361	Mar 27 15:28 1998	./mcnp4b/exec/flib/pltsrf.f
rw-rw-rw-	229/20	36938	Mar 27 15:28 1998	./mcnp4b/exec/flib/polhed.f
rw-rw-rw-	229/20	40077	Mar 27 15:28 1998	./mcnp4b/exec/flib/prhpdf.f
rw-rw-rw-	229/20	34456	Mar 27 15:28 1998	./mcnp4b/exec/flib/prinv.f
rw-rw-rw-	229/20	32704	Mar 27 15:28 1998	./mcnp4b/exec/flib/prlost.f
rw-rw-rw-	229/20	2993	Mar 27 15:28 1998	./mcnp4b/exec/flib/prodhh.f
rw-rw-rw-	229/20	31974	Mar 27 15:28 1998	./mcnp4b/exec/flib/prplot.f
rw-rw-rw-	229/20	30441	Mar 27 15:28 1998	./mcnp4b/exec/flib/prsdf.f
rw-rw-rw-	229/20	32266	Mar 27 15:28 1998	./mcnp4b/exec/flib/prsdt.f
rw-rw-rw-	229/20	25112	Mar 27 15:28 1998	./mcnp4b/exec/flib/prsrj.f
rw-rw-rw-	229/20	38179	Mar 27 15:28 1998	./mcnp4b/exec/flib/prstat.f
rw-rw-rw-	229/20	35697	Mar 27 15:28 1998	./mcnp4b/exec/flib/prtfcc.f
rw-rw-rw-	229/20	34456	Mar 27 15:28 1998	./mcnp4b/exec/flib/psurf.f
rw-rw-rw-	229/20	31901	Mar 27 15:28 1998	./mcnp4b/exec/flib/ptfc.f
rw-rw-rw-	229/20	22046	Mar 27 15:28 1998	./mcnp4b/exec/flib/ptimin.f
rw-rw-rw-	229/20	24747	Mar 27 15:28 1998	./mcnp4b/exec/flib/ptost.f
rw-rw-rw-	229/20	46720	Mar 27 15:28 1998	./mcnp4b/exec/flib/ptrak.f
rw-rw-rw-	229/20	21462	Mar 27 15:28 1998	./mcnp4b/exec/flib/pttyin.f
rw-rw-rw-	229/20	25039	Mar 27 15:28 1998	./mcnp4b/exec/flib/putlbl.f
rw-rw-rw-	229/20	27740	Mar 27 15:28 1998	./mcnp4b/exec/flib/putnq.f
rw-rw-rw-	229/20	6205	Mar 27 15:28 1998	./mcnp4b/exec/flib/qnc7.f
rw-rw-rw-	229/20	2117	Mar 27 15:28 1998	./mcnp4b/exec/flib/qpol.f
rw-rw-rw-	229/20	23944	Mar 27 15:28 1998	./mcnp4b/exec/flib/qtyyin.f
rw-rw-rw-	229/20	2336	Mar 27 15:28 1998	./mcnp4b/exec/flib/quad.f
rw-rw-rw-	229/20	11826	Mar 27 15:28 1998	./mcnp4b/exec/flib/quart.f
rw-rw-rw-	229/20	24893	Mar 27 15:28 1998	./mcnp4b/exec/flib/random.f
rw-rw-rw-	229/20	21973	Mar 27 15:28 1998	./mcnp4b/exec/flib/rang.f
rw-rw-rw-	229/20	28251	Mar 27 15:28 1998	./mcnp4b/exec/flib/rdprob.f
rw-rw-rw-	229/20	22185	Mar 27 15:28 1998	./mcnp4b/exec/flib/reflec.f
rw-rw-rw-	229/20	22192	Mar 27 15:28 1998	./mcnp4b/exec/flib/refpbc.f
rw-rw-rw-	229/20	38690	Mar 27 15:28 1998	./mcnp4b/exec/flib/regula.f
rw-rw-rw-	229/20	30660	Mar 27 15:28 1998	./mcnp4b/exec/flib/rhoden.f
rw-rw-rw-	229/20	33945	Mar 27 15:28 1998	./mcnp4b/exec/flib/ronge.f
rw-rw-rw-	229/20	6132	Mar 27 15:28 1998	./mcnp4b/exec/flib/rotas.f
rw-rw-rw-	229/20	22484	Mar 27 15:28 1998	./mcnp4b/exec/flib/rsimaz.f
rw-rw-rw-	229/20	23944	Mar 27 15:28 1998	./mcnp4b/exec/flib/runtpq.f
rw-rw-rw-	229/20	22192	Mar 27 15:28 1998	./mcnp4b/exec/flib/runtpr.f
rw-rw-rw-	229/20	21754	Mar 27 15:28 1998	./mcnp4b/exec/flib/runtpw.f
rw-rw-rw-	229/20	26353	Mar 27 15:28 1998	./mcnp4b/exec/flib/sabcol.f
rw-rw-rw-	229/20	23798	Mar 27 15:28 1998	./mcnp4b/exec/flib/scat.f
rw-rw-rw-	229/20	27010	Mar 27 15:28 1998	./mcnp4b/exec/flib/scatt.f
rw-rw-rw-	229/20	1679	Mar 27 15:28 1998	./mcnp4b/exec/flib/screen.f
rw-rw-rw-	229/20	730	Mar 27 15:28 1998	./mcnp4b/exec/flib/secnd.f
rw-rw-rw-	229/20	23798	Mar 27 15:28 1998	./mcnp4b/exec/flib/setcel.f
rw-rw-rw-	229/20	41099	Mar 27 15:28 1998	./mcnp4b/exec/flib/setdas.f
rw-rw-rw-	229/20	30149	Mar 27 15:28 1998	./mcnp4b/exec/flib/sfiles.f
rw-rw-rw-	229/20	29054	Mar 27 15:28 1998	./mcnp4b/exec/flib/shade.f
rw-rw-rw-	229/20	3066	Mar 27 15:28 1998	./mcnp4b/exec/flib/simint.f
rw-rw-rw-	229/20	28981	Mar 27 15:28 1998	./mcnp4b/exec/flib/simplx.f
rw-rw-rw-	229/20	32485	Mar 27 15:28 1998	./mcnp4b/exec/flib/sing.f
rw-rw-rw-	229/20	34456	Mar 27 15:28 1998	./mcnp4b/exec/flib/skcode.f
rw-rw-rw-	229/20	8030	Mar 27 15:28 1998	./mcnp4b/exec/flib/smevev.f
rw-rw-rw-	229/20	6643	Mar 27 15:28 1998	./mcnp4b/exec/flib/smhtr.f
rw-rw-rw-	229/20	32120	Mar 27 15:28 1998	./mcnp4b/exec/flib/smpsrc.f
rw-rw-rw-	229/20	49129	Mar 27 15:28 1998	./mcnp4b/exec/flib/sourcb.f

FW-FW-FW	229/20	21535	Mar 27	15:28	1998	./mcnp4b/exec/flib/source.f
FW-FW-FW	229/20	23287	Mar 27	15:28	1998	./mcnp4b/exec/flib/sourck.f
FW-FW-FW	229/20	25258	Mar 27	15:28	1998	./mcnp4b/exec/flib/spec.f
FW-FW-FW	229/20	25842	Mar 27	15:28	1998	./mcnp4b/exec/flib/splins.f
FW-FW-FW	229/20	39858	Mar 27	15:28	1998	./mcnp4b/exec/flib/sprob.f
FW-FW-FW	229/20	24601	Mar 27	15:28	1998	./mcnp4b/exec/flib/sqqint.f
FW-FW-FW	229/20	21097	Mar 27	15:28	1998	./mcnp4b/exec/flib/srcdx.f
FW-FW-FW	229/20	24236	Mar 27	15:28	1998	./mcnp4b/exec/flib/srcsrf.f
FW-FW-FW	229/20	25185	Mar 27	15:28	1998	./mcnp4b/exec/flib/sread.f
FW-FW-FW	229/20	27886	Mar 27	15:28	1998	./mcnp4b/exec/flib/ssmsrc.f
FW-FW-FW	229/20	38909	Mar 27	15:28	1998	./mcnp4b/exec/flib/startp.f
FW-FW-FW	229/20	27010	Mar 27	15:28	1998	./mcnp4b/exec/flib/status.f
FW-FW-FW	229/20	26645	Mar 27	15:28	1998	./mcnp4b/exec/flib/sttop.f
FW-FW-FW	229/20	36938	Mar 27	15:28	1998	./mcnp4b/exec/flib/stuff.f
FW-FW-FW	229/20	23360	Mar 27	15:28	1998	./mcnp4b/exec/flib/sufwrt.f
FW-FW-FW	229/20	39931	Mar 27	15:28	1998	./mcnp4b/exec/flib/sumary.f
FW-FW-FW	229/20	31828	Mar 27	15:28	1998	./mcnp4b/exec/flib/surfac.f
FW-FW-FW	229/20	36573	Mar 27	15:28	1998	./mcnp4b/exec/flib/sursrc.f
FW-FW-FW	229/20	29711	Mar 27	15:28	1998	./mcnp4b/exec/flib/talloc.f
FW-FW-FW	229/20	49056	Mar 27	15:28	1998	./mcnp4b/exec/flib/tally.f
FW-FW-FW	229/20	47377	Mar 27	15:28	1998	./mcnp4b/exec/flib/tallyd.f
FW-FW-FW	229/20	26061	Mar 27	15:28	1998	./mcnp4b/exec/flib/tallyh.f
FW-FW-FW	229/20	34091	Mar 27	15:28	1998	./mcnp4b/exec/flib/tallyp.f
FW-FW-FW	229/20	26499	Mar 27	15:28	1998	./mcnp4b/exec/flib/tallyq.f
FW-FW-FW	229/20	21462	Mar 27	15:28	1998	./mcnp4b/exec/flib/tallyx.f
FW-FW-FW	229/20	26864	Mar 27	15:28	1998	./mcnp4b/exec/flib/talph.f
FW-FW-FW	229/20	27302	Mar 27	15:28	1998	./mcnp4b/exec/flib/talshf.f
FW-FW-FW	229/20	22849	Mar 27	15:28	1998	./mcnp4b/exec/flib/tarea.f
FW-FW-FW	229/20	32266	Mar 27	15:28	1998	./mcnp4b/exec/flib/tekdrv.f
FW-FW-FW	229/20	24382	Mar 27	15:28	1998	./mcnp4b/exec/flib/tgtvel.f
FW-FW-FW	229/20	21024	Mar 27	15:28	1998	./mcnp4b/exec/flib/timint.f
FW-FW-FW	229/20	26207	Mar 27	15:28	1998	./mcnp4b/exec/flib/torus.f
FW-FW-FW	229/20	32120	Mar 27	15:28	1998	./mcnp4b/exec/flib/tpofil.f
FW-FW-FW	229/20	43800	Mar 27	15:28	1998	./mcnp4b/exec/flib/track.f
FW-FW-FW	229/20	25477	Mar 27	15:28	1998	./mcnp4b/exec/flib/transm.f
FW-FW-FW	229/20	34018	Mar 27	15:28	1998	./mcnp4b/exec/flib/trfmat.f
FW-FW-FW	229/20	32850	Mar 27	15:28	1998	./mcnp4b/exec/flib/trfsrf.f
FW-FW-FW	229/20	27667	Mar 27	15:28	1998	./mcnp4b/exec/flib/trnspt.f
FW-FW-FW	229/20	27521	Mar 27	15:28	1998	./mcnp4b/exec/flib/ttbr.f
FW-FW-FW	229/20	438	Mar 27	15:28	1998	./mcnp4b/exec/flib/tyint.f
FW-FW-FW	229/20	25185	Mar 27	15:28	1998	./mcnp4b/exec/flib/ufiles.f
FW-FW-FW	229/20	36354	Mar 27	15:28	1998	./mcnp4b/exec/flib/unimax.f
FW-FW-FW	229/20	1898	Mar 27	15:28	1998	./mcnp4b/exec/flib/unique.f
FW-FW-FW	229/20	22703	Mar 27	15:28	1998	./mcnp4b/exec/flib/uplev.f
FW-FW-FW	229/20	22265	Mar 27	15:28	1998	./mcnp4b/exec/flib/uplpos.f
FW-FW-FW	229/20	22776	Mar 27	15:28	1998	./mcnp4b/exec/flib/utask.f
FW-FW-FW	229/20	43143	Mar 27	15:28	1998	./mcnp4b/exec/flib/viewz.f
FW-FW-FW	229/20	24163	Mar 27	15:28	1998	./mcnp4b/exec/flib/voidcd.f
FW-FW-FW	229/20	33288	Mar 27	15:28	1998	./mcnp4b/exec/flib/volume.f
FW-FW-FW	229/20	24090	Mar 27	15:28	1998	./mcnp4b/exec/flib/vtask.f
FW-FW-FW	229/20	28032	Mar 27	15:28	1998	./mcnp4b/exec/flib/wgtul.f
FW-FW-FW	229/20	22119	Mar 27	15:28	1998	./mcnp4b/exec/flib/wgtwwg.f
FW-FW-FW	229/20	24966	Mar 27	15:28	1998	./mcnp4b/exec/flib/wrwsa.f
FW-FW-FW	229/20	30806	Mar 27	15:28	1998	./mcnp4b/exec/flib/wtcalc.f
FW-FW-FW	229/20	30733	Mar 27	15:28	1998	./mcnp4b/exec/flib/wtmult.f
FW-FW-FW	229/20	24236	Mar 27	15:28	1998	./mcnp4b/exec/flib/wtwno.f
FW-FW-FW	229/20	28324	Mar 27	15:28	1998	./mcnp4b/exec/flib/wvfile.f
FW-FW-FW	229/20	31390	Mar 27	15:28	1998	./mcnp4b/exec/flib/wvval.f
FW-FW-FW	229/20	24747	Mar 27	15:28	1998	./mcnp4b/exec/flib/xact.f
FW-FW-FW	229/20	22484	Mar 27	15:28	1998	./mcnp4b/exec/flib/xsec.f
FW-FW-FW	229/20	32339	Mar 27	15:28	1998	./mcnp4b/exec/flib/xsgeo.f
FW-FW-FW	229/20	7154	Mar 27	15:28	1998	./mcnp4b/exec/flib/xsprmr.f
FW-FW-FW	229/20	25696	Mar 27	15:28	1998	./mcnp4b/exec/flib/ypbssp.f
FW-FW-FW	229/20	1241	Mar 27	15:28	1998	./mcnp4b/exec/flib/zaid.f
FW-FW-FW	229/20	11826	Mar 27	15:28	1998	./mcnp4b/exec/flib/zblat.f
FW-FW-FW	229/20	39128	Mar 27	15:28	1998	./mcnp4b/exec/flib/mcnp.c
FWX-----	229/20	1396	Mar 1	13:23	1996	./mcnp4b/exec/inp01
FWX-XI-X	229/20	188416	Mar 27	15:28	1998	./mcnp4b/exec/mcsetup
FWX-XI-X	229/20	38920	Mar 27	14:57	1998	./mcnp4b/exec/mcsetup.for
FW-FW-FW	229/20	74991	Mar 27	15:48	1998	./mcnp4b/exec/install.log

FWKXFWKX	229/20	1458176	Mar 27 15:39 1998	./mcnp4b/exec/mcnp
FWX-XX-X	229/20	4871	Mar 27 14:57 1998	./mcnp4b/exec/runpraad
FWX-XX-X	229/20	3264	Mar 27 14:57 1998	./mcnp4b/exec/runprob
FWX-XX-X	229/20	22914	Mar 27 14:57 1998	./mcnp4b/exec/testdir
FWX-XX-X	229/20	196608	Mar 27 14:57 1998	./mcnp4b/exec/testinp.tar
FWX-XX-X	229/20	262144	Mar 27 14:57 1998	./mcnp4b/exec/testmae
FWX-XX-X	229/20	235520	Mar 27 14:57 1998	./mcnp4b/exec/testmctl.hp
FWX-XX-X	229/20	2097152	Mar 27 14:57 1998	./mcnp4b/exec/testoaf
FWX-XX-X	229/20	2048000	Mar 27 14:57 1998	./mcnp4b/exec/testoutp.hp
FWX-XX-X	229/20	2918	Mar 27 14:57 1998	./mcnp4b/exec/INSTALL.FIX.old
FWX-----	229/20	1963	Mar 2 12:09 1996	./mcnp4b/exec/inp02
FWX-XX-X	229/20	51042	Mar 27 14:58 1998	./mcnp4b/exec/makcs.id
FW-FW-FW	229/20	6924	Mar 27 15:28 1998	./mcnp4b/exec/patchf
FWX-XX-X	229/20	8443	Mar 27 14:58 1998	./mcnp4b/exec/prpr.id
FW-FW-FW	229/20	137	Mar 27 15:28 1998	./mcnp4b/exec/patchc
FWX-XX-X	229/20	135168	Mar 27 15:28 1998	./mcnp4b/exec/makxsf
FWX-XX-X	229/20	258048	Mar 27 15:28 1998	./mcnp4b/exec/prpr
FWXFWKX	229/20	0	Mar 27 15:39 1998	./mcnp4b/exec/olib/
FW-FW-FW	229/20	4348	Mar 27 15:28 1998	./mcnp4b/exec/olib/abvals.o
FW-FW-FW	229/20	9816	Mar 27 15:29 1998	./mcnp4b/exec/olib/acecas.o
FW-FW-FW	229/20	6356	Mar 27 15:29 1998	./mcnp4b/exec/olib/acecol.o
FW-FW-FW	229/20	1724	Mar 27 15:29 1998	./mcnp4b/exec/olib/acecos.o
FW-FW-FW	229/20	2540	Mar 27 15:29 1998	./mcnp4b/exec/olib/acecs6.o
FW-FW-FW	229/20	1644	Mar 27 15:29 1998	./mcnp4b/exec/olib/acefcn.o
FW-FW-FW	229/20	2328	Mar 27 15:29 1998	./mcnp4b/exec/olib/acefpt.o
FW-FW-FW	229/20	8868	Mar 27 15:29 1998	./mcnp4b/exec/olib/acegam.o
FW-FW-FW	229/20	1288	Mar 27 15:29 1998	./mcnp4b/exec/olib/acenu.o
FW-FW-FW	229/20	1432	Mar 27 15:29 1998	./mcnp4b/exec/olib/acethl.o
FW-FW-FW	229/20	6300	Mar 27 15:29 1998	./mcnp4b/exec/olib/acetot.o
FW-FW-FW	229/20	16440	Mar 27 15:29 1998	./mcnp4b/exec/olib/action.o
FW-FW-FW	229/20	4780	Mar 27 15:29 1998	./mcnp4b/exec/olib/addtfc.o
FW-FW-FW	229/20	1320	Mar 27 15:29 1998	./mcnp4b/exec/olib/advijk.o
FW-FW-FW	229/20	2684	Mar 27 15:29 1998	./mcnp4b/exec/olib/amatrx.o
FW-FW-FW	229/20	3148	Mar 27 15:29 1998	./mcnp4b/exec/olib/angl.o
FW-FW-FW	229/20	964	Mar 27 15:29 1998	./mcnp4b/exec/olib/arbobv.o
FW-FW-FW	229/20	4312	Mar 27 15:29 1998	./mcnp4b/exec/olib/axis.o
FW-FW-FW	229/20	4732	Mar 27 15:29 1998	./mcnp4b/exec/olib/axlabl.o
FW-FW-FW	229/20	1444	Mar 27 15:29 1998	./mcnp4b/exec/olib/backup.o
FW-FW-FW	229/20	4356	Mar 27 15:29 1998	./mcnp4b/exec/olib/bankit.o
FW-FW-FW	229/20	1372	Mar 27 15:29 1998	./mcnp4b/exec/olib/barplt.o
FW-FW-FW	229/20	1344	Mar 27 15:29 1998	./mcnp4b/exec/olib/begone.o
FW-FW-FW	229/20	10932	Mar 27 15:29 1998	./mcnp4b/exec/olib/binlin.o
FW-FW-FW	229/20	4320	Mar 27 15:29 1998	./mcnp4b/exec/olib/binval.o
FW-FW-FW	229/20	4228	Mar 27 15:29 1998	./mcnp4b/exec/olib/blkdatt.o
FW-FW-FW	229/20	5696	Mar 27 15:29 1998	./mcnp4b/exec/olib/brang.o
FW-FW-FW	229/20	5824	Mar 27 15:29 1998	./mcnp4b/exec/olib/brem.o
FW-FW-FW	229/20	6252	Mar 27 15:29 1998	./mcnp4b/exec/olib/brems.o
FW-FW-FW	229/20	2080	Mar 27 15:29 1998	./mcnp4b/exec/olib/broadn.o
FW-FW-FW	229/20	12636	Mar 27 15:29 1998	./mcnp4b/exec/olib/calcps.o
FW-FW-FW	229/20	7820	Mar 27 15:29 1998	./mcnp4b/exec/olib/calcva.o
FW-FW-FW	229/20	6740	Mar 27 15:29 1998	./mcnp4b/exec/olib/celnbr.o
FW-FW-FW	229/20	6040	Mar 27 15:29 1998	./mcnp4b/exec/olib/celpar.o
FW-FW-FW	229/20	15868	Mar 27 15:29 1998	./mcnp4b/exec/olib/celsrf.o
FW-FW-FW	229/20	12552	Mar 27 15:30 1998	./mcnp4b/exec/olib/chekcs.o
FW-FW-FW	229/20	54648	Mar 27 15:30 1998	./mcnp4b/exec/olib/chekit.o
FW-FW-FW	229/20	1628	Mar 27 15:30 1998	./mcnp4b/exec/olib/chgmem.o
FW-FW-FW	229/20	3984	Mar 27 15:30 1998	./mcnp4b/exec/olib/chkcel.o
FW-FW-FW	229/20	3376	Mar 27 15:30 1998	./mcnp4b/exec/olib/chkprb.o
FW-FW-FW	229/20	5144	Mar 27 15:30 1998	./mcnp4b/exec/olib/chksrc.o
FW-FW-FW	229/20	16252	Mar 27 15:30 1998	./mcnp4b/exec/olib/chkxss.o
FW-FW-FW	229/20	1716	Mar 27 15:30 1998	./mcnp4b/exec/olib/chqcal.o
FW-FW-FW	229/20	1132	Mar 27 15:30 1998	./mcnp4b/exec/olib/chrhol.o
FW-FW-FW	229/20	1848	Mar 27 15:30 1998	./mcnp4b/exec/olib/ckchar.o
FW-FW-FW	229/20	3880	Mar 27 15:30 1998	./mcnp4b/exec/olib/colidk.o
FW-FW-FW	229/20	7440	Mar 27 15:30 1998	./mcnp4b/exec/olib/colidn.o
FW-FW-FW	229/20	7744	Mar 27 15:30 1998	./mcnp4b/exec/olib/colidp.o
FW-FW-FW	229/20	10488	Mar 27 15:30 1998	./mcnp4b/exec/olib/colinp.o
FW-FW-FW	229/20	2472	Mar 27 15:30 1998	./mcnp4b/exec/olib/confid.o
FW-FW-FW	229/20	5244	Mar 27 15:30 1998	./mcnp4b/exec/olib/contr.o
FW-FW-FW	229/20	1976	Mar 27 15:30 1998	./mcnp4b/exec/olib/covar.o

rw-rw-rw-	229/20	7868	Mar 27 15:30 1998	./mcnp4b/exec/olib/cprinp.o
rw-rw-rw-	229/20	576	Mar 27 15:30 1998	./mcnp4b/exec/olib/crspro.o
rw-rw-rw-	229/20	7176	Mar 27 15:30 1998	./mcnp4b/exec/olib/crtcze.o
rw-rw-rw-	229/20	2700	Mar 27 15:30 1998	./mcnp4b/exec/olib/dbmin.o
rw-rw-rw-	229/20	2220	Mar 27 15:30 1998	./mcnp4b/exec/olib/dddet.o
rw-rw-rw-	229/20	6328	Mar 27 15:30 1998	./mcnp4b/exec/olib/dddiag.o
rw-rw-rw-	229/20	1700	Mar 27 15:30 1998	./mcnp4b/exec/olib/dddlev.o
rw-rw-rw-	229/20	1708	Mar 27 15:30 1998	./mcnp4b/exec/olib/dosef.o
rw-rw-rw-	229/20	580	Mar 27 15:30 1998	./mcnp4b/exec/olib/dotpro.o
rw-rw-rw-	229/20	3012	Mar 27 15:30 1998	./mcnp4b/exec/olib/dotrc1.o
rw-rw-rw-	229/20	8428	Mar 27 15:30 1998	./mcnp4b/exec/olib/dplinf.o
rw-rw-rw-	229/20	1780	Mar 27 15:30 1998	./mcnp4b/exec/olib/dunlev.o
rw-rw-rw-	229/20	7116	Mar 27 15:30 1998	./mcnp4b/exec/olib/dxdiag.o
rw-rw-rw-	229/20	8476	Mar 27 15:30 1998	./mcnp4b/exec/olib/dxtran.o
rw-rw-rw-	229/20	1436	Mar 27 15:30 1998	./mcnp4b/exec/olib/echkcl.o
rw-rw-rw-	229/20	7912	Mar 27 15:30 1998	./mcnp4b/exec/olib/electr.o
rw-rw-rw-	229/20	8468	Mar 27 15:30 1998	./mcnp4b/exec/olib/emaker.o
rw-rw-rw-	229/20	1444	Mar 27 15:30 1998	./mcnp4b/exec/olib/entwng.o
rw-rw-rw-	229/20	9176	Mar 27 15:31 1998	./mcnp4b/exec/olib/eqpbbn.o
rw-rw-rw-	229/20	1824	Mar 27 15:31 1998	./mcnp4b/exec/olib/erf2.o
rw-rw-rw-	229/20	1744	Mar 27 15:31 1998	./mcnp4b/exec/olib/ergimp.o
rw-rw-rw-	229/20	3216	Mar 27 15:31 1998	./mcnp4b/exec/olib/erprnt.o
rw-rw-rw-	229/20	1892	Mar 27 15:31 1998	./mcnp4b/exec/olib/errbar.o
rw-rw-rw-	229/20	3892	Mar 27 15:31 1998	./mcnp4b/exec/olib/errprn.o
rw-rw-rw-	229/20	2980	Mar 27 15:31 1998	./mcnp4b/exec/olib/esloss.o
rw-rw-rw-	229/20	9984	Mar 27 15:31 1998	./mcnp4b/exec/olib/eventp.o
rw-rw-rw-	229/20	10012	Mar 27 15:31 1998	./mcnp4b/exec/olib/exemes.o
rw-rw-rw-	229/20	2048	Mar 27 15:31 1998	./mcnp4b/exec/olib/exng.o
rw-rw-rw-	229/20	5628	Mar 27 15:31 1998	./mcnp4b/exec/olib/exord.o
rw-rw-rw-	229/20	2292	Mar 27 15:31 1998	./mcnp4b/exec/olib/exordp.o
rw-rw-rw-	229/20	3260	Mar 27 15:31 1998	./mcnp4b/exec/olib/expire.o
rw-rw-rw-	229/20	1196	Mar 27 15:31 1998	./mcnp4b/exec/olib/expirx.o
rw-rw-rw-	229/20	17004	Mar 27 15:31 1998	./mcnp4b/exec/olib/expung.o
rw-rw-rw-	229/20	1536	Mar 27 15:31 1998	./mcnp4b/exec/olib/extran.o
rw-rw-rw-	229/20	10360	Mar 27 15:31 1998	./mcnp4b/exec/olib/extrct.o
rw-rw-rw-	229/20	1412	Mar 27 15:31 1998	./mcnp4b/exec/olib/fastdr.o
rw-rw-rw-	229/20	1304	Mar 27 15:31 1998	./mcnp4b/exec/olib/ffetch.o
rw-rw-rw-	229/20	2536	Mar 27 15:31 1998	./mcnp4b/exec/olib/findel.o
rw-rw-rw-	229/20	2264	Mar 27 15:31 1998	./mcnp4b/exec/olib/findlv.o
rw-rw-rw-	229/20	2496	Mar 27 15:31 1998	./mcnp4b/exec/olib/finpht.o
rw-rw-rw-	229/20	3840	Mar 27 15:31 1998	./mcnp4b/exec/olib/forcol.o
rw-rw-rw-	229/20	2992	Mar 27 15:31 1998	./mcnp4b/exec/olib/fshort.o
rw-rw-rw-	229/20	676	Mar 27 15:31 1998	./mcnp4b/exec/olib/gacwk.o
rw-rw-rw-	229/20	576	Mar 27 15:31 1998	./mcnp4b/exec/olib/gclks.o
rw-rw-rw-	229/20	644	Mar 27 15:31 1998	./mcnp4b/exec/olib/gclrwk.o
rw-rw-rw-	229/20	964	Mar 27 15:31 1998	./mcnp4b/exec/olib/gclwk.o
rw-rw-rw-	229/20	660	Mar 27 15:31 1998	./mcnp4b/exec/olib/gdawk.o
rw-rw-rw-	229/20	916	Mar 27 15:31 1998	./mcnp4b/exec/olib/getexm.o
rw-rw-rw-	229/20	1424	Mar 27 15:31 1998	./mcnp4b/exec/olib/getidt.o
rw-rw-rw-	229/20	4152	Mar 27 15:31 1998	./mcnp4b/exec/olib/getxs.o
rw-rw-rw-	229/20	15540	Mar 27 15:31 1998	./mcnp4b/exec/olib/getxst.o
rw-rw-rw-	229/20	1520	Mar 27 15:31 1998	./mcnp4b/exec/olib/gfa.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/ginlc.o
rw-rw-rw-	229/20	5480	Mar 27 15:31 1998	./mcnp4b/exec/olib/gmgww.o
rw-rw-rw-	229/20	808	Mar 27 15:31 1998	./mcnp4b/exec/olib/gopks.o
rw-rw-rw-	229/20	1060	Mar 27 15:31 1998	./mcnp4b/exec/olib/gopwk.o
rw-rw-rw-	229/20	3308	Mar 27 15:31 1998	./mcnp4b/exec/olib/gpl.o
rw-rw-rw-	229/20	596	Mar 27 15:31 1998	./mcnp4b/exec/olib/gqcf.o
rw-rw-rw-	229/20	596	Mar 27 15:31 1998	./mcnp4b/exec/olib/grqlc.o
rw-rw-rw-	229/20	664	Mar 27 15:31 1998	./mcnp4b/exec/olib/gschh.o
rw-rw-rw-	229/20	668	Mar 27 15:31 1998	./mcnp4b/exec/olib/gschup.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/gschxp.o
rw-rw-rw-	229/20	624	Mar 27 15:31 1998	./mcnp4b/exec/olib/gscr.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/gads.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/gselnt.o
rw-rw-rw-	229/20	1120	Mar 27 15:31 1998	./mcnp4b/exec/olib/gsfaci.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/gsfais.o
rw-rw-rw-	229/20	600	Mar 27 15:31 1998	./mcnp4b/exec/olib/gsln.o
rw-rw-rw-	229/20	584	Mar 27 15:31 1998	./mcnp4b/exec/olib/gslwsc.o
rw-rw-rw-	229/20	1144	Mar 27 15:31 1998	./mcnp4b/exec/olib/gsplci.o

rw-rw-rw-	229/20	1120	Mar 27 15:31 1998	./mcnp4b/exec/olib/gstxci.o
rw-rw-rw-	229/20	528	Mar 27 15:31 1998	./mcnp4b/exec/olib/gstxftp.o
rw-rw-rw-	229/20	608	Mar 27 15:31 1998	./mcnp4b/exec/olib/gsvp.o
rw-rw-rw-	229/20	1648	Mar 27 15:31 1998	./mcnp4b/exec/olib/gswkm.o
rw-rw-rw-	229/20	740	Mar 27 15:31 1998	./mcnp4b/exec/olib/gswm.o
rw-rw-rw-	229/20	2604	Mar 27 15:31 1998	./mcnp4b/exec/olib/gtx.o
rw-rw-rw-	229/20	892	Mar 27 15:31 1998	./mcnp4b/exec/olib/guwk.o
rw-rw-rw-	229/20	7164	Mar 27 15:31 1998	./mcnp4b/exec/olib/gxaxis.o
rw-rw-rw-	229/20	1248	Mar 27 15:31 1998	./mcnp4b/exec/olib/gxhome.o
rw-rw-rw-	229/20	1368	Mar 27 15:31 1998	./mcnp4b/exec/olib/gxlims.o
rw-rw-rw-	229/20	984	Mar 27 15:31 1998	./mcnp4b/exec/olib/gxoff.o
rw-rw-rw-	229/20	3152	Mar 27 15:31 1998	./mcnp4b/exec/olib/gxon.o
rw-rw-rw-	229/20	1200	Mar 27 15:32 1998	./mcnp4b/exec/olib/gxquit.o
rw-rw-rw-	229/20	1060	Mar 27 15:32 1998	./mcnp4b/exec/olib/gxskip.o
rw-rw-rw-	229/20	1760	Mar 27 15:32 1998	./mcnp4b/exec/olib/hgram.o
rw-rw-rw-	229/20	1664	Mar 27 15:32 1998	./mcnp4b/exec/olib/hpsort.o
rw-rw-rw-	229/20	10948	Mar 27 15:32 1998	./mcnp4b/exec/olib/hstory.o
rw-rw-rw-	229/20	4316	Mar 27 15:32 1998	./mcnp4b/exec/olib/ibldat.o
rw-rw-rw-	229/20	3044	Mar 27 15:32 1998	./mcnp4b/exec/olib/lgeom.o
rw-rw-rw-	229/20	15540	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmcn.o
rw-rw-rw-	229/20	5076	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmpert.o
rw-rw-rw-	229/20	804	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmpire.o
rw-rw-rw-	229/20	8908	Mar 27 15:32 1998	./mcnp4b/exec/olib/lminter.o
rw-rw-rw-	229/20	5708	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmintsec.o
rw-rw-rw-	229/20	8840	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmipbc.o
rw-rw-rw-	229/20	1684	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmsheet.o
rw-rw-rw-	229/20	880	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmsos.o
rw-rw-rw-	229/20	2840	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmsourc.o
rw-rw-rw-	229/20	9800	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmssrc.o
rw-rw-rw-	229/20	41336	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmtally.o
rw-rw-rw-	229/20	15572	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmtalpr.o
rw-rw-rw-	229/20	4828	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmitems.o
rw-rw-rw-	229/20	10608	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmtwnd.o
rw-rw-rw-	229/20	14216	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmtdir.o
rw-rw-rw-	229/20	2028	Mar 27 15:32 1998	./mcnp4b/exec/olib/lmjbin.o
rw-rw-rw-	229/20	12888	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmjdecod.o
rw-rw-rw-	229/20	20216	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmjsourc.o
rw-rw-rw-	229/20	1624	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmjtskpt.o
rw-rw-rw-	229/20	7104	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkbatch.o
rw-rw-rw-	229/20	9748	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkcalc.o
rw-rw-rw-	229/20	1736	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkdarg.o
rw-rw-rw-	229/20	1044	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkdata.o
rw-rw-rw-	229/20	1520	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmklein.o
rw-rw-rw-	229/20	4288	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmknock.o
rw-rw-rw-	229/20	17200	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmknorm.o
rw-rw-rw-	229/20	20580	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkprint.o
rw-rw-rw-	229/20	9900	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkscyc.o
rw-rw-rw-	229/20	4292	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmksrctp.o
rw-rw-rw-	229/20	4720	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmktable.o
rw-rw-rw-	229/20	3540	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmkxray.o
rw-rw-rw-	229/20	44548	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlandau.o
rw-rw-rw-	229/20	27100	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlandct.o
rw-rw-rw-	229/20	4912	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlatcon.o
rw-rw-rw-	229/20	3616	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlbloca.o
rw-rw-rw-	229/20	676	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmleng.o
rw-rw-rw-	229/20	4124	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlvcel.o
rw-rw-rw-	229/20	3660	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlvchk.o
rw-rw-rw-	229/20	716	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlgeval.o
rw-rw-rw-	229/20	6444	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmlikebt.o
rw-rw-rw-	229/20	816	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmljusti.o
rw-rw-rw-	229/20	5368	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmmapmaz.o
rw-rw-rw-	229/20	1396	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmmapmpy.o
rw-rw-rw-	229/20	8636	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmncnp.o
rw-rw-rw-	229/20	20272	Mar 27 15:28 1998	./mcnp4b/exec/olib/lmncpc.o
rw-rw-rw-	229/20	5588	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmncplot.o
rw-rw-rw-	229/20	4376	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmncrun.o
rw-rw-rw-	229/20	7368	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmncstalr.o
rw-rw-rw-	229/20	9688	Mar 27 15:33 1998	./mcnp4b/exec/olib/lmncstalw.o
rw-rw-rw-	229/20	18816	Mar 27 15:34 1998	./mcnp4b/exec/olib/lmndecod.o
rw-rw-rw-	229/20	6392	Mar 27 15:34 1998	./mcnp4b/exec/olib/lmgacol.o

FW-FW-FW	229/20	9164	Mar 27 15:34 1998	./mcnp4b/exec/olib/mgcoln.o
FW-FW-FW	229/20	4012	Mar 27 15:34 1998	./mcnp4b/exec/olib/mgcolp.o
FW-FW-FW	229/20	12616	Mar 27 15:34 1998	./mcnp4b/exec/olib/mgimps.o
FW-FW-FW	229/20	10724	Mar 27 15:34 1998	./mcnp4b/exec/olib/mgtspt.o
FW-FW-FW	229/20	1852	Mar 27 15:34 1998	./mcnp4b/exec/olib/midpnt.o
FW-FW-FW	229/20	1672	Mar 27 15:34 1998	./mcnp4b/exec/olib/movlat.o
FW-FW-FW	229/20	3564	Mar 27 15:34 1998	./mcnp4b/exec/olib/mreset.o
FW-FW-FW	229/20	1208	Mar 27 15:34 1998	./mcnp4b/exec/olib/namchg.o
FW-FW-FW	229/20	1724	Mar 27 15:34 1998	./mcnp4b/exec/olib/namrsd.o
FW-FW-FW	229/20	6224	Mar 27 15:34 1998	./mcnp4b/exec/olib/newcd1.o
FW-FW-FW	229/20	5824	Mar 27 15:34 1998	./mcnp4b/exec/olib/newcel.o
FW-FW-FW	229/20	19780	Mar 27 15:34 1998	./mcnp4b/exec/olib/newcrd.o
FW-FW-FW	229/20	37284	Mar 27 15:34 1998	./mcnp4b/exec/olib/nextit.o
FW-FW-FW	229/20	8868	Mar 27 15:35 1998	./mcnp4b/exec/olib/norma.o
FW-FW-FW	229/20	7784	Mar 27 15:35 1998	./mcnp4b/exec/olib/normh.o
FW-FW-FW	229/20	17604	Mar 27 15:35 1998	./mcnp4b/exec/olib/nxtit1.o
FW-FW-FW	229/20	1232	Mar 27 15:35 1998	./mcnp4b/exec/olib/nxtsym.o
FW-FW-FW	229/20	5272	Mar 27 15:35 1998	./mcnp4b/exec/olib/oldcd1.o
FW-FW-FW	229/20	30628	Mar 27 15:35 1998	./mcnp4b/exec/olib/oldcrd.o
FW-FW-FW	229/20	3448	Mar 27 15:35 1998	./mcnp4b/exec/olib/output.o
FW-FW-FW	229/20	7272	Mar 27 15:35 1998	./mcnp4b/exec/olib/outwvg.o
FW-FW-FW	229/20	972	Mar 27 15:35 1998	./mcnp4b/exec/olib/pareto.o
FW-FW-FW	229/20	3668	Mar 27 15:35 1998	./mcnp4b/exec/olib/pass1.o
FW-FW-FW	229/20	3016	Mar 27 15:35 1998	./mcnp4b/exec/olib/pathmz.o
FW-FW-FW	229/20	1104	Mar 27 15:35 1998	./mcnp4b/exec/olib/pblat.o
FW-FW-FW	229/20	7084	Mar 27 15:35 1998	./mcnp4b/exec/olib/pconst.o
FW-FW-FW	229/20	2924	Mar 27 15:35 1998	./mcnp4b/exec/olib/pertub.o
FW-FW-FW	229/20	2528	Mar 27 15:35 1998	./mcnp4b/exec/olib/photot.o
FW-FW-FW	229/20	5432	Mar 27 15:35 1998	./mcnp4b/exec/olib/photp.o
FW-FW-FW	229/20	2980	Mar 27 15:35 1998	./mcnp4b/exec/olib/pieces.o
FW-FW-FW	229/20	1672	Mar 27 15:35 1998	./mcnp4b/exec/olib/plin.o
FW-FW-FW	229/20	6208	Mar 27 15:35 1998	./mcnp4b/exec/olib/plot2d.o
FW-FW-FW	229/20	5056	Mar 27 15:35 1998	./mcnp4b/exec/olib/plotcn.o
FW-FW-FW	229/20	7596	Mar 27 15:35 1998	./mcnp4b/exec/olib/plotg.o
FW-FW-FW	229/20	4600	Mar 27 15:35 1998	./mcnp4b/exec/olib/pltdxt.o
FW-FW-FW	229/20	3840	Mar 27 15:35 1998	./mcnp4b/exec/olib/pltitl.o
FW-FW-FW	229/20	6072	Mar 27 15:35 1998	./mcnp4b/exec/olib/pltsrf.o
FW-FW-FW	229/20	7832	Mar 27 15:35 1998	./mcnp4b/exec/olib/polhed.o
FW-FW-FW	229/20	14764	Mar 27 15:35 1998	./mcnp4b/exec/olib/prhpdf.o
FW-FW-FW	229/20	11092	Mar 27 15:35 1998	./mcnp4b/exec/olib/prinv.o
FW-FW-FW	229/20	11280	Mar 27 15:35 1998	./mcnp4b/exec/olib/prlost.o
FW-FW-FW	229/20	1588	Mar 27 15:35 1998	./mcnp4b/exec/olib/prodhh.o
FW-FW-FW	229/20	6512	Mar 27 15:35 1998	./mcnp4b/exec/olib/prplot.o
FW-FW-FW	229/20	7960	Mar 27 15:35 1998	./mcnp4b/exec/olib/prsdft.o
FW-FW-FW	229/20	11288	Mar 27 15:35 1998	./mcnp4b/exec/olib/prsdft.o
FW-FW-FW	229/20	5796	Mar 27 15:35 1998	./mcnp4b/exec/olib/prsrj.o
FW-FW-FW	229/20	13516	Mar 27 15:35 1998	./mcnp4b/exec/olib/prstat.o
FW-FW-FW	229/20	9240	Mar 27 15:35 1998	./mcnp4b/exec/olib/prtfc.o
FW-FW-FW	229/20	5168	Mar 27 15:35 1998	./mcnp4b/exec/olib/psurf.o
FW-FW-FW	229/20	12756	Mar 27 15:36 1998	./mcnp4b/exec/olib/ptfc.o
FW-FW-FW	229/20	1344	Mar 27 15:36 1998	./mcnp4b/exec/olib/ptimin.o
FW-FW-FW	229/20	2316	Mar 27 15:36 1998	./mcnp4b/exec/olib/ptost.o
FW-FW-FW	229/20	14496	Mar 27 15:36 1998	./mcnp4b/exec/olib/ptrak.o
FW-FW-FW	229/20	1276	Mar 27 15:36 1998	./mcnp4b/exec/olib/pttyin.o
FW-FW-FW	229/20	2316	Mar 27 15:36 1998	./mcnp4b/exec/olib/putlhl.o
FW-FW-FW	229/20	3716	Mar 27 15:36 1998	./mcnp4b/exec/olib/putnq.o
FW-FW-FW	229/20	2156	Mar 27 15:36 1998	./mcnp4b/exec/olib/qnc7.o
FW-FW-FW	229/20	1100	Mar 27 15:36 1998	./mcnp4b/exec/olib/qpol.o
FW-FW-FW	229/20	3708	Mar 27 15:36 1998	./mcnp4b/exec/olib/qtttyin.o
FW-FW-FW	229/20	932	Mar 27 15:36 1998	./mcnp4b/exec/olib/quad.o
FW-FW-FW	229/20	3544	Mar 27 15:36 1998	./mcnp4b/exec/olib/quart.o
FW-FW-FW	229/20	3352	Mar 27 15:36 1998	./mcnp4b/exec/olib/random.o
FW-FW-FW	229/20	1332	Mar 27 15:36 1998	./mcnp4b/exec/olib/rang.o
FW-FW-FW	229/20	3712	Mar 27 15:36 1998	./mcnp4b/exec/olib/rdprob.o
FW-FW-FW	229/20	2804	Mar 27 15:36 1998	./mcnp4b/exec/olib/reflec.o
FW-FW-FW	229/20	1564	Mar 27 15:36 1998	./mcnp4b/exec/olib/refpbc.o
FW-FW-FW	229/20	9584	Mar 27 15:36 1998	./mcnp4b/exec/olib/regula.o
FW-FW-FW	229/20	7356	Mar 27 15:36 1998	./mcnp4b/exec/olib/rhoden.o
FW-FW-FW	229/20	8672	Mar 27 15:36 1998	./mcnp4b/exec/olib/ronge.o
FW-FW-FW	229/20	2000	Mar 27 15:36 1998	./mcnp4b/exec/olib/rotas.o

rw-rw-rw-	229/20	1836	Mar 27 15:36 1998	./mcnp4b/exec/olib/rsimaz.o
rw-rw-rw-	229/20	2176	Mar 27 15:36 1998	./mcnp4b/exec/olib/runtpq.o
rw-rw-rw-	229/20	1852	Mar 27 15:36 1998	./mcnp4b/exec/olib/runtpr.o
rw-rw-rw-	229/20	1968	Mar 27 15:36 1998	./mcnp4b/exec/olib/runtpw.o
rw-rw-rw-	229/20	3164	Mar 27 15:36 1998	./mcnp4b/exec/olib/sabcol.o
rw-rw-rw-	229/20	2040	Mar 27 15:36 1998	./mcnp4b/exec/olib/scat.o
rw-rw-rw-	229/20	4040	Mar 27 15:36 1998	./mcnp4b/exec/olib/scatt.o
rw-rw-rw-	229/20	668	Mar 27 15:36 1998	./mcnp4b/exec/olib/secnd.o
rw-rw-rw-	229/20	1264	Mar 27 15:36 1998	./mcnp4b/exec/olib/screen.o
rw-rw-rw-	229/20	1984	Mar 27 15:36 1998	./mcnp4b/exec/olib/setcel.o
rw-rw-rw-	229/20	8336	Mar 27 15:36 1998	./mcnp4b/exec/olib/setdas.o
rw-rw-rw-	229/20	9688	Mar 27 15:36 1998	./mcnp4b/exec/olib/sfiles.o
rw-rw-rw-	229/20	2984	Mar 27 15:36 1998	./mcnp4b/exec/olib/shade.o
rw-rw-rw-	229/20	1836	Mar 27 15:36 1998	./mcnp4b/exec/olib/simint.o
rw-rw-rw-	229/20	2640	Mar 27 15:36 1998	./mcnp4b/exec/olib/simplx.o
rw-rw-rw-	229/20	9112	Mar 27 15:36 1998	./mcnp4b/exec/olib/sing.o
rw-rw-rw-	229/20	6220	Mar 27 15:36 1998	./mcnp4b/exec/olib/skcode.o
rw-rw-rw-	229/20	2808	Mar 27 15:36 1998	./mcnp4b/exec/olib/smevev.o
rw-rw-rw-	229/20	2728	Mar 27 15:36 1998	./mcnp4b/exec/olib/smhtr.o
rw-rw-rw-	229/20	7024	Mar 27 15:36 1998	./mcnp4b/exec/olib/smpsrc.o
rw-rw-rw-	229/20	12968	Mar 27 15:36 1998	./mcnp4b/exec/olib/sourcb.o
rw-rw-rw-	229/20	1156	Mar 27 15:36 1998	./mcnp4b/exec/olib/source.o
rw-rw-rw-	229/20	1708	Mar 27 15:36 1998	./mcnp4b/exec/olib/sourck.o
rw-rw-rw-	229/20	2004	Mar 27 15:36 1998	./mcnp4b/exec/olib/spec.o
rw-rw-rw-	229/20	3196	Mar 27 15:36 1998	./mcnp4b/exec/olib/splins.o
rw-rw-rw-	229/20	17972	Mar 27 15:37 1998	./mcnp4b/exec/olib/sprob.o
rw-rw-rw-	229/20	2060	Mar 27 15:37 1998	./mcnp4b/exec/olib/sqqint.o
rw-rw-rw-	229/20	836	Mar 27 15:37 1998	./mcnp4b/exec/olib/srcdx.o
rw-rw-rw-	229/20	1704	Mar 27 15:37 1998	./mcnp4b/exec/olib/srcsrf.o
rw-rw-rw-	229/20	5568	Mar 27 15:37 1998	./mcnp4b/exec/olib/sread.o
rw-rw-rw-	229/20	3048	Mar 27 15:37 1998	./mcnp4b/exec/olib/smsrc.o
rw-rw-rw-	229/20	12052	Mar 27 15:37 1998	./mcnp4b/exec/olib/startp.o
rw-rw-rw-	229/20	9420	Mar 27 15:37 1998	./mcnp4b/exec/olib/status.o
rw-rw-rw-	229/20	4228	Mar 27 15:37 1998	./mcnp4b/exec/olib/sttop.o
rw-rw-rw-	229/20	9656	Mar 27 15:37 1998	./mcnp4b/exec/olib/stuff.o
rw-rw-rw-	229/20	2788	Mar 27 15:37 1998	./mcnp4b/exec/olib/sufwrt.o
rw-rw-rw-	229/20	22384	Mar 27 15:37 1998	./mcnp4b/exec/olib/summary.o
rw-rw-rw-	229/20	4952	Mar 27 15:37 1998	./mcnp4b/exec/olib/surfac.o
rw-rw-rw-	229/20	6244	Mar 27 15:37 1998	./mcnp4b/exec/olib/sursrc.o
rw-rw-rw-	229/20	4440	Mar 27 15:37 1998	./mcnp4b/exec/olib/talloc.o
rw-rw-rw-	229/20	12952	Mar 27 15:37 1998	./mcnp4b/exec/olib/tally.o
rw-rw-rw-	229/20	12680	Mar 27 15:37 1998	./mcnp4b/exec/olib/tallyd.o
rw-rw-rw-	229/20	5936	Mar 27 15:37 1998	./mcnp4b/exec/olib/tallyh.o
rw-rw-rw-	229/20	9072	Mar 27 15:37 1998	./mcnp4b/exec/olib/tallyp.o
rw-rw-rw-	229/20	5136	Mar 27 15:37 1998	./mcnp4b/exec/olib/tallyq.o
rw-rw-rw-	229/20	1272	Mar 27 15:37 1998	./mcnp4b/exec/olib/tallyx.o
rw-rw-rw-	229/20	3724	Mar 27 15:37 1998	./mcnp4b/exec/olib/talph.o
rw-rw-rw-	229/20	3604	Mar 27 15:37 1998	./mcnp4b/exec/olib/talshf.o
rw-rw-rw-	229/20	1180	Mar 27 15:37 1998	./mcnp4b/exec/olib/tarea.o
rw-rw-rw-	229/20	8900	Mar 27 15:37 1998	./mcnp4b/exec/olib/tekdrv.o
rw-rw-rw-	229/20	2296	Mar 27 15:37 1998	./mcnp4b/exec/olib/tgtvel.o
rw-rw-rw-	229/20	836	Mar 27 15:37 1998	./mcnp4b/exec/olib/timint.o
rw-rw-rw-	229/20	2688	Mar 27 15:37 1998	./mcnp4b/exec/olib/torus.o
rw-rw-rw-	229/20	10868	Mar 27 15:37 1998	./mcnp4b/exec/olib/tpefil.o
rw-rw-rw-	229/20	6828	Mar 27 15:38 1998	./mcnp4b/exec/olib/track.o
rw-rw-rw-	229/20	2396	Mar 27 15:38 1998	./mcnp4b/exec/olib/transm.o
rw-rw-rw-	229/20	5004	Mar 27 15:38 1998	./mcnp4b/exec/olib/trfmat.o
rw-rw-rw-	229/20	5148	Mar 27 15:38 1998	./mcnp4b/exec/olib/trfsrf.o
rw-rw-rw-	229/20	3884	Mar 27 15:38 1998	./mcnp4b/exec/olib/trnspt.o
rw-rw-rw-	229/20	4168	Mar 27 15:38 1998	./mcnp4b/exec/olib/ttbr.o
rw-rw-rw-	229/20	692	Mar 27 15:38 1998	./mcnp4b/exec/olib/ttyint.o
rw-rw-rw-	229/20	4036	Mar 27 15:38 1998	./mcnp4b/exec/olib/ufiles.o
rw-rw-rw-	229/20	5428	Mar 27 15:38 1998	./mcnp4b/exec/olib/unimaz.o
rw-rw-rw-	229/20	2096	Mar 27 15:38 1998	./mcnp4b/exec/olib/unique.o
rw-rw-rw-	229/20	1812	Mar 27 15:38 1998	./mcnp4b/exec/olib/uplev.o
rw-rw-rw-	229/20	1204	Mar 27 15:38 1998	./mcnp4b/exec/olib/uplpos.o
rw-rw-rw-	229/20	1436	Mar 27 15:38 1998	./mcnp4b/exec/olib/utask.o
rw-rw-rw-	229/20	9688	Mar 27 15:38 1998	./mcnp4b/exec/olib/viewz.o
rw-rw-rw-	229/20	1672	Mar 27 15:38 1998	./mcnp4b/exec/olib/voidcd.o
rw-rw-rw-	229/20	6324	Mar 27 15:38 1998	./mcnp4b/exec/olib/volume.o



rw-rw-rw-	229/20	1988	Mar	27	15:38	1998	./mcnp4b/exec/olib/vtask.o
rw-rw-rw-	229/20	2768	Mar	27	15:38	1998	./mcnp4b/exec/olib/wgtul.o
rw-rw-rw-	229/20	1472	Mar	27	15:38	1998	./mcnp4b/exec/olib/wgtwwg.o
rw-rw-rw-	229/20	5036	Mar	27	15:38	1998	./mcnp4b/exec/olib/wrwssa.o
rw-rw-rw-	229/20	4012	Mar	27	15:38	1998	./mcnp4b/exec/olib/wtcalc.o
rw-rw-rw-	229/20	4416	Mar	27	15:38	1998	./mcnp4b/exec/olib/wtmult.o
rw-rw-rw-	229/20	1960	Mar	27	15:38	1998	./mcnp4b/exec/olib/wtwndo.o
rw-rw-rw-	229/20	5580	Mar	27	15:38	1998	./mcnp4b/exec/olib/wwfile.o
rw-rw-rw-	229/20	3648	Mar	27	15:38	1998	./mcnp4b/exec/olib/wwval.o
rw-rw-rw-	229/20	4096	Mar	27	15:38	1998	./mcnp4b/exec/olib/xact.o
rw-rw-rw-	229/20	2020	Mar	27	15:38	1998	./mcnp4b/exec/olib/xsec.o
rw-rw-rw-	229/20	9092	Mar	27	15:38	1998	./mcnp4b/exec/olib/xsgen.o
rw-rw-rw-	229/20	4412	Mar	27	15:38	1998	./mcnp4b/exec/olib/xsprmr.o
rw-rw-rw-	229/20	3352	Mar	27	15:38	1998	./mcnp4b/exec/olib/ypbssp.o
rw-rw-rw-	229/20	1268	Mar	27	15:38	1998	./mcnp4b/exec/olib/zaid.o
rw-rw-rw-	229/20	4360	Mar	27	15:38	1998	./mcnp4b/exec/olib/zblat.o
rw-rw-rw-	229/20	632	Mar	27	15:28	1998	./mcnp4b/exec/makemcnp
rw-----	229/20	1911	Mar	1	13:26	1996	./mcnp4b/exec/inp03
rw-----	229/20	1052	Mar	1	13:31	1996	./mcnp4b/exec/inp04
rw-rw-rw-	229/20	4067098	Mar	27	15:23	1998	./mcnp4b/exec/mcnp4b.id
rw-----	229/20	2164	Mar	1	13:31	1996	./mcnp4b/exec/inp05
rw-----	229/20	1599	Mar	1	13:32	1996	./mcnp4b/exec/inp06
rw-----	229/20	1539	Mar	1	13:32	1996	./mcnp4b/exec/inp07
rw-----	229/20	3287	Mar	4	08:53	1996	./mcnp4b/exec/inp08
rw-----	229/20	1261	Mar	1	15:56	1996	./mcnp4b/exec/inp09
rw-----	229/20	1004	Mar	1	13:34	1996	./mcnp4b/exec/inp10
rw-----	229/20	2023	Mar	2	12:21	1996	./mcnp4b/exec/inp11
rw-----	229/20	46304	Mar	4	09:00	1996	./mcnp4b/exec/inp12
rw-----	229/20	1172	Mar	1	11:10	1996	./mcnp4b/exec/inp13
rw-----	229/20	2459	Mar	1	13:52	1996	./mcnp4b/exec/inp14
rw-----	229/20	1104	Mar	1	13:53	1996	./mcnp4b/exec/inp15
rw-----	229/20	2220	Mar	1	13:54	1996	./mcnp4b/exec/inp16
rw-----	229/20	968	Mar	1	13:54	1996	./mcnp4b/exec/inp17
rw-----	229/20	4323	Mar	4	07:50	1996	./mcnp4b/exec/inp18
rw-----	229/20	567	Mar	1	13:55	1996	./mcnp4b/exec/inp19
rw-----	229/20	1171	Mar	1	13:56	1996	./mcnp4b/exec/inp20
rw-----	229/20	8134	Mar	2	12:03	1996	./mcnp4b/exec/inp21
rw-----	229/20	7496	Mar	1	15:25	1996	./mcnp4b/exec/inp22
rw-----	229/20	5496	Mar	1	15:26	1996	./mcnp4b/exec/inp23
rw-----	229/20	2096	Mar	1	13:13	1996	./mcnp4b/exec/inp24
rw-----	229/20	42	Feb	29	14:35	1996	./mcnp4b/exec/inp25
rw-----	229/20	42	Feb	29	14:35	1996	./mcnp4b/exec/inp26
rw-----	229/20	917	Mar	1	15:27	1996	./mcnp4b/exec/inp27
rw-----	229/20	5756	Feb	29	14:35	1996	./mcnp4b/exec/inp28
rw-----	229/20	839	Mar	4	08:00	1996	./mcnp4b/exec/inp29
rw-r--r--	229/20	6853	Jan	6	14:04	1997	./mcnp4b/exec/mct101
rw-r--r--	229/20	15297	Jan	6	14:04	1997	./mcnp4b/exec/mct102
rw-r--r--	229/20	1793	Jan	6	14:04	1997	./mcnp4b/exec/mct103
rw-r--r--	229/20	11301	Jan	6	14:04	1997	./mcnp4b/exec/mct104
rw-r--r--	229/20	2199	Jan	6	14:04	1997	./mcnp4b/exec/mct105
rw-r--r--	229/20	4956	Jan	6	14:04	1997	./mcnp4b/exec/mct106
rw-r--r--	229/20	1472	Jan	6	14:04	1997	./mcnp4b/exec/mct107
rw-r--r--	229/20	3457	Jan	6	14:04	1997	./mcnp4b/exec/mct108
rw-r--r--	229/20	17893	Jan	6	14:04	1997	./mcnp4b/exec/mct109
rw-r--r--	229/20	748	Jan	6	14:04	1997	./mcnp4b/exec/mct110
rw-r--r--	229/20	4562	Jan	6	14:04	1997	./mcnp4b/exec/mct111
rw-r--r--	229/20	3600	Jan	6	14:04	1997	./mcnp4b/exec/mct112
rw-r--r--	229/20	2889	Jan	6	14:04	1997	./mcnp4b/exec/mct113
rw-r--r--	229/20	3212	Jan	6	14:04	1997	./mcnp4b/exec/mct114
rw-r--r--	229/20	771	Jan	6	14:04	1997	./mcnp4b/exec/mct115
rw-r--r--	229/20	1366	Jan	6	14:04	1997	./mcnp4b/exec/mct116
rw-r--r--	229/20	11346	Jan	6	14:04	1997	./mcnp4b/exec/mct117
rw-r--r--	229/20	8487	Jan	6	14:04	1997	./mcnp4b/exec/mct118
rw-r--r--	229/20	2414	Jan	6	14:04	1997	./mcnp4b/exec/mct119
rw-r--r--	229/20	9663	Jan	6	14:04	1997	./mcnp4b/exec/mct120
rw-r--r--	229/20	23069	Jan	6	14:04	1997	./mcnp4b/exec/mct121
rw-r--r--	229/20	1503	Jan	6	14:04	1997	./mcnp4b/exec/mct122
rw-r--r--	229/20	2944	Jan	6	14:04	1997	./mcnp4b/exec/mct123
rw-r--r--	229/20	1240	Jan	6	14:04	1997	./mcnp4b/exec/mct124
rw-r--r--	229/20	1472	Jan	6	14:04	1997	./mcnp4b/exec/mct125

RW-R--R--	229/20	18897	Jan	6	14:04	1997	./mcnp4b/exec/mct126
RW-R--R--	229/20	3062	Jan	6	14:04	1997	./mcnp4b/exec/mct127
RW-R--R--	229/20	37974	Jan	6	14:04	1997	./mcnp4b/exec/mct128
RW-R--R--	229/20	1380	Jan	6	14:04	1997	./mcnp4b/exec/mct129
RW-R--R--	229/20	109352	Jan	6	14:04	1997	./mcnp4b/exec/outp01
RW-R--R--	229/20	116665	Jan	6	14:04	1997	./mcnp4b/exec/outp02
RW-R--R--	229/20	19769	Jan	6	14:04	1997	./mcnp4b/exec/outp03
RW-R--R--	229/20	144259	Jan	6	14:04	1997	./mcnp4b/exec/outp04
RW-R--R--	229/20	22577	Jan	6	14:04	1997	./mcnp4b/exec/outp05
RW-R--R--	229/20	34544	Jan	6	14:04	1997	./mcnp4b/exec/outp06
RW-R--R--	229/20	75653	Jan	6	14:04	1997	./mcnp4b/exec/outp07
RW-R--R--	229/20	176554	Jan	6	14:04	1997	./mcnp4b/exec/outp08
RW-R--R--	229/20	57202	Jan	6	14:04	1997	./mcnp4b/exec/outp09
RW-R--R--	229/20	31787	Jan	6	14:04	1997	./mcnp4b/exec/outp10
RW-R--R--	229/20	56608	Jan	6	14:04	1997	./mcnp4b/exec/outp11
RW-R--R--	229/20	170494	Jan	6	14:04	1997	./mcnp4b/exec/outp12
RW-R--R--	229/20	89657	Jan	6	14:04	1997	./mcnp4b/exec/outp13
RW-R--R--	229/20	31715	Jan	6	14:04	1997	./mcnp4b/exec/outp14
RW-R--R--	229/20	44841	Jan	6	14:04	1997	./mcnp4b/exec/outp15
RW-R--R--	229/20	51524	Jan	6	14:04	1997	./mcnp4b/exec/outp16
RW-R--R--	229/20	107636	Jan	6	14:04	1997	./mcnp4b/exec/outp17
RW-R--R--	229/20	77712	Jan	6	14:04	1997	./mcnp4b/exec/outp18
RW-R--R--	229/20	14787	Jan	6	14:04	1997	./mcnp4b/exec/outp19
RW-R--R--	229/20	54656	Jan	6	14:04	1997	./mcnp4b/exec/outp20
RW-R--R--	229/20	81680	Jan	6	14:04	1997	./mcnp4b/exec/outp21
RW-R--R--	229/20	52192	Jan	6	14:04	1997	./mcnp4b/exec/outp22
RW-R--R--	229/20	91245	Jan	6	14:04	1997	./mcnp4b/exec/outp23
RW-R--R--	229/20	33164	Jan	6	14:04	1997	./mcnp4b/exec/outp24
RW-R--R--	229/20	17877	Jan	6	14:04	1997	./mcnp4b/exec/outp25
RW-R--R--	229/20	57594	Jan	6	14:04	1997	./mcnp4b/exec/outp26
RW-R--R--	229/20	17907	Jan	6	14:04	1997	./mcnp4b/exec/outp27
RWXR-XR-X	229/20	13492	Mar	27	14:59	1998	./mcnp4b/exec/readmaag
RW-R--R--	229/20	144379	Jan	6	14:04	1997	./mcnp4b/exec/outp28
RW-R--R--	229/20	36905	Jan	6	14:04	1997	./mcnp4b/exec/outp29
RW-RW-RW	229/20	109352	Mar	27	15:39	1998	./mcnp4b/exec/inp01o
RW-RW-RW	229/20	33468	Mar	27	15:39	1998	./mcnp4b/exec/inp01p
RW-RW-RW	229/20	116665	Mar	27	15:39	1998	./mcnp4b/exec/inp02o
RW-RW-RW	229/20	6853	Mar	27	15:39	1998	./mcnp4b/exec/inp01m
RW-RW-RW	229/20	0	Mar	27	15:39	1998	./mcnp4b/exec/difm01
RW-RW-RW	229/20	0	Mar	27	15:39	1998	./mcnp4b/exec/difo01
RW-RW-RW	229/20	25038	Mar	27	15:39	1998	./mcnp4b/exec/inp02p
RW-RW-RW	229/20	19769	Mar	27	15:40	1998	./mcnp4b/exec/inp03o
RW-RW-RW	229/20	15297	Mar	27	15:39	1998	./mcnp4b/exec/inp02m
RW-RW-RW	229/20	0	Mar	27	15:39	1998	./mcnp4b/exec/difm02
RW-RW-RW	229/20	0	Mar	27	15:39	1998	./mcnp4b/exec/difo02
RW-RW-RW	229/20	144259	Mar	27	15:40	1998	./mcnp4b/exec/inp04o
RW-RW-RW	229/20	1793	Mar	27	15:40	1998	./mcnp4b/exec/inp03m
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difm03
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difo03
RW-RW-RW	229/20	22577	Mar	27	15:40	1998	./mcnp4b/exec/inp05o
RW-RW-RW	229/20	11301	Mar	27	15:40	1998	./mcnp4b/exec/inp04m
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difm04
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difo04
RW-RW-RW	229/20	34544	Mar	27	15:40	1998	./mcnp4b/exec/inp06o
RW-RW-RW	229/20	2199	Mar	27	15:40	1998	./mcnp4b/exec/inp05m
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difm05
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difo05
RW-RW-RW	229/20	75653	Mar	27	15:41	1998	./mcnp4b/exec/inp07o
RW-RW-RW	229/20	4956	Mar	27	15:40	1998	./mcnp4b/exec/inp06m
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difm06
RW-RW-RW	229/20	0	Mar	27	15:40	1998	./mcnp4b/exec/difo06
RW-RW-RW	229/20	1472	Mar	27	15:41	1998	./mcnp4b/exec/inp07m
RW-RW-RW	229/20	176554	Mar	27	15:41	1998	./mcnp4b/exec/inp08o
RW-RW-RW	229/20	481295	Mar	27	15:41	1998	./mcnp4b/exec/inp07w
RW-RW-RW	229/20	0	Mar	27	15:41	1998	./mcnp4b/exec/difm07
RW-RW-RW	229/20	0	Mar	27	15:41	1998	./mcnp4b/exec/difo07
RW-RW-RW	229/20	812	Mar	27	15:41	1998	./mcnp4b/exec/inp08p
RW-RW-RW	229/20	57202	Mar	27	15:41	1998	./mcnp4b/exec/inp09o
RW-RW-RW	229/20	3457	Mar	27	15:41	1998	./mcnp4b/exec/inp08m
RW-RW-RW	229/20	0	Mar	27	15:41	1998	./mcnp4b/exec/difm08

rw-rw-rw-	229/20	0	Mar 27 15:41 1998	./mcnp4b/exec/difo08
rw-rw-rw-	229/20	17893	Mar 27 15:41 1998	./mcnp4b/exec/inp09m
rw-rw-rw-	229/20	180036	Mar 27 15:41 1998	./mcnp4b/exec/inp09s
rw-rw-rw-	229/20	17907	Mar 27 15:47 1998	./mcnp4b/exec/inp27o
rw-rw-rw-	229/20	180036	Mar 27 15:47 1998	./mcnp4b/exec/inp26s
rw-rw-rw-	229/20	0	Mar 27 15:41 1998	./mcnp4b/exec/difm09
rw-rw-rw-	229/20	0	Mar 27 15:41 1998	./mcnp4b/exec/difo09
rw-rw-rw-	229/20	31787	Mar 27 15:42 1998	./mcnp4b/exec/inp10o
rw-rw-rw-	229/20	56608	Mar 27 15:42 1998	./mcnp4b/exec/inp11o
rw-rw-rw-	229/20	748	Mar 27 15:42 1998	./mcnp4b/exec/inp10m
rw-rw-rw-	229/20	0	Mar 27 15:42 1998	./mcnp4b/exec/difm10
rw-rw-rw-	229/20	0	Mar 27 15:42 1998	./mcnp4b/exec/difo10
rw-rw-rw-	229/20	170494	Mar 27 15:43 1998	./mcnp4b/exec/inp12o
rw-rw-rw-	229/20	4562	Mar 27 15:42 1998	./mcnp4b/exec/inp11m
rw-rw-rw-	229/20	0	Mar 27 15:42 1998	./mcnp4b/exec/difm11
rw-rw-rw-	229/20	0	Mar 27 15:42 1998	./mcnp4b/exec/difo11
rw-rw-rw-	229/20	89657	Mar 27 15:43 1998	./mcnp4b/exec/inp13o
rw-rw-rw-	229/20	3600	Mar 27 15:43 1998	./mcnp4b/exec/inp12m
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difm12
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difo12
rw-rw-rw-	229/20	31715	Mar 27 15:43 1998	./mcnp4b/exec/inp14o
rw-rw-rw-	229/20	2889	Mar 27 15:43 1998	./mcnp4b/exec/inp13m
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difm13
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difo13
rw-rw-rw-	229/20	44841	Mar 27 15:43 1998	./mcnp4b/exec/inp15o
rw-rw-rw-	229/20	3212	Mar 27 15:43 1998	./mcnp4b/exec/inp14m
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difm14
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difo14
rw-rw-rw-	229/20	51524	Mar 27 15:43 1998	./mcnp4b/exec/inp16o
rw-rw-rw-	229/20	771	Mar 27 15:43 1998	./mcnp4b/exec/inp15m
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difm15
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difo15
rw-rw-rw-	229/20	77712	Mar 27 15:44 1998	./mcnp4b/exec/inp18o
rw-rw-rw-	229/20	1366	Mar 27 15:43 1998	./mcnp4b/exec/inp16m
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difm16
rw-rw-rw-	229/20	0	Mar 27 15:43 1998	./mcnp4b/exec/difo16
rw-rw-rw-	229/20	107636	Mar 27 15:44 1998	./mcnp4b/exec/inp17o
rw-rw-rw-	229/20	180036	Mar 27 15:44 1998	./mcnp4b/exec/inp18s
rw-rw-rw-	229/20	11346	Mar 27 15:44 1998	./mcnp4b/exec/inp17m
rw-rw-rw-	229/20	0	Mar 27 15:44 1998	./mcnp4b/exec/difm17
rw-rw-rw-	229/20	0	Mar 27 15:44 1998	./mcnp4b/exec/difo17
rw-rw-rw-	229/20	1443	Mar 27 15:44 1998	./mcnp4b/exec/inp18p
rw-rw-rw-	229/20	14787	Mar 27 15:45 1998	./mcnp4b/exec/inp19o
rw-rw-rw-	229/20	8487	Mar 27 15:44 1998	./mcnp4b/exec/inp18m
rw-rw-rw-	229/20	0	Mar 27 15:44 1998	./mcnp4b/exec/difm18
rw-rw-rw-	229/20	0	Mar 27 15:44 1998	./mcnp4b/exec/difo18
rw-rw-rw-	229/20	54656	Mar 27 15:45 1998	./mcnp4b/exec/inp20o
rw-rw-rw-	229/20	2414	Mar 27 15:45 1998	./mcnp4b/exec/inp19m
rw-rw-rw-	229/20	0	Mar 27 15:45 1998	./mcnp4b/exec/difm19
rw-rw-rw-	229/20	0	Mar 27 15:45 1998	./mcnp4b/exec/difo19
rw-rw-rw-	229/20	81680	Mar 27 15:46 1998	./mcnp4b/exec/inp21o
rw-rw-rw-	229/20	9663	Mar 27 15:45 1998	./mcnp4b/exec/inp20m
rw-rw-rw-	229/20	0	Mar 27 15:45 1998	./mcnp4b/exec/difm20
rw-rw-rw-	229/20	0	Mar 27 15:45 1998	./mcnp4b/exec/difo20
rw-rw-rw-	229/20	23069	Mar 27 15:46 1998	./mcnp4b/exec/inp21m
rw-rw-rw-	229/20	52192	Mar 27 15:46 1998	./mcnp4b/exec/inp22o
rw-rw-rw-	229/20	3420431	Mar 27 15:46 1998	./mcnp4b/exec/inp21w
rw-rw-rw-	229/20	0	Mar 27 15:46 1998	./mcnp4b/exec/difm21
rw-rw-rw-	229/20	0	Mar 27 15:46 1998	./mcnp4b/exec/difo21
rw-rw-rw-	229/20	91245	Mar 27 15:47 1998	./mcnp4b/exec/inp23o
rw-rw-rw-	229/20	1503	Mar 27 15:46 1998	./mcnp4b/exec/inp22m
rw-rw-rw-	229/20	0	Mar 27 15:46 1998	./mcnp4b/exec/difm22
rw-rw-rw-	229/20	0	Mar 27 15:46 1998	./mcnp4b/exec/difo22
rw-rw-rw-	229/20	31209	Mar 27 15:47 1998	./mcnp4b/exec/inp23p
rw-rw-rw-	229/20	33164	Mar 27 15:47 1998	./mcnp4b/exec/inp24o
rw-rw-rw-	229/20	2944	Mar 27 15:47 1998	./mcnp4b/exec/inp23m
rw-rw-rw-	229/20	0	Mar 27 15:47 1998	./mcnp4b/exec/difm23
rw-rw-rw-	229/20	0	Mar 27 15:47 1998	./mcnp4b/exec/difo23
rw-rw-rw-	229/20	180036	Mar 27 15:47 1998	./mcnp4b/exec/inp24s
rw-rw-rw-	229/20	57594	Mar 27 15:47 1998	./mcnp4b/exec/inp26o

IV-IV-IV-	229/20	1240	Mar 27 15:47	1998	./mcp4b/exec/imp24m
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm24
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm24
IV-IV-IV-	229/20	17877	Mar 27 15:47	1998	./mcp4b/exec/imp25s
IV-IV-IV-	229/20	180036	Mar 27 15:47	1998	./mcp4b/exec/imp25s
IV-IV-IV-	229/20	1472	Mar 27 15:47	1998	./mcp4b/exec/imp25m
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm25
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm25
IV-IV-IV-	229/20	3971	Mar 27 14:59	1998	./mcp4b/exec/install1
IV-IV-IV-	229/20	18897	Mar 27 15:47	1998	./mcp4b/exec/imp26m
IV-IV-IV-	229/20	644815	Mar 27 15:47	1998	./mcp4b/exec/di_fm26
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm26
IV-IV-IV-	229/20	37974	Mar 27 15:47	1998	./mcp4b/exec/imp28m
IV-IV-IV-	229/20	3062	Mar 27 15:47	1998	./mcp4b/exec/imp27m
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm27
IV-IV-IV-	229/20	36905	Mar 27 15:47	1998	./mcp4b/exec/di_fm27
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/di_fm28
IV-IV-IV-	229/20	144379	Mar 27 15:47	1998	./mcp4b/exec/di_fm28
IV-IV-IV-	229/20	0	Mar 27 15:47	1998	./mcp4b/exec/imp28c
IV-IV-IV-	229/20	4523	Mar 27 14:59	1998	./mcp4b/exec/INSTALL.VMS
IV-IV-IV-	229/20	193536	Mar 27 14:59	1998	./mcp4b/exec/TESTING.VMS
IV-IV-IV-	229/20	16038097	Mar 27 14:59	1998	./mcp4b/exec/testlib1
IV-IV-IV-	229/20	1380	Mar 27 15:48	1998	./mcp4b/exec/imp29m
IV-IV-IV-	229/20	0	Mar 27 15:48	1998	./mcp4b/exec/di_fm29
IV-IV-IV-	229/20	0	Mar 27 15:48	1998	./mcp4b/exec/di_fm29
IV-IV-IV-	229/20	0	Mar 31 08:17	1998	./mcp4b/exec/di_fm29
IV-IV-IV-	229/20	0	Mar 31 15:58	1998	./mcp4b/ver-val/
IV-IV-IV-	229/20	0	Mar 27 16:55	1998	./mcp4b/ver-val/shield/mcnp symbolic link to
./././exec/mcnp					
IV-IV-IV-	229/20	430511	Mar 30 18:18	1998	./mcp4b/ver-val/shield/mc10newo
IV-IV-IV-	229/20	25500	Mar 30 08:25	1998	./mcp4b/ver-val/shield/uekl.1o
IV-IV-IV-	229/20	146	Mar 27 16:57	1998	./mcp4b/ver-val/shield/runshld1
IV-IV-IV-	229/20	145	Mar 27 16:57	1998	./mcp4b/ver-val/shield/runshld2
IV-IV-IV-	229/20	63	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/
IV-IV-IV-	229/20	53	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mc10rg3c.z
IV-IV-IV-	229/20	940	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mc10rgdc.z
IV-IV-IV-	229/20	1090	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.11.z
IV-IV-IV-	229/20	6866	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.12.z
IV-IV-IV-	229/20	32943	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.13.z
IV-IV-IV-	229/20	8098	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mc10rg2.z
IV-IV-IV-	229/20	32469	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mc10rgp.z
IV-IV-IV-	229/20	1268	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mc10rg2pr.z
IV-IV-IV-	229/20	910	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.15.z
IV-IV-IV-	229/20	1076	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.2.z
IV-IV-IV-	229/20	1198	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.21.z
IV-IV-IV-	229/20	1382	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.22.z
IV-IV-IV-	229/20	1483	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.25.z
IV-IV-IV-	229/20	1961	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.26.z
IV-IV-IV-	229/20	1024	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.27.z
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IV-IV-IV-	229/20	1125	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.33.z
IV-IV-IV-	229/20	1213	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.34.z
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IV-IV-IV-	229/20	12524	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/mcnp.z
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IV-IV-IV-	229/20	33335	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl4.z
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IV-IV-IV-	229/20	1175	Mar 27 15:53	1998	./mcp4b/ver-val/shield/plots/uekl.1.z
IV-IV-IV-	229/20				./mcp4b/ver-val/shield/plots/uekl.14.z

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FW-Y-----	229/20	2248	Mar 27 15:53	1998	./mcnp4b/ver-val/shield/ueki.5
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FW-FW-FW	229/20	28831	Mar 30 09:41	1998	./mcnp4b/ver-val/shield/ueki.210
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FW-FW-FW	229/20	30020	Mar 30 10:42	1998	./mcnp4b/ver-val/shield/ueki.250
FW-FW-FW	229/20	32832	Mar 30 11:15	1998	./mcnp4b/ver-val/shield/ueki.260
FW-FW-FW	229/20	49473	Mar 30 11:44	1998	./mcnp4b/ver-val/shield/ueki.270
FW-FW-FW	229/20	25727	Mar 30 11:52	1998	./mcnp4b/ver-val/shield/ueki.310
FW-FW-FW	229/20	26333	Mar 30 11:56	1998	./mcnp4b/ver-val/shield/ueki.320
FW-FW-FW	229/20	29570	Mar 30 12:01	1998	./mcnp4b/ver-val/shield/ueki.330
FW-FW-FW	229/20	33195	Mar 30 12:17	1998	./mcnp4b/ver-val/shield/ueki.340
FW-FW-FW	229/20	35983	Mar 30 13:21	1998	./mcnp4b/ver-val/shield/ueki.350
FW-FW-FW	229/20	25594	Mar 30 13:33	1998	./mcnp4b/ver-val/shield/ueki.40
FW-FW-FW	229/20	29286	Mar 30 15:29	1998	./mcnp4b/ver-val/shield/ueki.50
FW-FW-FW	229/20	6942720	Mar 31 08:24	1998	./mcnp4b/ver-val/smlset.opus
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FW-Y--Y--	229/20	5160	Mar 27 15:53	1998	./mcnp4b/ver-val/endif5/exp22
FW-Y--Y--	229/20	5259	Mar 27 15:53	1998	./mcnp4b/ver-val/endif5/exp23
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FW-Y--Y--	229/20	5420	Mar 27 15:53	1998	./mcnp4b/ver-val/endif5/exp26
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.../exec/mcnp					
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FW-FW-FW	229/20	241429	Mar 28 12:38	1998	./mcnp4b/ver-val/endif5/LA1X50
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FW-Y--Y--	229/20	146972	Mar 27 15:53	1998	./mcnp4b/ver-val/endif5/xsdir

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RW-R--R--	229/20	5723	Mar 27	15:53	1998	./mcnp4b/ver-val/endif5/exp1
RW-RW-RW	229/20	935571	Mar 28	03:32	1998	./mcnp4b/ver-val/endif5/exp23o
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RW-RW-RW	229/20	853564	Mar 28	08:54	1998	./mcnp4b/ver-val/endif5/exp26o
RW-RW-RW	229/20	903521	Mar 28	10:07	1998	./mcnp4b/ver-val/endif5/exp27o
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RW-RW-RW	229/20	271384	Mar 28	13:07	1998	./mcnp4b/ver-val/endif5/LA3X5o
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RW-RW-RW	229/20	175648	Mar 30	07:25	1998	./mcnp4b/ver-val/endif6/godivao
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RW-R--R--	229/20	3169	Mar 31	08:16	1998	./mcnp4b/ver-val/smlset/probl
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RW-RW-RW	229/20	241421	Mar 31	08:16	1998	./mcnp4b/ver-val/smlset/LA1Xo
RW-R--R--	229/20	5050	Mar 31	08:16	1998	./mcnp4b/ver-val/smlset/LA3
RW-RW-RW	229/20	287883	Mar 31	08:16	1998	./mcnp4b/ver-val/smlset/LA3o
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## **1. Introduction**

The "Selection of MCNP Cross Section Libraries" report documents the selection of continuous-energy cross section libraries to be used with MCNP (Ref. 1) in criticality benchmark calculations. This report contains comparative graphical representations of the various continuous-energy cross section libraries available for each element or isotope. In the context of this report, the term "cross section library" refers to an individual cross section data table, delineated by a unique MCNP ZAID (cross section data table identifier), for any element or isotope.

### **1.1. Background**

MCNP has the capability to model complex geometries and implement continuous-energy cross section libraries rather than only multi-group cross section libraries. For these reasons, MCNP is currently used by the Waste Package Design Department (WPDD) to perform criticality, shielding, and other particle-transport-based calculations. Cross section libraries must be assigned to each element or isotope defining a material composition in an MCNP input deck. Multiple continuous-energy cross section libraries are available for use with many elements and isotopes. A specified set of continuous-energy cross section libraries must be established to ensure consistency throughout the various criticality benchmark and design calculations.

### **1.2. Objective**

The objective of the "Selection of MCNP Cross Section Libraries" report is to present the basis for selecting specific MCNP cross section libraries to be used in the criticality benchmark calculations that support the "Disposal Criticality Analysis Methodology Topical Report." The "Disposal Criticality Analysis Methodology Topical Report" will be presented to the United States Nuclear Regulatory Commission when approved by the United States Department of Energy Office of Civilian Radioactive Waste Management.

### **1.3. Scope**

The "Selection of MCNP Cross Section Libraries" report will present the reasoning for selecting specific MCNP cross section libraries. The report is to be a supporting document for other reports and calculations that will support the "Disposal Criticality Analysis Methodology Topical Report."

### **1.4. Quality Assurance (QA)**

The QA program applies to the development of this report. The information provided in the technical document is to be indirectly used in the evaluation of the Mined Geologic Repository waste package and engineered barrier segment. The waste package and engineered barrier segment have been identified as items important to safety, waste isolation, and physical protection of materials in the QAP-2-3 evaluation entitled "Classification of the Preliminary MGDS Repository Design" (Ref. 2, TBV-228). The WPDD responsible manager has evaluated the technical document development activity in accordance with QAP-2-0, "Conduct of

Activities." The QAP-2-0 activity evaluation, "Develop Technical Documents" (Ref. 3), has determined that the preparation and review of this technical document is subject to "Quality Assurance Requirements and Description" (Ref. 4) requirements. As specified in NLP-3-18, "Documentation of QA Controls on Drawings, Specifications, Design Analyses, and Technical Documents," this activity is subject to QA controls.

## 1.5. Use of Computer Software

The MCNP code (Ref. 1) was used to generate the cross section library plots documented in this report. The software specifications are as follow:

- Program Name: MCNP
- Version/Revision Number: Version 4B2
- CSCI Number: 30033 V4BLV
- Computer Type: HP 9000 Series Workstation

The MCNP input file used in the generation of the various cross section plots is presented in Section 5. The MCNP generated cross section plots are contained on the attached CD-ROM identified as Attachment I. The MCNP software used was: (a) appropriate for the application of cross section plotting, (b) used only within the range of validation, (c) obtained from the Software Configuration Manager in accordance with appropriate procedures.

## 2. Description of Cross Section Processing for MCNP

Figure 2.1 presents a graphical representation of the cross section processing for MCNP. Basically, the evaluated nuclear data files are processed into formats which are accessible to neutron transport codes. The evaluated nuclear data files are developed based on experimental measurements, predictions of nuclear models, and evaluator experience. Several sources of evaluated nuclear data files exist. The primary sources of evaluated nuclear data files used in the United States include the following (pp. 2-17 through 2-18, Ref. 1):

- ENDF/B system
- LLNL (Lawrence Livermore National Laboratory) Evaluated Nuclear Data Library
- LANL (Los Alamos National Laboratory) Nuclear Theory & Applications Group
- Los Alamos Master Data File

Processing codes are used to generate transport code accessible cross section data tables from the evaluated nuclear data files. These processing codes (such as NJOY (Ref. 6)) are comprehensive, sophisticated code packages that process evaluated nuclear data into forms appropriate for application codes. For radiation transport codes, the product of the processing code is a multi-group or pointwise (continuous-energy) cross section library.

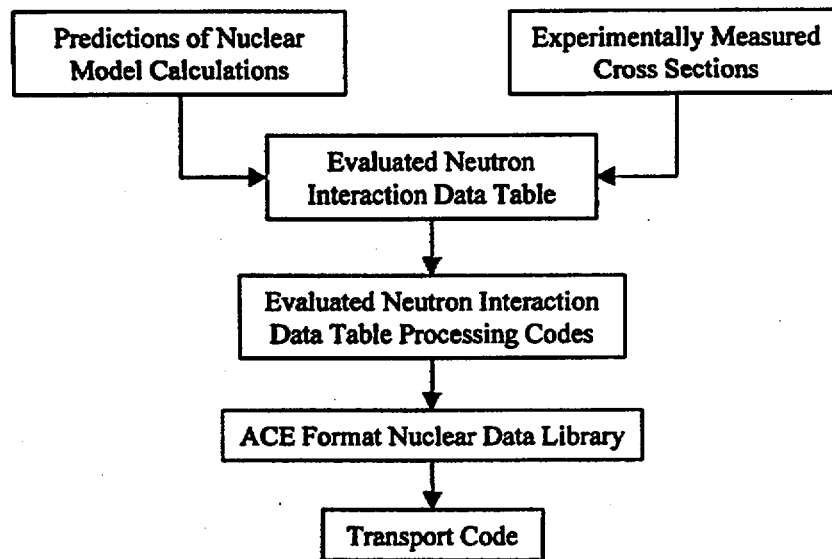
This report discusses the selection of continuous-energy cross section libraries for use in MCNP criticality calculations. The continuous-energy cross section libraries are processed into the ACE format (p. F-1, Ref. 1) by various national laboratories. The ACE format cross section libraries are then distributed with the MCNP software.



The continuous-energy cross section libraries are essentially cross section tables containing all cross sections tabulated on a fixed main energy grid. The characteristics of the fixed main energy grid are the same for a given library, but may differ between various libraries. The main energy grid for each cross section library is fine enough that MCNP can use a linear-linear interpolation between energy points to reproduce the evaluated cross sections within a specified tolerance. Generally, this specified tolerance for data reproduction is established as being within 1% of the data contained in the evaluation (p. 2-18, Ref. 1). Therefore, the particle energies in the cross section tables are truly continuous. Each nuclear reaction is represented separately in the cross section tables. For each individual reaction, secondary particle angular and energy distributions are provided as a function of incident neutron energy (at specific energies with interpolation between energies). The cross section tables also contain other information needed by MCNP such as multiplicities, atomic weight ratios, average  $\nu$  (prompt, total, or both prompt and total), average heating numbers, and reaction Q-values. The generated cross section tables are essentially application independent. The format of the cross section tables allow the transport codes to utilize the nuclear data in as much detail as required. Information on continuous-energy cross section data tables is available on pages F-4 through F-31 of Reference 1.

The use of the continuous-energy cross section libraries in MCNP involve some neutron physics approximations. Information on these neutron physics approximations are provided on pages 2-27 through 2-57 of Reference 1. The following are some of the primary neutron physics approximations:

- (n,xn) reactions are sampled independently (no conservation of energy)
- (n,f) and (n,xn) reactions are sampled as if they occur instantly
- unresolved resonances are treated as average cross sections
- tolerance on the main energy grid is generally set such that the evaluated nuclear data can be reproduced by linear-linear interpolation to within 1%
- angular distributions of scattered neutrons from neutron emitting reactions (as tabulated on reaction-dependent grids of incident neutron energy) are sampled to conserve energy on an average basis rather than on a single collision basis
- evaluated angular distributions for secondary neutrons and photons are approximated in MCNP cross section tables by 32 equally probable cosine bins
- secondary neutron energy distributions are sometimes approximated in MCNP cross section tables by 32 equally probable energy bins.



**Figure 2-1. Sequence for MCNP Cross Section Processing**

### **3. Criteria for Selecting MCNP Cross Section Libraries**

More than one cross section library is available for most of the elements and isotopes for which ACE format cross section libraries have been developed. Some of the reasons for the existence of more than one cross section library for a given element or isotope include:

- different evaluated nuclear data sources
- different processing tolerances
- different temperatures at which the data was processed.

All of the cross section libraries for the various elements and isotopes are considered acceptable for use in MCNP transport calculations. However, depending on the evaluated system, some cross section libraries may provide a better representation of the nuclear reaction probabilities for a given element or isotope. Some things that should be considered when selecting neutron cross section libraries include:

- differences in evaluator's processing criteria (i.e., size optimization criteria for resulting cross section data tables)
- neutron energy spectrum
- temperature at which the evaluated nuclear data was processed to generate the cross section library
- sensitivity of results to different evaluations.

Bias and uncertainty values associated with the use of certain cross section libraries in the evaluation of systems having specific ranges of neutronic characteristics may be determined. The application of bias and uncertainty values to an evaluation is only appropriate if the bias and uncertainty values were determined from benchmark evaluations which bound both the

characteristics of the evaluated system and the utilized cross section libraries. Therefore, it is important to establish a consistent set of cross section libraries to be used in both criticality benchmarks and design calculations. This report documents a set of selected cross section libraries to be used in criticality benchmark and design calculations performed by the WPDD.

The performance of the selected cross section libraries in the evaluation of systems having varying neutronic characteristics may be quantified in the form of bias values through the evaluation of critical benchmarks which are representative of the various configurations. The performance of the selected cross section libraries as presented in this document has been shown to be acceptable based on the evaluation of numerous critical benchmark configurations representing a variety of neutronic characteristics (spectrum, geometry, reflection, etc.) (References 8, 9, 10, 11, and 12).

The following criteria were used to select the continuous-energy cross section libraries for use with MCNP:

- ENDF/B-V based cross section libraries were selected for use when available with the exceptions of H-2, B-11, Zr (natural), Ag-107, Ag-109, Eu-151, and Eu-153
- either ENDF/B-VI, T-2, or LLNL based cross section libraries were selected for use when ENDF/B-V based libraries were not available or selected
- parameters compared when selecting between ENDF/B-VI, T-2, or LLNL based cross section libraries included the following: number of energy points included in the main energy grid, date of evaluation, and availability of certain data.

Section 6 provides a listing of the continuous-energy cross section libraries that were selected for use with MCNP. Descriptions of how the criteria listed above were used to select the various cross section libraries are also provided in Section 6.

#### 4. Available MCNP Cross Section Libraries

Table 4.1 lists all of the continuous-energy MCNP cross section libraries currently available for use by the WPDD. The information in Table 4.1 is obtained from pages G-8 through G-29 of Reference 1. The following index applies to the cross section library filenames in Table 4.1 (p. II-15, Ref. 5):

- endf5p: 23 tables from ENDF/B-V continuous energy
- endf5u: 31 tables from ENDF/B-V continuous energy neutron
- newxs: newly processed evaluations 4/19/91
- rmccs: 64 tables from ENDF/B-V, LANL, and ENDL85 (continuous energy neutron)
- rmccsa: 27 tables from ENDF/B-V, LANL, and ENDL85 (continuous energy neutron)
- kidman: data for a number of fission product nuclides at 300 K
- misc5xs: corrected data for ENDF/B-V based Zr, and data libraries IRNAT, MISCXS, ARKRC, TM169, GDT2GP, and T2DDC
- endf5mt: data previously available in the library EPRIXS (evaluations at various temperatures including 300 K, 600 K, and 900 K for 7 isotopes), along with the U600K data library

- endl85: ENDL85 based continuous energy neutron cross sections
- endf60: 124 nuclides with an individual data file for each (processed with NJOY91 at room temperature (300 K), using flat weighting, and thinned such that most nuclides had no more than 400,000 words)
- 100xs: data files for nuclides having an evaluation extending to 100 MeV

The entries in Table 4.1 are described as follows (pp. G-6 through G-7, Ref. 1):

**ZAID:** The ZAID is the nuclide identification number with the form ZZZAAA.nnX. "ZZZ" is the atomic number. "AAA" is the mass number (000 for naturally occurring elements). "nn" is the neutron cross section identifier. "X"="c" for continuous-energy neutron tables.

**AWR (Atomic Weight Ratio):** The AWR is the ratio of the atomic mass of the nuclide to a neutron. This is the AWR that is contained in the original evaluation and that was used in the NJOY processing of the evaluation. The atomic mass of a neutron is 1.008664904 atomic mass units.

**Library Name:** This entry is the name of the library that contains the data file for that ZAID. The number in brackets following a data file name refers to one of the special notes at the end of Table 4.1.

**Source:** The source indicates the originating evaluation for that data file.

ENDF/B-V.# or ENDF/B-VI.# (such as B-V.0 and B-VI.1) are the Evaluated Nuclear Data Files, a United States effort coordinated by the National Nuclear Data Center at Brookhaven National Laboratory. The evaluations are updated periodically by evaluators from all over the country, and the release number of the evaluation is given. This is not necessarily the same as the ENDF revision number for that evaluation. For example, Pu-242 is noted as ENDF/B-VI.2 as it is from release 2 of ENDF/B-VI, but it is revision 1 of that evaluation.

**LLNL:** This source refers to the evaluated nuclear data libraries compiled by the Nuclear Data Group at Lawrence Livermore National Laboratory. The number in the library name indicates the year the library was produced or received.

**T-2:** This source refers to the nuclear data evaluations performed by the Nuclear Theory and Applications Group T-2 at Los Alamos National Laboratory.

**\_\_:T-2 or \_\_:XTM:** This source identifier indicates that the original evaluation has been modified by the Los Alamos National Laboratory groups T-2 or XTM.

**Eval Date:** This entry indicates the year that the evaluation was completed or accepted. In cases where this information is not known, the date that the data library was produced is given. If minor corrections were made to an evaluation, the original evaluation date was kept. The notation "<1985" means "before" 1985.

Temp: Indicates the temperature (K) at which the data were processed. The temperature enters into the processing of the evaluation into a data file only through the Doppler broadening of cross sections. Doppler broadening refers to a change in cross section resulting from thermal motion of nuclei in a target material. Doppler broadening is done on all cross sections for incident neutrons (non-relativistic energies) on a target at some temperature (Temp) in which the free-atom approximation is valid. In general, an increase in the temperature of the material containing neutron-absorbing nuclei in a homogeneous system results in Doppler broadening of resonances and an increase in resonance absorption. Furthermore, a constant cross section at 0 K goes to  $1/v$  behavior as the temperature increases.

Length: This entry is the total length of the particular cross section file in words. It is understood that the actual storage requirement in an MCNP problem will often be less because certain data that are not needed for a problem may be expunged.

NE: This entry is the number of energy points on the grid used for the neutron cross sections for that data file. In general, a finer energy grid (or greater number of points) indicates a more accurate representation of the cross sections, particularly through the resonance region.

$E_{max}$ : The maximum incident energy for that data file. For all incident neutron energies greater than  $E_{max}$ , MCNP assumes the last cross section value given.

GPD: "yes" means that photon-production data are included. "no" means that photon-production data are not included.

$\bar{\nu}$ : For fissionable material, this entry indicates the type of fission nu data available. "p" means that only prompt nu data are available. "t" means that only total nu data are available. "b" means that both prompt and total nu data are available.

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

Z AID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	$E_{max}$ (MeV)	GPD	$\bar{\nu}$
-------	-----	--------------	--------	-----------	----------	----------------	----	-----------------	-----	-------------

Z=1\*\*\*\*\*Hydrogen\*\*\*\*\*

\*\*H-1\*\*

1001.35c	0.9992	endl85	LLNL	<1985	0	3,506	330	20	yes	no
1001.50c	0.9992	rmccs	B-V.0	1977	294	2,766	244	20	yes	no
1001.53c	0.9992	endf5mt[1]	B-V.0	1977	587	4,001	394	20	yes	no
1001.60c	0.9992	endf60	B-VI.1	1989	294	3,484	357	100	yes	no

\*\*H-2\*\*

1002.35c	1.9968	endl85	LLNL	<1985	0	2,507	135	20	yes	no
1002.50c	1.9968	endf5p	B-V.0	1967	294	3,987	214	20	yes	no
1002.55c	1.9968	rmccs	T-2	1982	294	5,981	285	20	yes	no
1002.60c	1.9968	endf60[2]	B-VI.0	1967[2]	294	2,704	178	20	yes	no

\*\*H-3\*\*

1003.35c	2.9901	endl85	LLNL	<1985	0	1,269	76	20	no	no
1003.50c	2.9901	rmccs	B-V.0	1965	294	2,428	184	20	no	no
1003.60c	2.9901	endf60	B-VI.0	1965	294	3,338	180	20	no	no

Z=2\*\*\*\*\*Helium\*\*\*\*\*

\*\*He-3\*\*

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
2003.35c	2.9901	endl85	LLNL	<1985	0	2,481	182	20	yes	no
2003.50c	2.9901	rmccs	B-V.0	1971	294	2,320	229	20	no	no
2003.60c	2.9890	endf60	B-VI.1	1990	294	2,834	342	20	no	no
<b>**He-4**</b>										
2004.35c	3.9682	endl85	LLNL	<1985	0	1,442	78	20	no	no
2004.50c	4.0015	rmccs	B-V.0	1973	294	3,061	345	20	no	no
2004.60c	4.0015	endf60	B-VI.0	1973	294	2,971	327	20	no	no
<b>Z=3*****Lithium*****</b>										
<b>**Li-6**</b>										
3006.50c	5.9634	rmccs	B-V.0	1977	294	9,932	373	20	yes	no
3006.60c	5.9634	endf60	B-VI.1	1989	294	12,385	498	20	yes	no
<b>**Li-7**</b>										
3007.50c	6.9557	endf5p	B-V.0	1972	294	4,864	343	20	yes	no
3007.55c	6.9557	rmccs	B-V.2	1979	294	13,171	328	20	yes	no
3007.60c	6.9557	endf60	B-VI.0	1988	294	14,567	387	20	yes	no
<b>Z=4*****Beryllium*****</b>										
<b>**Be-7**</b>										
4007.35c	6.9567	endl85	LLNL	<1985	0	1,834	180	20	no	no
<b>**Be-9**</b>										
4009.21c	8.9348	100xs[3]	T-2:XTM	1989	300	28,964	316	100	yes	no
4009.50c	8.9348	rmccs	B-V.0	1976	294	8,886	329	20	yes	no
4009.60c	8.9348	endf60	B-VI.0	1986	294	64,410	276	20	yes	no
<b>Z=5*****Boron*****</b>										
<b>**B-10**</b>										
5010.50c	9.9269	rmccs	B-V.0	1977	294	20,200	514	20	yes	no
5010.53c	9.9269	endf5mt[1]	B-V.0	1977	587	23,676	700	20	yes	no
5010.60c	9.9269	endf60	B-VI.1	1989	294	27,957	673	20	yes	no
<b>**B-11**</b>										
5011.35c	10.9147	endl85	LLNL	<1985	0	4,289	247	20	yes	no
5011.50c	10.9150	endf5p	B-V.0	1974	294	4,344	487	20	no	no
5011.55c	10.9150	rmccsa	B-V.0:T-2	1971	294	12,254	860	20	yes	no
5011.56c	10.9147	newxs	T-2	1986	294	56,929	1,762	20	yes	no
5011.60c	10.9147	endf60	B-VI.0	1989	294	108,351	2,969	20	yes	no
<b>Z=6*****Carbon*****</b>										
<b>**C-nat**</b>										
6000.50c	11.8969	rmccs	B-V.0	1977	294	23,326	875	20	yes	no
6000.60c	11.8980	endf60	B-VI.1	1989	294	22,422	978	32	yes	no
<b>**C-12**</b>										
6012.21c	11.8969	100xs[3]	T-2:XTM	1989	300	28,809	919	100	yes	no
6012.35c	11.8969	endl85	LLNL	<1985	0	5,154	225	20	yes	no
6012.50c	11.8969	rmccs[4,5]	B-V.0	1977	294	23,326	875	20	yes	no
<b>**C-13**</b>										
6013.35c	12.8916	endl85	LLNL	<1985	0	4,886	395	20	yes	no
<b>Z=7*****Nitrogen*****</b>										
<b>**N-14**</b>										
7014.50c	13.8830	rmccs	B-V.0	1973	294	45,457	1,196	20	yes	no
7014.60c	13.8828	endf60	T-2	1992	294	60,397	1,379	20	yes	no
<b>**N-15**</b>										
7015.55c	14.8710	rmccsa	T-2	1983	294	20,920	744	20	yes	no
7015.60c	14.8710	endf60	B-VI.0	1993	294	24,410	653	20	yes	no

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
Z=8*****Oxygen*****										
**O-16**										
8016.21c	15.8575	100xs[3]	T-2:XTM	1989	300	45,016	1,427	100	yes	no
8016.35c	15.8575	endl85	LLNL	<1985	0	10,357	465	20	yes	no
8016.50c	15.8580	rmccs	B-V.0	1972	294	37,942	1,391	20	yes	no
8016.53c	15.8580	endf5mt[1]	B-V.0	1972	587	37,989	1,398	20	yes	no
8016.54c	15.8580	endf5mt[1]	B-V.0	1972	881	38,017	1,402	20	yes	no
8016.60c	15.8532	endf60	B-VI.0	1990	294	58,253	1,609	20	yes	no
**O-17**										
8017.60c	16.8531	endf60	B-VI.0	1978	294	4,200	335	20	no	no
Z=9*****Fluorine*****										
**F-19**										
9019.35c	18.8352	endl85	LLNL	<1985	0	31,547	1,452	20	yes	no
9019.50c	18.8350	endf5p	B-V.0	1976	294	44,130	1,569	20	yes	no
9019.51c	18.8350	rmccs	B-V.0	1976	294	41,442	1,541	20	yes	no
9019.60c	18.8350	endf60	B-VI.0	1990	300	93,826	1,433	20	yes	no
Z=11*****Sodium*****										
**Na-23**										
11023.35c	22.7923	endl85	LLNL	<1985	0	22,777	1,559	20	yes	no
11023.50c	22.7920	endf5p	B-V.0	1977	294	52,252	2,703	20	yes	no
11023.51c	22.7920	rmccs	B-V.0	1977	294	48,863	2,228	20	yes	no
11023.60c	22.7920	endf60	B-VI.1	1977	294	50,294	2,543	20	yes	no
Z=12*****Magnesium*****										
**Mg-nat**										
12000.35c	24.0962	endl85	LLNL	<1985	0	9,686	675	20	yes	no
12000.50c	24.0963	endf5u	B-V.0	1978	294	56,334	2,430	20	yes	no
12000.51c	24.0963	rmccs	B-V.0	1978	294	48,917	1,928	20	yes	no
12000.60c	24.0963	endf60	B-VI.0	1978	294	55,776	2,525	20	yes	no
Z=13*****Aluminum*****										
**Al-27**										
13027.21c	26.7498	100xs[3]	T-2:XTM	1989	300	35,022	1,473	100	yes	no
13027.35c	26.7498	endl85	LLNL	<1985	0	36,895	2,038	20	yes	no
13027.50c	26.7500	rmccs	B-V.0	1973	294	54,162	2,028	20	yes	no
13027.60c	26.7500	endf60	B-VI.0	1973	294	55,427	2,241	20	yes	no
Z=14*****Silicon*****										
**Si-nat**										
14000.21c	27.8440	100xs[3]	T-2:XTM	1989	300	76,399	2,883	100	yes	no
14000.35c	27.8442	endl85	LLNL	<1985	0	19,016	1,012	20	yes	no
14000.50c	27.8440	endf5p	B-V.0	1976	294	98,609	2,440	20	yes	no
14000.51c	27.8440	rmccs	B-V.0	1976	294	88,129	1,887	20	yes	no
14000.60c	27.8440	endf60	B-VI.0	1976	294	104,198	2,824	20	yes	no
Z=15*****Phosphorus*****										
**P-31**										
15031.35c	30.7077	endl85	LLNL	<1985	0	5,875	303	20	yes	no
15031.50c	30.7080	endf5u	B-V.0	1977	294	5,733	326	20	yes	no
15031.51c	30.7080	rmccs	B-V.0	1977	294	5,732	326	20	yes	no
15031.60c	30.7080	endf60	B-VI.0	1977	294	6,715	297	20	yes	no
Z=16*****Sulfur*****										
**S-nat**										
16000.60c	31.7882	endf60	B-VI.0	1979	294	108,683	8,382	20	yes	no

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
<b>**S-32**</b>										
16032.35c	31.6974	endl85	LLNL	<1985	0	7,054	357	20	yes	no
16032.50c	31.6970	endf5u	B-V.0	1977	294	6,789	363	20	yes	no
16032.51c	31.6970	rmccs	B-V.0	1977	294	6,780	362	20	yes	no
16032.60c	31.6970	endf60	B-VI.0	1977	294	7,025	377	20	yes	no
Z=17*****Chlorine*****										
<b>**Cl-nat**</b>										
17000.35c	35.1484	endl85	LLNL	<1985	0	12,903	1,014	20	yes	no
17000.50c	35.1480	endf5p	B-V.0	1967	294	23,313	1,499	20	yes	no
17000.51c	35.1480	rmccs	B-V.0	1967	294	21,084	1,375	20	yes	no
17000.60c	35.1480	endf60	B-VI.0	1967	294	24,090	1,816	20	yes	no
Z=18*****Argon*****										
<b>**Ar-nat**</b>										
18000.35c	39.6048	rmccsa	LLNL	<1985	0	5,585	259	20	yes	no
18000.59c	39.6048	misc5xs[6,7]	T-2	1982	294	3,473	252	20	yes	no
Z=19*****Potassium*****										
<b>**K-nat**</b>										
19000.35c	38.7624	endl85	LLNL	<1985	0	11,130	714	20	yes	no
19000.50c	38.7660	endf5u	B-V.0	1974	294	22,051	1,243	20	yes	no
19000.51c	38.7660	rmccs	B-V.0	1974	294	18,798	1,046	20	yes	no
19000.60c	38.7660	endf60	B-VI.0	1974	294	24,482	1,767	20	yes	no
Z=20*****Calcium*****										
<b>**Ca-nat**</b>										
20000.35c	39.7357	endl85	LLNL	<1985	0	12,933	974	20	yes	no
20000.50c	39.7360	endf5u	B-V.0	1976	294	62,624	2,394	20	yes	no
20000.51c	39.7360	rmccs	B-V.0	1976	294	53,372	1,796	20	yes	no
20000.60c	39.7360	endf60	B-VI.0	1980	294	76,468	2,704	20	yes	no
<b>**Ca-40**</b>										
20040.21c	39.6193	100xs[3]	T-2:XTM	1989	300	53,013	2,718	100	yes	no
Z=21*****Scandium*****										
<b>**Sc-45**</b>										
21045.60c	44.5679	endf60	B-VI.2	1992	294	105,627	10,639	20	yes	no
Z=22*****Titanium*****										
<b>**Ti-nat**</b>										
22000.35c	47.4885	endl85	LLNL	<1985	0	13,421	1,337	20	yes	no
22000.50c	47.4676	endf5u	B-V.0	1977	294	54,801	4,434	20	yes	no
22000.51c	47.4676	rmccs	B-V.0	1977	294	31,832	1,934	20	yes	no
22000.60c	47.4676	endf60	B-VI.0	1977	294	76,454	7,761	20	yes	no
Z=23*****Vanadium*****										
<b>**V-nat**</b>										
23000.50c	50.5040	endf5u	B-V.0	1977	294	38,312	2,265	20	yes	no
23000.51c	50.5040	rmccs	B-V.0	1977	294	34,110	1,899	20	yes	no
23000.60c	50.5040	endf60	B-VI.0	1988	294	167,334	8,957	20	yes	no
Z=24*****Chromium*****										
<b>**Cr-nat**</b>										
24000.35c	51.5493	endl85	LLNL	<1985	0	9,218	358	20	yes	no
24000.50c	51.5490	rmccs	B-V.0	1977	294	134,454	11,050	20	yes	no
<b>**Cr-50**</b>										
24050.60c	49.5170	endf60	B-VI.1	1989	294	119,178	11,918	20	yes	no
<b>**Cr-52**</b>										



Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
24052.60c	51.4940	endf60	B-VI.1	1989	294	117,680	10,679	20	yes	no
<b>**Cr-53**</b>										
24053.60c	52.4860	endf60	B-VI.1	1989	294	114,982	10,073	20	yes	no
<b>**Cr-54**</b>										
24054.60c	53.4760	endf60	B-VI.1	1989	294	98,510	9,699	20	yes	no
<b>Z=25*****Manganese*****</b>										
<b>**Mn-55**</b>										
25055.35c	54.4661	endl85	LLNL	<1985	0	7,493	446	20	yes	no
25055.50c	54.4661	endf5u	B-V.0	1977	294	105,093	12,525	20	yes	no
25055.51c	54.4661	rmccs	B-V.0	1977	294	25,727	1,578	20	yes	no
25055.60c	54.4661	endf60	B-VI.0	1988	294	184,269	8,207	20	yes	no
<b>Z=26*****Iron*****</b>										
<b>**Fe-nat**</b>										
26000.21c	55.3650	100xs[3]	T-2:XTM	1989	300	149,855	15,598	100	yes	no
26000.35c	55.3672	endl85	LLNL	<1985	0	30,983	2,772	20	yes	no
26000.50c	55.3650	endf5p	B-V.0	1978	294	115,447	10,957	20	yes	no
26000.55c	55.3650	rmccs	T-2	1986	294	178,392	6,899	20	yes	no
<b>**Fe-54**</b>										
26054.60c	53.4760	endf60	B-VI.1	1989	294	121,631	10,701	20	yes	no
<b>**Fe-56**</b>										
26056.60c	55.4540	endf60	B-VI.1	1989	294	174,517	11,618	20	yes	no
<b>**Fe-57**</b>										
26057.60c	56.4460	endf60	B-VI.1	1989	294	133,995	7,606	20	yes	no
<b>**Fe-58**</b>										
26058.60c	57.4360	endf60	B-VI.1	1989	294	93,450	6,788	20	yes	no
<b>Z=27*****Cobalt*****</b>										
<b>**Co-59**</b>										
27059.35c	58.4269	endl85	LLNL	<1985	0	38,958	4,177	20	yes	no
27059.50c	58.4269	endf5u	B-V.0	1977	294	117,075	14,502	20	yes	no
27059.51c	58.4269	rmccs	B-V.0	1977	294	28,355	1,928	20	yes	no
27059.60c	58.4269	endf60	B-VI.2	1992	294	186,618	11,838	20	yes	no
<b>Z=28*****Nickel*****</b>										
<b>**Ni-nat**</b>										
28000.50c	58.1826	rmccs	B-V.0	1977	294	139,913	8,927	20	yes	no
<b>**Ni-58**</b>										
28058.35c	57.4376	endl85	LLNL	<1985	0	42,744	4,806	20	yes	no
28058.60c	57.4380	endf60	B-VI.1	1989	294	172,069	16,445	20	yes	no
<b>**Ni-60**</b>										
28060.60c	59.4160	endf60	B-VI.1	1991	294	110,885	10,055	20	yes	no
<b>**Ni-61**</b>										
28061.60c	60.4080	endf60	B-VI.1	1989	294	93,801	5,882	20	yes	no
<b>**Ni-62**</b>										
28062.60c	61.3960	endf60	B-VI.1	1989	294	82,085	7,230	20	yes	no
<b>**Ni-64**</b>										
28064.60c	63.3790	endf60	B-VI.1	1989	294	66,656	6,144	20	yes	no
<b>Z=29*****Copper*****</b>										
<b>**Cu-nat**</b>										
29000.35c	63.0001	endl85	LLNL	<1985	0	7,039	293	20	yes	no
29000.50c	63.5460	rmccs	B-V.0	1978	294	51,850	3,435	20	yes	no
<b>**Cu-63**</b>										

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
29063.60c	62.3890	endf60	B-VI.2	1989	294	119,097	11,309	20	yes	no
**Cu-65**										
29065.60c	64.3700	endf60	B-VI.2	1989	294	118,385	11,801	20	yes	no
Z=31*****Gallium*****										
**Ga-nat**										
31000.35c	69.1211	endl85	LLNL	<1985	0	7,509	469	20	yes	no
31000.50c	69.1211	rmccs	B-V.0	1980	294	7,928	511	20	yes	no
31000.60c	69.1211	endf60	B-VI.0	1980	294	9,228	566	20	yes	no
Z=33*****Arsenic*****										
**As-74**										
33074.35c	73.2889	endl85	LLNL	<1985	0	50,881	6,424	20	yes	no
**As-75**										
33075.35c	74.2780	rmccsa	B-V.0	1974	0	50,931	6,421	20	yes	no
Z=35*****Bromine*****										
**Br-79**										
35079.55c	78.2404	misc5xs[6,8]	T-2	1982	294	10,431	1,589	20	no	no
**Br-81**										
35081.55c	80.2212	misc5xs[6,8]	T-2	1982	294	5,342	831	20	no	no
Z=36*****Krypton*****										
**Kr-78**										
36078.50c	77.2510	rmccsa	B-V.0	1978	294	9,057	939	20	no	no
**Kr-80**										
36080.50c	79.2298	rmccsa	B-V.0	1978	294	10,165	1,108	20	no	no
**Kr-82**										
36082.50c	81.2098	rmccsa	B-V.0	1978	294	7,220	586	20	no	no
36082.59c	81.2098	misc5xs[6,7]	T-2	1982	294	7,010	499	20	yes	no
**Kr-83**										
36083.50c	82.2018	rmccsa	B-V.0	1978	294	8,078	811	20	no	no
36083.59c	82.2018	misc5xs[6,7]	T-2	1982	294	8,069	704	20	yes	no
**Kr-84**										
36084.50c	83.1906	rmccsa	B-V.0	1978	294	9,364	944	20	no	no
36084.59c	83.1906	misc5xs[6,7]	T-2	1982	294	10,370	954	20	yes	no
**Kr-86**										
36086.50c	85.1726	rmccsa	B-V.0	1975	294	10,416	741	20	no	no
36086.59c	85.1726	misc5xs[6,7]	T-2	1982	294	8,740	551	20	yes	no
Z=37*****Rubidium*****										
**Rb-85**										
37085.55c	84.1824	misc5xs[6,8]	T-2	1982	294	27,304	4,507	20	no	no
**Rb-87**										
37087.55c	86.1626	misc5xs[6,8]	T-2	1982	294	8,409	1,373	20	no	no
Z=39*****Yttrium*****										
**Y-88**										
39088.35c	87.1543	endl85	LLNL	<1985	0	11,299	272	20	yes	no
**Y-89**										
39089.35c	88.1421	misc5xs[6]	LLNL		0	49,885	6,154	20	yes	no
39089.50c	88.1421	endf5u	B-V.0[9]	1985	294	18,631	3,029	20	no	no
39089.60c	88.1420	endf60	B-VI.0	1986	294	86,556	9,567	20	yes	no
Z=40*****Zirconium*****										
**Zr-nat**										
40000.35c	90.4364	endl85	LLNL	<1985	0	14,738	1,292	20	yes	no

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
40000.56c	90.4360	misc5xs[6,10]	B-V:XTM	1976	300	52,064	7944	20	no	no
40000.57c	90.4360	misc5xs[6,10]	B-V:XTM	1976	300	16,816	2,116	20	no	no
40000.58c	90.4360	misc5xs[6,10]	B-V:XTM	1976	587	57,528	8,777	20	no	no
40000.60c	90.4360	endf60	B-VI.1	1976[10]	294	66,035	10,298	20	no	no
<b>**Zr-93**</b>										
40093.50c	92.1083	kidman	B-V.0	1974	294	2,579	236	20	no	no
Z=41*****Niobium*****										
<b>**Nb-93**</b>										
41093.35c	92.1083	endl85	LLNL	<1985	0	50,441	6,095	20	yes	no
41093.50c	92.1051	endf5p	B-V.0	1974	294	128,960	17,279	20	yes	no
41093.51c	92.1051	rmccs	B-V.0	1974	294	14,675	963	20	yes	no
41093.60c	92.1051	endf60	B-VI.1	1990	294	110,269	10,678	20	yes	no
Z=42*****Molybdenum*****										
<b>**Mo-nat**</b>										
42000.35c	95.1158	endl85	LLNL	<1985	0	8,628	573	20	yes	no
42000.50c	95.1160	endf5u	B-V.0	1979	294	35,634	4,260	20	yes	no
42000.51c	95.1160	rmccs	B-V.0	1979	294	10,139	618	20	yes	no
42000.60c	95.1160	endf60	B-VI.0	1979	294	45,573	5,466	20	yes	no
<b>**Mo-95**</b>										
42095.50c	94.0906	kidman	B-V.0	1980	294	15,411	2,256	20	no	no
Z=43*****Technetium*****										
<b>**Tc-99**</b>										
43099.50c	98.1500	kidman	B-V.0	1978	294	12,152	1,640	20	no	no
43099.60c	98.1500	endf60	B-VI.0	1978	294	54,262	8,565	20	no	no
Z=44*****Ruthenium*****										
<b>**Ru-101**</b>										
44101.50c	100.0390	kidman	B-V.0	1980	294	5,299	543	20	no	no
<b>**Ru-103**</b>										
44103.50c	102.0220	kidman	B-V.0	1974	294	3,052	235	20	no	no
Z=45*****Rhodium*****										
<b>**Rh-103**</b>										
45103.50c	102.0210	rmccsa	B-V.0	1978	294	18,870	2,608	20	no	no
<b>**Rh-105**</b>										
45105.50c	104.0050	kidman	B-V.0	1974	294	1,591	213	20	no	no
Z=46*****Palladium*****										
<b>**Pd-105**</b>										
46105.50c	104.0040	kidman	B-V.0	1980	294	4,647	505	20	no	no
<b>**Pd-108**</b>										
46108.50c	106.9770	kidman	B-V.0	1980	294	4,549	555	20	no	no
Z=47*****Silver*****										
<b>**Ag-nat**</b>										
47000.55c	106.9420	rmccsa	T-2	1984	294	29,092	2,350	20	yes	no
<b>**Ag-107**</b>										
47107.35c	105.9867	endl85	LLNL	<1985	0	13,134	994	20	yes	no
47107.50c	105.9870	rmccsa	B-V.0	1978	294	12,111	1,669	20	no	no
47107.60c	105.9870	endf60	B-VI.0	1983	294	64,008	10,101	20	no	no
<b>**Ag-109**</b>										
47109.35c	107.9692	endl85	LLNL	<1985	0	13,452	1,094	20	yes	no
47109.50c	107.9690	rmccsa	B-V.0	1978	294	14,585	2,120	20	no	no
47109.60c	107.9690	endf60	B-VI.0	1983	294	76,181	11,903	20	no	no

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
Z=48*****Cadmium*****										
**Cd-nat**										
48000.35c	111.4443	endl85	LLNL	<1985	0	12,283	1,115	20	yes	no
48000.50c	111.4600	endf5u	B-V.0	1974	294	19,714	2,981	20	no	no
48000.51c	111.4600	rmccs	B-V.0	1974	294	6,734	818	20	no	no
Z=49*****Indium*****										
**In-nat**										
49000.60c	113.8340	endf60	B-VI.0	1990	294	93,662	10,116	20	yes	no
Z=50*****Tin*****										
**Sn-nat**										
50000.35c	117.6704	endl85	LLNL	<1985	0	5,970	205	20	yes	no
Z=53*****Iodine*****										
**I-127**										
53127.55c	125.8140	misc5xs[6,8]	T-2	1982	294	59,725	9,423	20	no	no
53127.60c	125.8143	endf60[12]	T-2	1991	294	399,760	7,888	30	yes	no
**I-129**										
53129.60c	127.7980	endf60	B-VI.0	1980	294	8,792	1,237	20	no	no
**I-135**										
53135.50c	133.7510	kidman	B-V.0	1974	294	1,232	194	20	no	no
Z=54*****Xenon*****										
**Xe-nat**										
54000.35c	130.1721	endl85	LLNL	<1985	0	41,432	5,228	20	yes	no
**Xe-131**										
54131.50c	129.7810	kidman	B-V.0	1978	294	22,572	3,376	20	no	no
**Xe-134**										
54134.35c	132.7551	endl85	LLNL	<1985	0	7,463	359	20	yes	no
**Xe-135**										
54135.50c	133.7480	endf5mt[1]	B-V	1975	294	5,529	704	20	no	no
54135.53c	133.7480	endf5mt[1]	B-V	1975	587	5,541	706	20	no	no
54135.54c	133.7480	endf5mt[1]	B-V	1975	881	5,577	712	20	no	no
Z=55*****Cesium*****										
**Cs-133**										
55133.50c	131.7640	kidman	B-V.0	1978	294	26,713	4,142	20	no	no
55133.55c	131.7640	misc5xs[6,8]	T-2	1982	294	67,893	11,025	20	no	no
55133.60c	131.7640	endf60	B-VI.0	1978	294	54,723	8,788	20	no	no
**Cs-134**										
55134.60c	132.7570	endf60	B-VI.0	1988	294	10,227	1,602	20	no	no
**Cs-135**										
55135.50c	133.7470	kidman	B-V.0	1974	294	1,903	199	20	no	no
55135.60c	133.7470	endf60	B-VI.0	1974	294	3,120	388	20	no	no
**Cs-136**										
55136.60c	134.7400	endf60	B-VI.0	1974	294	10,574	1,748	20	no	no
**Cs-137**										
55137.60c	135.7310	endf60	B-VI.0	1974	294	2,925	369	20	no	no
Z=56*****Barium*****										
**Ba-138**										
56138.35c	136.7206	endl85	LLNL	<1985	0	5,985	262	20	yes	no
56138.50c	136.7150	rmccs	B-V.0	1978	294	6,018	292	20	yes	no
56138.60c	136.7150	endf60	B-VI.0	1978	294	7,347	267	20	yes	no
Z=59*****Praseodymium*****										

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
<b>**Pr-141**</b>										
59141.50c	139.6970	kidman	B-V.0	1980	294	15,620	1,354	20	no	no
Z=60*****Neodymium*****										
<b>**Nd-143**</b>										
60143.50c	141.6820	kidman	B-V.0	1980	294	17,216	1,701	20	no	no
<b>**Nd-145**</b>										
60145.50c	143.6680	kidman	B-V.0	1980	294	38,473	3,985	20	no	no
<b>**Nd-147**</b>										
60147.50c	145.6540	kidman	B-V.0	1979	294	1,816	251	20	no	no
<b>**Nd-148**</b>										
60148.50c	146.6460	kidman	B-V.0	1980	294	10,867	1,054	20	no	no
Z=61*****Promethium*****										
<b>**Pm-147**</b>										
61147.50c	145.6530	kidman	B-V.0	1980	294	9,152	825	20	no	no
<b>**Pm-148**</b>										
61148.50c	146.6470	kidman	B-V.0	1979	294	1,643	257	20	no	no
<b>**Pm-149**</b>										
61149.50c	147.6390	kidman	B-V.0	1979	294	2,069	238	20	no	no
Z=62*****Samarium*****										
<b>**Sm-147**</b>										
62147.50c	145.6530	kidman	B-V.0	1980	294	33,773	2,885	20	no	no
<b>**Sm-149**</b>										
62149.50c	147.6380	endf5u	B-V.0	1978	294	15,662	2,008	20	no	no
<b>**Sm-150**</b>										
62150.50c	148.6290	kidman	B-V.0	1974	294	9,345	1,329	20	no	no
<b>**Sm-151**</b>										
62151.50c	149.6230	kidman	B-V.0	1980	294	7,303	605	20	no	no
<b>**Sm-152**</b>										
62152.50c	150.6150	kidman	B-V.0	1980	294	41,252	4,298	20	no	no
Z=63*****Europium*****										
<b>**Eu-nat**</b>										
63000.35c	150.6546	rmccsa	LLNL	<1985	0	6,926	364	20	yes	no
<b>**Eu-151**</b>										
63151.50c	149.6230	rmccs	B-V.0	1977	294	68,057	5,465	20	yes	no
63151.55c	149.6230	newxs	T-2	1986	294	86,575	4,749	20	yes	no
63151.60c	149.6230	endf60	B-VI.0	1986	294	96,099	7,394	20	yes	no
<b>**Eu-152**</b>										
63152.50c	150.6200	endf5u	B-V.0	1975	294	49,313	4,553	20	no	no
<b>**Eu-153**</b>										
63153.50c	151.6070	rmccs	B-V.0	1978	294	55,231	4,636	20	yes	no
63153.55c	151.6080	newxs	T-2	1986	294	72,971	4,174	20	yes	no
63153.60c	151.6080	endf60	B-VI.0	1986	294	86,490	6,198	20	yes	no
<b>**Eu-154**</b>										
63154.50c	152.6000	endf5u	B-V.0	1975	294	37,008	4,030	20	no	no
<b>**Eu-155**</b>										
63155.50c	153.5920	kidman	B-V.0	1974	294	4,532	273	20	no	no
Z=64*****Gadolinium*****										
<b>**Gd-nat**</b>										
64000.35c	155.8991	rmccsa	LLNL	<1985	0	7,878	454	20	yes	no
<b>**Gd-152**</b>										

**Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries**

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
64152.50c	150.6150	endf5u	B-V.0	1977	294	26,251	3,285	20	no	no
64152.55c	150.6150	misc5xs[6,13]	B-V.0:T-2	1986	294	32,590	3,285	20	yes	no
64152.60c	150.6150	endf60	B-VI.0	1977	294	32,760	4,391	20	no	no
<b>**Gd-154**</b>										
64154.50c	152.5990	endf5u	B-V.0	1977	294	49,572	7,167	20	no	no
64154.55c	152.5990	misc5xs[6,13]	B-V.0:T-2	1986	294	59,814	7,167	20	yes	no
64154.60c	152.5990	endf60	B-VI.0	1977	294	67,662	10,189	20	no	no
<b>**Gd-155**</b>										
64155.50c	153.5920	endf5u	B-V.0	1977	294	44,965	6,314	20	no	no
64155.55c	153.5920	misc5xs[6,13]	B-V.0:T-2	1986	294	54,346	6,314	20	yes	no
64155.60c	153.5920	endf60	B-VI.0	1977	294	61,398	9,052	20	no	no
<b>**Gd-156**</b>										
64156.50c	154.5830	endf5u	B-V.0	1977	294	37,371	3,964	20	no	no
64156.55c	154.5830	misc5xs[6,13]	B-V.0:T-2	1986	294	44,391	3,964	20	yes	no
64156.60c	154.5830	endf60	B-VI.0	1977	294	42,885	5,281	20	no	no
<b>**Gd-157**</b>										
64157.50c	155.5760	endf5u	B-V.0	1977	294	38,975	5,370	20	no	no
64157.55c	155.5760	misc5xs[6,13]	B-V.0:T-2	1986	294	47,271	5,370	20	yes	no
64157.60c	155.5760	endf60	B-VI.0	1977	294	56,957	8,368	20	no	no
<b>**Gd-158**</b>										
64158.50c	156.5670	endf5u	B-V.0	1977	294	95,876	15,000	20	no	no
64158.55c	156.5670	misc5xs[6,13]	B-V.0:T-2	1986	294	113,916	15,000	20	yes	no
64158.60c	156.5670	endf60	B-VI.0	1977	294	59,210	8,909	20	no	no
<b>**Gd-160**</b>										
64160.50c	158.5530	endf5u	B-V.0	1977	294	53,988	8,229	20	no	no
64160.55c	158.5530	misc5xs[6,13]	B-V.0:T-2	1986	294	65,261	8,229	20	yes	no
64160.60c	158.5530	endf60	B-VI.0	1977	294	54,488	8,304	20	no	no
<b>Z=67*****Holmium*****</b>										
<b>**Ho-165**</b>										
67165.35c	163.5135	rmccsa	LLNL	<1985	0	54,279	7,075	20	yes	no
67165.55c	163.5130	newxs	T-2	1986	294	56,605	2,426	30	yes	no
67165.60c	163.5130	endf60	B-VI.0	1988	294	75,307	4,688	30	yes	no
<b>Z=69*****Thulium*****</b>										
<b>**Tm-169**</b>										
69169.55c	167.4830	misc5xs[6]	T-2	1986	300	47,941	4,738	20	no	no
<b>Z=72*****Hafnium*****</b>										
<b>**Hf-nat**</b>										
72000.35c	176.9567	endl85	LLNL	<1985	0	75,862	9,636	20	yes	no
72000.50c	176.9540	newxs	B-V.0	1976	294	52,231	8,270	20	no	no
72000.60c	176.9540	endf60	B-VI.0	1976	294	84,369	13,634	20	no	no
<b>Z=73*****Tantalum*****</b>										
<b>**Ta-181**</b>										
73181.35c	179.3936	endl85	LLNL	<1985	0	33,547	2,812	20	yes	no
73181.50c	179.4000	endf5u	B-V.0	1972	294	60,740	6,341	20	yes	no
73181.51c	179.4000	rmccs	B-V.0	1972	294	21,527	753	20	yes	no
73181.60c	179.4000	endf60	B-VI.0	1972	294	91,374	10,352	20	yes	no
<b>**Ta-182**</b>										
73182.60c	180.3870	endf60	B-VI.0	1971	294	12,085	1,698	20	no	no
<b>Z=74*****Tungsten*****</b>										
<b>**W-nat**</b>										

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
74000.21c	182.2706	100xs[3]	T-2:XTM	1989	300	194,513	21,386	100	yes	no
74000.55c	182.2770	rmccs	B-V.2	1982	294	50,639	1,816	20	yes	no
**W-182**										
74182.50c	180.3900	endf5p	B-V.0	1973	294	94,367	11,128	20	yes	no
74182.55c	180.3900	rmccsa	B-V.2	1980	294	122,290	13,865	20	yes	no
74182.60c	180.3900	endf60	B-VI.0	1980	294	113,177	12,283	20	yes	no
**W-183**										
74183.50c	181.3800	endf5p	B-V.0	1973	294	58,799	5,843	20	yes	no
74183.55c	181.3800	rmccsa	B-V.2	1980	294	79,534	8,083	20	yes	no
74183.60c	181.3800	endf60	B-VI.0	1980	294	89,350	9,131	20	yes	no
**W-184**										
74184.50c	182.3700	endf5p	B-V.0	1973	294	58,870	6,173	20	yes	no
74184.55c	182.3700	rmccsa	B-V.2	1980	294	80,006	7,835	20	yes	no
74184.60c	182.3700	endf60	B-VI.0	1980	294	78,809	7,368	20	yes	no
**W-186**										
74186.50c	184.3600	endf5p	B-V.0	1973	294	63,701	6,866	20	yes	no
74186.55c	184.3600	rmccsa	B-V.2	1980	294	83,618	8,342	20	yes	no
74186.60c	184.3600	endf60	B-VI.0	1980	294	82,010	7,793	20	yes	no
Z=75*****Rhenium*****										
**Re-185**										
75185.32c	183.3612	misc5xs[6]	LLNL	<1985	0	13,650	1,488	20	yes	no
75185.35c	183.3641	endl85	LLNL	<1985	0	16,038	1,487	20	yes	no
75185.50c	183.3640	rmccsa	B-V.0	1968	294	9,190	1,168	20	no	no
75185.60c	183.3640	endf60	B-VI.0	1990	294	102,775	16,719	20	no	no
**Re-187**										
75187.32c	185.3539	misc5xs[6]	LLNL	<1985	0	12,318	1,296	20	yes	no
75187.35c	185.3497	endl85	LLNL	<1985	0	14,769	1,295	20	yes	no
75187.50c	185.3500	rmccsa	B-V.0	1968	294	8,262	959	20	no	no
75187.60c	185.3500	endf60	B-VI.0	1990	294	96,989	15,624	20	no	no
Z=77*****Iridium*****										
**Ir-nat**										
77000.55c	190.5630	misc5xs[6]	T-2	1986	300	43,071	3,704	20	no	no
Z=78*****Platinum*****										
**Pt-nat**										
78000.35c	193.4141	rmccsa	LLNL	<1985	0	15,371	1,497	20	yes	no
Z=79*****Gold*****										
**Au-197**										
79197.35c	195.2745	endl85	LLNL	<1985	0	31,871	3,781	20	yes	no
79197.50c	195.2740	endf5p	B-V.0	1977	294	139,425	22,632	20	no	no
79197.55c	195.2740	rmccsa	T-2	1983	294	134,325	17,909	20	yes	no
79197.56c	195.2740	newxs	T-2	1984	294	122,482	11,823	30	yes	no
79197.60c	195.2740	endf60	B-VI.1	1984	294	161,039	17,724	30	yes	no
Z=82*****Lead*****										
**Pb-nat**										
82000.35c	205.4200	endl85	LLNL	<1985	0	6,639	349	20	yes	no
82000.50c	205.4300	rmccs	B-V.0	1976	294	37,633	1,346	20	yes	no
**Pb-206**										
82206.60c	204.2000	endf60	B-VI.0	1989	294	148,815	12,872	20	yes	no
**Pb-207**										
82207.60c	205.2000	endf60	B-VI.1	1991	294	111,750	7,524	20	yes	no

Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries

Z AID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{v}$
<b>**Pb-208**</b>										
82208.60c	206.1900	endf60	B-VI.0	1989	294	70,740	5,105	20	yes	no
Z=83*****Bismuth*****										
<b>**Bi-209**</b>										
83209.35c	207.1851	endl85	LLNL	<1985	0	18,316	1,303	20	yes	no
83209.50c	207.1850	endf5u	B-V.0	1980	294	14,939	1,300	20	yes	no
83209.51c	207.1850	rmccs	B-V.0	1980	294	13,721	1,186	20	yes	no
83209.60c	207.1850	endf60	B-VI.0	1989	294	100,138	8,427	20	yes	no
Z=90*****Thorium*****										
<b>**Th-230**</b>										
90230.60c	228.0600	endf60	B-VI.0	1977	294	35,155	5,533	20	no	t
<b>**Th-231**</b>										
90231.35c	229.0516	endl85	LLNL	<1985	0	9,157	308	20	yes	p
<b>**Th-232**</b>										
90232.35c	230.0447	endl85	LLNL	<1985	0	56,091	6,169	20	yes	p
90232.50c	230.0400	endf5u	B-V.0	1977	294	152,782	17,901	20	yes	b
90232.51c	230.0400	rmccs	B-V.0	1977	294	17,925	1,062	20	yes	b
90232.60c	230.0400	endf60	B-VI.0	1977	294	127,606	16,381	20	yes	b
<b>**Th-233**</b>										
90233.35c	231.0396	endl85	LLNL	<1985	0	9,352	348	20	yes	p
Z=91*****Protactinium*****										
<b>**Pa-231**</b>										
91231.60c	229.0500	endf60	B-VI.0	1977	294	19,835	2,610	20	no	b
<b>**Pa-233**</b>										
91233.35c	231.0383	endl85	LLNL	<1985	0	19,170	1,910	20	yes	p
91233.50c	231.0380	endf5u	B-V.0	1974	294	19,519	2,915	20	no	t
91233.51c	231.0380	rmccs	B-V.0	1974	294	5,641	637	20	no	t
Z=92*****Uranium*****										
<b>**U-232**</b>										
92232.60c	230.0400	endf60	B-VI.0	1977	294	13,839	1,759	20	no	b
<b>**U-233**</b>										
92233.35c	231.0377	endl85	LLNL	<1985	0	29,674	2,924	20	yes	p
92233.50c	231.0430	rmccs	B-V.0	1978	294	18,815	2,293	20	no	b
92233.60c	231.0430	endf60[14]	B-VI.0	1978	294	32,226	3,223	20	yes	b
<b>**U-234**</b>										
92234.35c	232.0304	endl85	LLNL	<1985	0	8,557	237	20	yes	p
92234.50c	232.0300	endf5p	B-V.0	1978	294	89,433	12,430	20	no	t
92234.51c	232.0300	rmccs	B-V.0	1978	294	6,426	672	20	no	t
92234.60c	232.0300	endf60	B-VI.0	1978	294	77,059	10,660	17.5	no	b
<b>**U-235**</b>										
92235.50c	233.0250	rmccs	B-V.0	1977	294	60,489	5,725	20	yes	b
92235.52c	233.0250	endf5mt[1]	B-V.0	1977	587	65,286	6,320	20	yes	b
92235.53c	233.0250	endf5mt[1]	B-V.0	1977	587	36,120	2,685	20	yes	b
92235.54c	233.0250	endf5mt[1]	B-V.0	1977	881	36,008	2,671	20	yes	b
92235.60c	233.0250	endf60	B-VI.2	1989	294	289,975	28,110	20	yes	b
<b>**U-236**</b>										
92236.35c	234.0178	endl85	LLNL	<1985	0	8,699	224	20	yes	p
92236.50c	234.0180	endf5p	B-V.0	1978	294	138,715	19,473	20	no	t
92236.51c	234.0180	rmccs	B-V.0	1978	294	7,302	800	20	no	t
92236.60c	234.0180	endf60	B-VI.0	1989	294	82,819	10,454	20	no	b



**Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries**

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
<b>**U-237**</b>										
92237.35c	235.0123	endl85	LLNL	<1985	0	9,364	353	20	yes	p
92237.50c	235.0120	endf5p	B-V.0	1976	294	32,445	3,293	20	yes	t
92237.51c	235.0120	rmccs	B-V.0	1976	294	10,317	527	20	yes	t
<b>**U-238**</b>										
92238.21c	236.0060	100xs[3]	T-2:XTM	1989	300	279,245	30,911	100	yes	b
92238.35c	236.0058	endl85	LLNL	<1985	0	27,168	1,845	20	yes	p
92238.50c	236.0060	rmccs	B-V.0	1979	294	88,998	9,285	20	yes	b
92238.52c	236.0060	endf5mt[1]	B-V.0	1979	587	123,199	8,454	20	yes	b
92238.53c	236.0060	endf5mt[1]	B-V.0	1979	587	160,107	17,876	20	yes	b
92238.54c	236.0060	endf5mt[1]	B-V.0	1979	881	160,971	17,984	20	yes	b
92238.60c	236.0060	endf60	B-VI.2	1993	294	206,322	22,600	20	yes	b
<b>**U-239**</b>										
92239.35c	237.0007	rmccsa	LLNL	<1985	0	9,809	394	20	yes	p
<b>**U-240**</b>										
92240.35c	237.9944	endl85	LLNL	<1985	0	8,495	218	20	yes	p
Z=93*****Neptunium*****										
<b>**Np-235**</b>										
93235.35c	233.0249	endl85	LLNL	<1985	0	9,490	364	20	yes	p
<b>**Np-236**</b>										
93236.35c	234.0188	endl85	LLNL	<1985	0	8,821	284	20	yes	p
<b>**Np-237**</b>										
93237.35c	235.0118	endl85	LLNL	<1985	0	20,225	1,678	20	yes	p
93237.50c	235.0120	endf5p	B-V.0	1978	294	63,223	8,519	20	no	t
93237.55c	235.0120	rmccsa	T-2	1984	294	32,558	1,682	20	no	b
93237.60c	235.0118	endf60	B-VI.1	1990	294	105,150	7,218	20	yes	b
<b>**Np-238**</b>										
93238.35c	236.0060	endl85	LLNL	<1985	0	8,878	282	20	yes	p
<b>**Np-239**</b>										
93239.60c	236.9990	endf60	B-VI.0	1988	294	7,406	562	20	no	t
Z=94*****Plutonium*****										
<b>**Pu-236**</b>										
94236.60c	234.0180	endf60	B-VI.0	1978	294	33,448	4,610	20	no	t
<b>**Pu-237**</b>										
94237.35c	235.0120	endl85	LLNL	<1985	0	11,300	202	20	yes	p
94237.60c	235.0120	endf60	B-VI.0	1978	294	3,524	257	20	no	t
<b>**Pu-238**</b>										
94238.35c	236.0046	endl85	LLNL	<1985	0	15,619	958	20	yes	p
94238.50c	236.1670	endf5p	B-V.0	1978	294	18,763	2,301	20	no	t
94238.51c	236.1670	rmccs	B-V.0	1978	294	6,067	537	20	no	t
94238.60c	236.0045	endf60	B-VI.0	1978	294	29,054	3,753	20	no	b
<b>**Pu-239**</b>										
94239.50c	236.9990	endf5p	B-V.0	1976	294	74,049	7,809	20	yes	b
94239.55c	236.9990	rmccs	B-V.2	1983	294	102,099	10,318	20	yes	b
94239.60c	236.9986	endf60	B-VI.2	1993	294	283,354	26,847	20	yes	b
<b>**Pu-240**</b>										
94240.50c	237.9920	rmccs	B-V.0	1977	294	58,917	6,549	20	yes	b
94240.60c	237.9920	endf60	B-VI.2	1986	294	133,071	15,676	20	yes	b
<b>**Pu-241**</b>										

**Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries**

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
94241.35c	238.9860	endl85	LLNL	<1985	0	8,844	257	20	yes	p
94241.50c	238.9780	endf5p	B-V.0	1977	294	38,601	3,744	20	yes	b
94241.51c	238.9780	rmccs	B-V.0	1977	294	13,403	623	20	yes	b
94241.60c	238.9780	endf60	B-VI.1	1988	294	76,453	8,112	20	yes	b
<b>**Pu-242**</b>										
94242.35c	239.9793	endl85	LLNL	<1985	0	21,159	1,724	20	yes	p
94242.50c	239.9790	endf5p	B-V.0	1978	294	71,429	7,636	20	yes	b
94242.51c	239.9790	rmccs	B-V.0	1978	294	15,702	728	20	yes	b
94242.60c	239.9790	endf60	B-VI.0	1978	294	73,725	7,896	20	yes	b
<b>**Pu-243**</b>										
94243.35c	240.9740	endl85	LLNL	<1985	0	10,763	485	20	yes	p
94243.60c	240.9740	endf60	B-VI.2	1976	294	45,142	4,452	20	yes	t
<b>**Pu-244**</b>										
94244.60c	241.9680	endf60	B-VI.0	1978	294	23,654	3,695	20	no	t
<b>Z=95*****Americium*****</b>										
<b>**Am-241**</b>										
95241.35c	238.9860	endl85	LLNL	<1985	0	25,290	1,982	20	yes	p
95241.50c	238.9860	endf5u	B-V.0	1978	294	42,084	4,420	20	yes	t
95241.51c	238.9860	rmccs	B-V.0	1978	294	12,374	713	20	yes	t
95241.60c	238.9860	endf60	T-2	1994	300	168,924	13,556	30	yes	b
<b>**Am-242ms**</b>										
95242.35c	239.9801	endl85	LLNL	<1985	0	20,908	1,817	20	yes	p
95242.50c	239.9800	endf5u	B-V.0	1978	294	8,593	323	20	yes	t
95242.51c	239.9800	rmccs	B-V.0	1978	294	8,502	317	20	yes	t
<b>**Am-243**</b>										
95243.35c	240.9733	endl85	LLNL	<1985	0	39,400	4,093	20	yes	p
95243.50c	240.9730	endf5u	B-V.0	1978	294	92,015	11,921	20	yes	t
95243.51c	240.9730	rmccs	B-V.0	1978	294	13,684	757	20	yes	t
95243.60c	240.9730	endf60	B-VI.0	1988	294	104,257	11,984	20	yes	b
<b>Z=96*****Curium*****</b>										
<b>**Cm-241**</b>										
96241.60c	238.9870	endf60	B-VI.0	1978	294	3,132	278	20	no	t
<b>**Cm-242**</b>										
96242.35c	239.9794	endl85	LLNL	<1985	0	21,653	1,891	20	yes	p
96242.50c	239.9790	endf5u	B-V.0	1978	294	30,897	3,113	20	yes	t
96242.51c	239.9790	rmccs	B-V.0	1978	294	9,767	472	20	yes	t
96242.60c	239.9790	endf60	B-VI.0	1978	294	34,374	3,544	20	yes	b
<b>**Cm-243**</b>										
96243.35c	240.9733	endl85	LLNL	<1985	0	21,577	1,880	20	yes	p
96243.60c	240.9730	endf60	B-VI.0	1978	294	18,860	1,445	20	yes	t
<b>**Cm-244**</b>										
96244.35c	241.9661	endl85	LLNL	<1985	0	21,196	1,815	20	yes	p
96244.50c	241.9660	endf5u	B-V.0	1978	294	45,991	4,919	20	yes	t
96244.51c	241.9660	rmccs	B-V.0	1978	294	10,847	566	20	yes	t
96244.60c	241.9660	endf60	B-VI.0	1978	294	73,001	8,294	20	yes	t
<b>**Cm-245**</b>										
96245.35c	242.9602	endl85	LLNL	<1985	0	24,128	2,230	20	yes	p
96245.60c	242.9600	endf60	B-VI.2	1979	294	29,535	2,636	20	yes	b
<b>**Cm-246**</b>										

**Table 4-1. Available Continuous-Energy MCNP Cross Section Libraries**

ZAID	AWR	Library Name	Source	Eval Date	Temp (K)	Length (words)	NE	E <sub>max</sub> (MeV)	GPD	$\bar{\nu}$
96246.35c	243.9534	endl85	LLNL	<1985	0	12,489	711	20	yes	p
96246.60c	243.9530	endf60	B-VI.2	1976	294	37,948	3,311	20	yes	t
<b>**Cm-247**</b>										
96247.35c	244.9479	endl85	LLNL	<1985	0	20,265	1,654	20	yes	p
96247.60c	244.9500	endf60	B-VI.2	1976	294	38,800	3,679	20	yes	t
<b>**Cm-248**</b>										
96248.35c	245.9413	endl85	LLNL	<1985	0	18,178	1,425	20	yes	p
96248.60c	245.9410	endf60	B-VI.0	1978	294	83,452	9,706	20	yes	t
<b>Z=97*****Berkelium*****</b>										
<b>**Bk-249**</b>										
97249.35c	246.9353	endl85	LLNL	<1985	0	11,783	633	20	yes	p
97249.60c	246.9400	endf60	B-VI:XTM	1986	294	50,503	5,268	20	no	b
<b>Z=98*****Californium*****</b>										
<b>**Cf-249**</b>										
98249.35c	246.9352	endl85	LLNL	<1985	0	28,055	2,659	20	yes	p
98249.60c	246.9400	endf60	B-VI:XTM	1989	294	41,271	4,329	20	no	b
<b>**Cf-250**</b>										
98250.35c	247.9281	endl85	LLNL	<1985	0	10,487	457	20	yes	p
98250.60c	247.9280	endf60	B-VI.2	1976	294	47,758	5,554	20	yes	t
<b>**Cf-251**</b>										
98251.35c	248.9227	endl85	LLNL	<1985	0	10,969	516	20	yes	p
98251.60c	248.9230	endf60	B-VI.2	1976	294	42,817	4,226	20	yes	b
<b>**Cf-252**</b>										
98252.35c	249.9161	endl85	LLNL	<1985	0	17,908	1,535	20	yes	p
98252.60c	249.9160	endf60	B-VI.2	1976	294	49,204	5,250	20	yes	b

Special Notes (pp. G-29 and G-30, Ref. 1):

Note 1: The data libraries previously known as EPRIXS and U600K are now a part of the data library ENDF5MT. (Affected cross section libraries: 1001.53c, 5010.53c, 8016.53c, 8016.54c, 54135.50c, 54135.53c, 54135.54c, 92235.52c, 92235.53c, 92235.54c, 92238.52c, 92238.53c, 92238.54c)

Note 2: Data translated to ENDF/B-VI format with some modifications by LANL. (Affected cross section library: 1002.60c)

Note 3: The 100XS data library contains data for 9 nuclides up to 100 MeV. Heating numbers on this data library are known to be incorrect, overestimating the energy deposition. (Affected cross section libraries: 4009.21c, 6012.21c, 8016.21c, 13027.21c, 14000.21c, 20040.21c, 26000.21c, 74000.21c, 92238.21c)

Note 4: The natural carbon data 6000.50c are repeated here with the ZAID of 6012.50c for the user's convenience. Both are based on the natural carbon ENDF/B-V.0 evaluation. (Affected cross section library: 6012.50c)

**Note 5:** The data libraries previously known as ARKRC, GDT2GP, IRNAT, MISCXS, TM169, and T2DDC are now part of the data library MISC5XS. (Affected cross section library: 6012.50c)

**Note 6:** Photon production data were added to the existing ENDF evaluation in 1984. A complete new evaluation was performed in 1986. (Affected cross section libraries: 18000.59c, 35079.55c, 35081.55c, 36082.59c, 36083.59c, 36084.59c, 36086.59c, 37085.55c, 37087.55c, 39089.35c, 40000.56c, 40000.57c, 40000.58c, 53127.55c, 55133.55c, 64152.55c, 64154.55c, 64155.55c, 64156.55c, 64157.55c, 64158.55c, 64160.55c, 69169.55c, 75185.32c, 75187.32c, 77000.55c)

**Note 7:** Photon production added to ENDF/B-V.0 neutron files by T-2, with the intent to estimate photon heating roughly. (Affected cross section libraries: 18000.59c, 36082.59c, 36083.59c, 36084.59c, 36086.59c)

**Note 8:** These data were taken from incomplete fission-product evaluations. (Affected cross section libraries: 35079.55c, 35081.55c, 37085.55c, 37087.55c, 53127.55c, 55133.55c)

**Note 9:** This is ENDF/B-V.0 after modification by evaluator to get better agreement with ENDL85. (Affected cross section library: 39089.50c)

**Note 10:** The following files for Zr have been replaced by the indicated ZAID, eliminating the rare problem of having a secondary neutron energy greater than the incident neutron energy caused by an ENDF/B-V.0 evaluation problem. Note that this correction has been made for the ENDF/B-VI evaluation (40000.60c).

40000.50c	rmccs	→	40000.56c	misc5xs
40000.51c	endf5p	→	40000.57c	misc5xs
40000.53c	eprixs	→	40000.58c	misc5xs

**Note 11:** This note is not referenced in Table 4.1.

**Note 12:** The LANL/T-2 evaluation for I-127 was accepted for ENDF/B-VI.2 with modifications. These data are processed from the original LANL/T-2 evaluation. (Affected cross section library: 53127.60c)

**Note 13:** Photon production for GDT2GP. Photon production data were added to the ENDF/B-V.0 neutron cross sections by T-2. These data are valid only to 1 MeV. (Affected cross section libraries: 64152.55c, 64154.55c, 64155.55c, 64156.55c, 64157.55c, 64158.55c, 64160.55c)

**Note 14:** Photon production data added to original evaluation in 1981 by LANL. (Affected cross section library: 92233.60c)

## 5. Comparison of Available Cross Section Libraries

The comparison of the available continuous-energy cross section libraries documented in this report consisted of comparing the graphical representation of the various cross section libraries. A total of 757 plots were generated to compare the ACE format cross section libraries of 193 elements and isotopes. Table 5.10 presents the index for the 757 cross section plots. The cross section plots are presented in the Graphics Interchanged Format (GIF) on the attached CD-ROM identified as Attachment I. The filenames for the various cross section plots contained on the CD-ROM follow the format "p#.gif", where # corresponds to the plot number shown in Table 5.10. If multiple cross section libraries were available for each of the elements or isotopes, they were presented simultaneously in the various plots. If the natural cross section library and all of the constituent isotopic cross section libraries were available for a given element, a comparison plot was made for the natural cross section and isotopic representation of the natural cross section. The elements for which these natural versus isotopic-based natural cross section comparison plots were generated include: Cr, Fe, Ni, Cu, Ag, Eu, Gd, W, and Pb.

The natural versus isotopic-based natural cross section comparison plots for Eu are presented in Figures 5.1 through 5.6, as an example of the types of comparisons plots that are contained in Attachment I.

The various plots indexed in Table 5.10 were created using the MC PLOT feature available in MCNP4B (pp. B-10 through B-19, Ref. 1). The various cross section plots were generated using the following MCNP input deck:

```
Model for Cross Section Plotting
C
C This model is used solely for cross section plotting.
C The cross section plots for the QAP-3-5 technical
C report entitled "Selection of MCNP Cross Section
C Libraries" are generated using this model as a source.
C
C Geometry Specifications
1 1 -1.0 -1 IMP:N=1 $ Sphere containing all cross section libraries
2 2 -1.0 +1 -2 IMP:N=1 $ Spherical shell containing natural Cr
3 3 -1.0 +2 -3 IMP:N=1 $ Spherical shell containing natural Fe
4 4 -1.0 +3 -4 IMP:N=1 $ Spherical shell containing natural Ni
5 5 -1.0 +4 -5 IMP:N=1 $ Spherical shell containing natural Cu
6 6 -1.0 +5 -6 IMP:N=1 $ Spherical shell containing natural Ag
7 7 -1.0 +6 -7 IMP:N=1 $ Spherical shell containing natural Ag
8 8 -1.0 +7 -8 IMP:N=1 $ Spherical shell containing natural Ag
9 9 -1.0 +8 -9 IMP:N=1 $ Spherical shell containing natural Eu
10 10 -1.0 +9 -10 IMP:N=1 $ Spherical shell containing natural Eu
11 11 -1.0 +10 -11 IMP:N=1 $ Spherical shell containing natural Eu
12 12 -1.0 +11 -12 IMP:N=1 $ Spherical shell containing natural Gd
13 13 -1.0 +12 -13 IMP:N=1 $ Spherical shell containing natural Gd
14 14 -1.0 +13 -14 IMP:N=1 $ Spherical shell containing natural Gd
15 15 -1.0 +14 -15 IMP:N=1 $ Spherical shell containing natural W
16 16 -1.0 +15 -16 IMP:N=1 $ Spherical shell containing natural W
17 17 -1.0 +16 -17 IMP:N=1 $ Spherical shell containing natural W
18 18 -1.0 +17 -18 IMP:N=1 $ Spherical shell containing natural Pb
19 0 +18 IMP:N=0 $ Zero importance region

C Surface Specifications
1 SO 1
2 SO 2
3 SO 3
4 SO 4
5 SO 5
```

6	SO	6
7	SO	7
8	SO	8
9	SO	9
10	SO	10
11	SO	11
12	SO	12
13	SO	13
14	SO	14
15	SO	15
16	SO	16
17	SO	17
18	SO	18

C Material Specifications

M1	1001.35c	-100
	1001.50c	-100
	1001.53c	-100
	1001.60c	-100
	1002.35c	-100
	1002.50c	-100
	1002.55c	-100
	1002.60c	-100
	1003.35c	-100
	1003.50c	-100
	1003.60c	-100
	2003.35c	-100
	2003.50c	-100
	2003.60c	-100
	2004.35c	-100
	2004.50c	-100
	2004.60c	-100
	3006.50c	-100
	3006.60c	-100
	3007.50c	-100
	3007.55c	-100
	3007.60c	-100
	4007.35c	-100
	4009.21c	-100
	4009.50c	-100
	4009.60c	-100
	5010.50c	-100
	5010.53c	-100
	5010.60c	-100
	5011.35c	-100
	5011.50c	-100
	5011.55c	-100
	5011.56c	-100
	5011.60c	-100
	6000.50c	-100
	6000.60c	-100
	6012.21c	-100
	6012.35c	-100
	6012.50c	-100
	6013.35c	-100
	7014.50c	-100
	7014.60c	-100
	7015.55c	-100
	7015.60c	-100
	8016.21c	-100
	8016.35c	-100
	8016.50c	-100
	8016.53c	-100
	8016.54c	-100
	8016.60c	-100
	8017.60c	-100
	9019.35c	-100
	9019.50c	-100
	9019.51c	-100
	9019.60c	-100
	11023.35c	-100

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29000.50c -100  
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	97249.60c	-100	
	98249.35c	-100	
	98249.60c	-100	
	98250.35c	-100	
	98250.60c	-100	
	98251.35c	-100	
	98251.60c	-100	
	98252.35c	-100	
	98252.60c	-100	
M2	24050.60c	-4.173708	\$ Natural Cr Using ENDF/B-VI Cross Section Libraries
	24052.60c	-83.700254	
	24053.60c	-9.672640	
	24054.60c	-2.453398	
M3	26054.60c	-5.698834	\$ Natural Fe Using ENDF/B-VI Cross Section Libraries
	26056.60c	-91.869632	
	26057.60c	-2.141054	
	26058.60c	-0.290481	
M4	28058.60c	-67.394713	\$ Natural Ni Using ENDF/B-VI Cross Section Libraries
	28060.60c	-26.652659	
	28061.60c	-1.173193	
	28062.60c	-3.788185	
	28064.60c	-0.991250	
M5	29063.60c	-68.499441	\$ Natural Cu Using ENDF/B-VI Cross Section Libraries
	29065.60c	-31.500559	
M6	47107.60c	-51.376290	\$ Natural Ag Using ENDF/B-VI Cross Section Libraries (endf602)
	47109.60c	-48.623710	
M7	47107.35c	-51.376290	\$ Natural Ag Using ENDF/B-VI Cross Section Libraries (endf602)
	47109.35c	-48.623710	
M8	47107.50c	-51.376290	\$ Natural Ag Using ENDF/B-V Cross Section Libraries (rmccsa2)
	47109.50c	-48.623710	
M9	63151.60c	-47.471252	\$ Natural Eu Using ENDF/B-VI Cross Section Libraries (endf602)
	63153.60c	-52.528748	
M10	63151.50c	-47.471252	\$ Natural Eu Using ENDF/B-V Cross Section Libraries (rmccs2)
	63153.50c	-52.528748	
M11	63151.55c	-47.471252	\$ Natural Eu Using ENDF/B-V Cross Section Libraries (newxs2)
	63153.55c	-52.528748	
M12	64152.60c	-0.193219	\$ Natural Gd Using ENDF/B-VI Cross Section Libraries (endf602)
	64154.60c	-2.133824	
	64155.60c	-14.580782	
	64156.60c	-20.296917	
	64157.60c	-15.617353	
	64158.60c	-24.946080	
	64160.60c	-22.231825	
M13	64152.50c	-0.193219	\$ Natural Gd Using ENDF/B-V Cross Section Libraries (endf5u2)
	64154.50c	-2.133824	
	64155.50c	-14.580782	
	64156.50c	-20.296917	
	64157.50c	-15.617353	
	64158.50c	-24.946080	
	64160.50c	-22.231825	
M14	64152.55c	-0.193219	\$ Natural Gd Using ENDF/B-V Cross Section Libraries (misc5xs2)
	64154.55c	-2.133824	
	64155.55c	-14.580782	
	64156.55c	-20.296917	
	64157.55c	-15.617353	
	64158.55c	-24.946080	
	64160.55c	-22.231825	
M15	74182.60c	-26.027729	\$ Natural W Using ENDF/B-VI Cross Section Libraries (endf602)
	74183.60c	-14.209725	
	74184.60c	-30.835720	
	74186.60c	-28.926827	
M16	74182.50c	-26.027729	\$ Natural W Using ENDF/B-V Cross Section Libraries (endf5p2)
	74183.50c	-14.209725	
	74184.50c	-30.835720	
	74186.50c	-28.926827	
M17	74182.55c	-26.027729	\$ Natural W Using ENDF/B-V Cross Section Libraries (rmccsa2)
	74183.55c	-14.209725	

```

74184.55c -30.835720
74186.55c -28.926827
M18 82206.60c -23.948519 $ Natural Pb Using ENDF/B-VI Cross Section Libraries (endf602)
82207.60c -22.068637
82208.60c -53.982844

```

```

C
C Fake control specifications
MODE N
KCODE 100 1 10 100
KSRC 0 0 0
PRINT -128

```

The natural compositions for material numbers M2 through M18 in the MCNP input deck presented above were calculated using Equations 5.1 and 5.2 and the data presented in Tables 5.1 through 5.9. The atomic weight ratio values for the various isotopes in Tables 5.1 through 5.9 were obtained from the *xsdir* file used by MCNP (p. F-2, Ref. 1 and p. III-3, Ref. 5). The atom percent in nature of the various isotopes in Tables 5.1 through 5.9 are obtained from Reference 7. The number of significant figures presented for the elemental atomic weight ratios and the isotopic weight percents in nature in Tables 5.1 through 5.9 are a function of the calculations and should not be interpreted as a reflection of accuracy.

**Equation 5-1. Atomic Weight Ratio of Element in Nature** (The atomic weight ratio of an entity is the ratio of the entity's mass to the mass of a neutron.)

$$\text{Atomic Weight Ratio of Element in Nature} = \sum_{i=1}^I \left[ \frac{(\text{Atomic Weight Ratio of Isotope})_i *}{(\text{Atom Percent of Isotope in Nature})_i} \right]$$

where I is the total number of isotopes composing the element in its natural state.

**Equation 5-2. Weight Percent of an Isotope in a Natural Elemental Composition**

$$\left[ \frac{\text{Isotopic Weight Percent in Elemental Composition}}{\text{Atomic Weight Ratio of Element in Nature}} \right] = \frac{[(\text{Atomic Weight Ratio of Isotope})_i *]}{(\text{Atom Percent of Isotope in Nature})_i}$$

**Table 5-1. Data for Isotopic Representation of Natural Chromium**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Cr-50	49.5170	4.345	4.173708
Cr-52	51.4940	83.79	83.700254
Cr-53	52.4860	9.50	9.672640
Cr-54	53.4760	2.365	2.453398
Cr (natural)	51.549214	100	100

**Table 5-2. Data for Isotopic Representation of Natural Iron**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Fe-54	53.4760	5.9	5.698834
Fe-56	55.4540	91.72	91.869632
Fe-57	56.4460	2.1	2.141054
Fe-58	57.4360	0.28	0.290481
Fe (natural)	55.363680	100	100

**Table 5-3. Data for Isotopic Representation of Natural Nickel**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Ni-58	57.4380	68.27	67.394713
Ni-60	59.4160	26.10	26.652659
Ni-61	60.4080	1.13	1.173193
Ni-62	61.3960	3.59	3.788185
Ni-64	63.3790	0.91	0.991250
Ni (natural)	58.183974	100	100

**Table 5-4. Data for Isotopic Representation of Natural Copper**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Cu-63	62.3890	69.17	68.499441
Cu-65	64.3700	30.83	31.500559
Cu (natural)	62.999742	100	100

**Table 5-5. Data for Isotopic Representation of Natural Silver**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Ag-107	105.9870	51.839	51.376290
Ag-109	107.9690	48.161	48.623710
Ag (natural)	106.941551	100	100

**Table 5-6. Data for Isotopic Representation of Natural Europium**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Eu-151	149.6230	47.8	47.471252
Eu-153	151.6080	52.2	52.528748
Eu (natural)	150.659170	100	100

**Table 5-7. Data for Isotopic Representation of Natural Gadolinium**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Gd-152	150.6150	0.20	0.193219
Gd-154	152.5990	2.18	2.133824
Gd-155	153.5920	14.80	14.580782
Gd-156	154.5830	20.47	20.296917
Gd-157	155.5760	15.65	15.617353
Gd-158	156.5670	24.84	24.946080
Gd-160	158.5530	21.86	22.231825
Gd (natural)	155.901217	100	100

**Table 5-8. Data for Isotopic Representation of Natural Tungsten**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
W-180	Cross Section Library Not Available	0.12	The atom % in nature of W-180 was added to the W-184 atom % in nature.
W-182	180.3900	26.3	26.027729
W-183	181.3800	14.28	14.209725
W-184	182.3700	30.7	30.835720
W-186	184.3600	28.6	28.926827
W (natural)	182.277028	100	100

**Table 5-9. Data for Isotopic Representation of Natural Lead**

Element or Isotope	Atomic Weight Ratio	Atom % in Nature	Weight % in Nature
Pb-204	Cross Section Library Not Available	1.4	The atom % in nature of Pb-204 was added to the Pb-208 atom % in nature.
Pb-206	204.2000	24.1	23.948519
Pb-207	205.2000	22.1	22.068637
Pb-208	206.1900	52.4	53.982844
Pb (natural)	205.491620	100	100

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
H-1	Elastic Scattering	Total	1
H-1	Total Absorption	Total	2
H-2	Elastic Scattering	Total	3
H-2	Total Absorption	Total	4
H-3	Elastic Scattering	Total	5
He-3	Elastic Scattering	Total	6
He-3	Total Absorption	Total	7
He-4	Elastic Scattering	Total	8
Li-6	Elastic Scattering	Total	9
Li-6	Total Absorption	Total	10
Li-7	Elastic Scattering	Total	11
Li-7	Total Absorption	Total	12
Be-7	Elastic Scattering	Total	13
Be-7	Total Absorption	Total	14
Be-9	Elastic Scattering	Total	15
Be-9	Total Absorption	Total	16
B-10	Elastic Scattering	Total	17
B-10	Elastic Scattering	0.1 to 50.0 MeV	18
B-10	Total Absorption	Total	19
B-10	Total Absorption	0.7 to 50.0 MeV	20
B-11	Elastic Scattering	Total	21
B-11	Elastic Scattering	0.01 to 20.0 MeV	22
B-11	Total Absorption	Total	23
B-11	Total Absorption	0.01 to 20.0 MeV	24
C (natural)	Elastic Scattering	Total	25
C (natural)	Elastic Scattering	1.0 to 20.0 MeV	26
C (natural)	Total Absorption	Total	27
C (natural)	Total Absorption	5.0 to 20.0 MeV	28
C-12	Elastic Scattering	Total	29
C-12	Elastic Scattering	1.0 to 20.0 MeV	30
C-12	Total Absorption	Total	31
C (natural) & C-12	Elastic Scattering	Total	32
C (natural) & C-12	Elastic Scattering	1.0 to 20.0 MeV	33
C (natural) & C-12	Total Absorption	Total	34
C (natural) & C-12	Total Absorption	1.0 to 20.0 MeV	35
C-13	Elastic Scattering	Total	36
C-13	Total Absorption	Total	37
N-14	Elastic Scattering	Total	38
N-14	Elastic Scattering	0.1 to 20.0 MeV	39
N-14	Total Absorption	Total	40

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
N-14	Total Absorption	0.1 to 20.0 MeV	41
N-15	Elastic Scattering	Total	42
N-15	Elastic Scattering	1.0 to 20.0 MeV	43
N-15	Total Absorption	Total	44
O-16	Elastic Scattering	Total	45
O-16	Elastic Scattering	0.3 to 20.0 MeV	46
O-16	Total Absorption	Total	47
O-16	Total Absorption	2.0 to 20.0 MeV	48
O-17	Elastic Scattering	Total	49
O-17	Total Absorption	Total	50
F-19	Elastic Scattering	Total	51
F-19	Elastic Scattering	0.01 to 20.0 MeV	52
F-19	Total Absorption	Total	53
F-19	Total Absorption	0.01 to 20.0 MeV	54
Na-23	Elastic Scattering	Total	55
Na-23	Elastic Scattering	0.001 to 20.0 MeV	56
Na-23	Total Absorption	Total	57
Na-23	Total Absorption	0.001 to 20.0 MeV	58
Mg (natural)	Elastic Scattering	Total	59
Mg (natural)	Elastic Scattering	0.01 to 20.0 MeV	60
Mg (natural)	Total Absorption	Total	61
Mg (natural)	Total Absorption	0.01 to 20.0 MeV	62
Al-27	Elastic Scattering	Total	63
Al-27	Elastic Scattering	0.003 to 20.0 MeV	64
Al-27	Total Absorption	Total	65
Si (natural)	Elastic Scattering	Total	66
Si (natural)	Elastic Scattering	0.005 to 20.0 MeV	67
Si (natural)	Total Absorption	Total	68
Si (natural)	Total Absorption	0.001 to 20.0 MeV	69
P-31	Elastic Scattering	Total	70
P-31	Elastic Scattering	0.002 to 20.0 MeV	71
P-31	Total Absorption	Total	72
P-31	Total Absorption	0.1 to 20.0 MeV	73
S (natural)	Elastic Scattering	Total	74
S (natural)	Total Absorption	Total	75
S-32	Elastic Scattering	Total	76
S-32	Elastic Scattering	0.01 to 20.0 MeV	77
S-32	Total Absorption	Total	78
S-32	Total Absorption	0.01 to 20.0 MeV	79
S (natural) & S-32	Elastic Scattering	Total	80
S (natural) & S-32	Elastic Scattering	0.01 to 20.0 MeV	81
S (natural) & S-32	Total Absorption	Total	82
S (natural) & S-32	Total Absorption	0.01 to 20.0 MeV	83
Cl (natural)	Elastic Scattering	Total	84
Cl (natural)	Elastic Scattering	1.0E-4 to 2.0 MeV	85
Cl (natural)	Total Absorption	Total	86
Ar (natural)	Elastic Scattering	Total	87
Ar (natural)	Total Absorption	Total	88
K (natural)	Elastic Scattering	Total	89
K (natural)	Elastic Scattering	0.001 to 10.0 MeV	90
K (natural)	Total Absorption	Total	91



**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Ca (natural)	Elastic Scattering	Total	92
Ca (natural)	Elastic Scattering	0.01 to 20.0 MeV	93
Ca (natural)	Total Absorption	Total	94
Ca (natural)	Total Absorption	0.001 to 20.0 MeV	95
Ca-40	Elastic Scattering	Total	279
Ca-40	Total Absorption	Total	280
Sc-45	Elastic Scattering	Total	96
Sc-45	Elastic Scattering	0.001 to 0.2 MeV	97
Sc-45	Total Absorption	Total	98
Sc-45	Total Absorption	0.001 to 0.2 MeV	99
Ti (natural)	Elastic Scattering	Total	100
Ti (natural)	Elastic Scattering	0.002 to 0.3 MeV	101
Ti (natural)	Total Absorption	Total	102
Ti (natural)	Total Absorption	0.002 to 0.3 MeV	103
V (natural)	Elastic Scattering	Total	104
V (natural)	Elastic Scattering	0.001 to 20.0 MeV	105
V (natural)	Total Absorption	Total	106
V (natural)	Total Absorption	0.001 to 0.2 MeV	107
Cr (natural)	Elastic Scattering	Total	108
Cr (natural)	Elastic Scattering	0.01 to 5.0 MeV	109
Cr (natural)	Total Absorption	Total	110
Cr (natural)	Total Absorption	0.001 to 2.0 MeV	111
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Elastic Scattering	Total	112
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Elastic Scattering	1.0E-4 to 0.1 MeV	113
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Elastic Scattering	0.1 to 1.0 MeV	114
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Elastic Scattering	1.0 to 20.0 MeV	115
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Total Absorption	Total	116
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Total Absorption	0.001 to 0.01 MeV	117
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Total Absorption	0.01 to 1.0 MeV	118
Cr Isotopic Cross Sections in Natural Composition & Natural Cr Cross Sections	Total Absorption	1.0 to 20.0 MeV	119
Mn-55	Elastic Scattering	Total	120
Mn-55	Elastic Scattering	1.0E-4 to 0.01 MeV	121
Mn-55	Elastic Scattering	0.01 to 10.0 MeV	122
Mn-55	Total Absorption	Total	123
Mn-55	Total Absorption	1.0E-4 to 0.01 MeV	124
Mn-55	Total Absorption	0.01 to 0.2 MeV	125

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Fe (natural)	Elastic Scattering	Total	126
Fe (natural)	Elastic Scattering	0.001 to 0.1 MeV	127
Fe (natural)	Elastic Scattering	0.1 to 1.0 MeV	128
Fe (natural)	Elastic Scattering	1.0 to 10.0 MeV	129
Fe (natural)	Total Absorption	Total	130
Fe (natural)	Total Absorption	1.0E-4 to 0.01 MeV	131
Fe (natural)	Total Absorption	0.01 to 0.1 MeV	132
Fe (natural)	Total Absorption	0.1 to 1.0 MeV	133
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Elastic Scattering	Total	134
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Elastic Scattering	0.001 to 0.1 MeV	135
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Elastic Scattering	0.1 to 1.0 MeV	136
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Elastic Scattering	1.0 to 10.0 MeV	137
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Total Absorption	Total	138
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Total Absorption	0.001 to 0.1 MeV	139
Fe Isotopic Cross Sections in Natural Composition & Natural Fe Cross Sections	Total Absorption	0.1 to 1.0 MeV	140
Co-59	Elastic Scattering	Total	141
Co-59	Elastic Scattering	0.01 to 0.1 MeV	142
Co-59	Elastic Scattering	0.1 to 1.0 MeV	143
Co-59	Elastic Scattering	1.0 to 10.0 MeV	144
Co-59	Total Absorption	Total	145
Co-59	Total Absorption	0.001 to 0.01 MeV	146
Co-59	Total Absorption	0.01 to 0.1 MeV	147
Co-59	Total Absorption	0.1 to 20.0 MeV	148
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Elastic Scattering	Total	149
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Elastic Scattering	0.01 to 0.1 MeV	150
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Elastic Scattering	0.1 to 1.0 MeV	151
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Elastic Scattering	1.0 to 10.0 MeV	152
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Total Absorption	Total	153

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Total Absorption	0.001 to 0.01 MeV	154
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Total Absorption	0.01 to 0.1 MeV	155
Ni Isotopic Cross Sections in Natural Composition & Natural Ni Cross Sections	Total Absorption	0.1 to 1.0 MeV	156
Ni-58	Elastic Scattering	Total	157
Ni-58	Elastic Scattering	0.01 to 1.0 MeV	158
Ni-58	Elastic Scattering	1.0 to 10.0 MeV	159
Ni-58	Total Absorption	Total	160
Ni-58	Total Absorption	0.001 to 0.1 MeV	161
Ni-58	Total Absorption	0.1 to 1.0 MeV	162
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Elastic Scattering	Total	163
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Elastic Scattering	2.0E-4 to 0.01 MeV	164
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Elastic Scattering	0.01 to 0.1 MeV	165
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Elastic Scattering	0.1 to 1.0 MeV	166
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Total Absorption	Total	167
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Total Absorption	1.0E-4 to 0.001 MeV	168
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Total Absorption	0.001 to 0.01 MeV	169
Cu Isotopic Cross Sections in Natural Composition & Natural Cu Cross Sections	Total Absorption	0.01 to 0.2 MeV	170
Ga (natural)	Elastic Scattering	Total	171
Ga (natural)	Total Absorption	Total	172
As-74	Elastic Scattering	Total	173
As-74	Total Absorption	Total	174
As-75	Elastic Scattering	Total	175
As-75	Total Absorption	Total	176
Br-79	Elastic Scattering	Total	177
Br-79	Total Absorption	Total	178
Br-81	Elastic Scattering	Total	179
Br-81	Total Absorption	Total	180
Kr-78	Elastic Scattering	Total	181
Kr-78	Total Absorption	Total	182
Kr-80	Elastic Scattering	Total	183

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Kr-80	Total Absorption	Total	184
Kr-82	Elastic Scattering	Total	185
Kr-82	Total Absorption	Total	186
Kr-83	Elastic Scattering	Total	187
Kr-83	Total Absorption	Total	188
Kr-84	Elastic Scattering	Total	189
Kr-84	Total Absorption	Total	190
Kr-86	Elastic Scattering	Total	191
Kr-86	Total Absorption	Total	192
Rb-85	Elastic Scattering	Total	193
Rb-85	Total Absorption	Total	194
Rb-87	Elastic Scattering	Total	195
Rb-87	Total Absorption	Total	196
Y-88	Elastic Scattering	Total	197
Y-88	Total Absorption	Total	198
Y-89	Elastic Scattering	Total	199
Y-89	Elastic Scattering	0.001 to 0.01 MeV	200
Y-89	Elastic Scattering	0.01 to 0.1 MeV	201
Y-89	Elastic Scattering	0.1 to 1.0 MeV	202
Y-89	Total Absorption	Total	203
Y-89	Total Absorption	0.001 to 0.01 MeV	204
Y-89	Total Absorption	0.01 to 0.1 MeV	205
Y-89	Total Absorption	0.1 to 1.0 MeV	206
Zr (natural)	Elastic Scattering	Total	207
Zr (natural)	Elastic Scattering	1.0E-4 to 0.001 MeV	208
Zr (natural)	Elastic Scattering	0.001 to 0.01 MeV	209
Zr (natural)	Elastic Scattering	0.01 to 0.1 MeV	210
Zr (natural)	Total Absorption	Total	211
Zr (natural)	Total Absorption	1.0E-4 to 0.001 MeV	212
Zr (natural)	Total Absorption	0.001 to 0.01 MeV	213
Zr (natural)	Total Absorption	0.01 to 0.1 MeV	214
Zr-93	Elastic Scattering	Total	215
Zr-93	Total Absorption	Total	216
Nb-93	Elastic Scattering	Total	217
Nb-93	Elastic Scattering	1.0E-4 to 0.001 MeV	218
Nb-93	Elastic Scattering	0.001 to 0.01 MeV	219
Nb-93	Total Absorption	Total	220
Nb-93	Total Absorption	1.0E-5 to 1.0E-4 MeV	221
Nb-93	Total Absorption	1.0E-4 to 0.001 MeV	222
Nb-93	Total Absorption	0.001 to 0.01 MeV	223
Nb-93	Total Absorption	0.01 to 1.0 MeV	224
Mo (natural)	Elastic Scattering	Total	225
Mo (natural)	Elastic Scattering	1.0E-5 to 0.01 MeV	226
Mo (natural)	Total Absorption	Total	227
Mo (natural)	Total Absorption	1.0E-5 to 0.002 MeV	228
Mo-95	Elastic Scattering	Total	229
Mo-95	Total Absorption	Total	230
Tc-99	Elastic Scattering	Total	231
Tc-99	Total Absorption	Total	232
Ru-101	Elastic Scattering	Total	233
Ru-101	Total Absorption	Total	234

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Ru-103	Elastic Scattering	Total	235
Ru-103	Total Absorption	Total	236
Rh-103	Elastic Scattering	Total	237
Rh-103	Total Absorption	Total	238
Rh-105	Elastic Scattering	Total	239
Rh-105	Total Absorption	Total	240
Pd-105	Elastic Scattering	Total	241
Pd-105	Total Absorption	Total	242
Pd-108	Elastic Scattering	Total	243
Pd-108	Total Absorption	Total	244
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Elastic Scattering	Total	245
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Elastic Scattering	1.0E-6 to 1.0E-5 MeV	246
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	247
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Elastic Scattering	1.0E-4 to 0.001 MeV	248
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Elastic Scattering	0.001 to 0.01 MeV	249
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Total Absorption	Total	250
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Total Absorption	1.0E-5 to 1.0E-4 MeV	251
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Total Absorption	1.0E-4 to 0.001 MeV	252
Ag Isotopic Cross Sections in Natural Composition & Natural Ag Cross Sections	Total Absorption	0.001 to 0.01 MeV	253
Ag-107	Elastic Scattering	Total	254
Ag-107	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	255
Ag-107	Elastic Scattering	1.0E-4 to 0.001 MeV	256
Ag-107	Elastic Scattering	0.001 to 0.01 MeV	257
Ag-107	Total Absorption	Total	258
Ag-107	Total Absorption	1.0E-5 to 1.0E-4 MeV	259
Ag-107	Total Absorption	1.0E-4 to 0.001 MeV	260
Ag-107	Total Absorption	0.001 to 0.01 MeV	261
Ag-109	Elastic Scattering	Total	262
Ag-109	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	263
Ag-109	Elastic Scattering	1.0E-4 to 0.001 MeV	264
Ag-109	Elastic Scattering	0.001 to 0.01 MeV	265
Ag-109	Total Absorption	Total	266
Ag-109	Total Absorption	1.0E-5 to 1.0E-4 MeV	267
Ag-109	Total Absorption	1.0E-4 to 0.001 MeV	268

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Ag-109	Total Absorption	0.001 to 0.01 MeV	269
Cd (natural)	Elastic Scattering	Total	270
Cd (natural)	Elastic Scattering	3.0E-5 to 0.002 MeV	271
Cd (natural)	Total Absorption	Total	272
Cd (natural)	Total Absorption	1.0E-5 to 1.0E-4 MeV	273
Cd (natural)	Total Absorption	1.0E-4 to 0.002 MeV	274
In (natural)	Elastic Scattering	Total	275
In (natural)	Total Absorption	Total	276
Sn (natural)	Elastic Scattering	Total	277
Sn (natural)	Total Absorption	Total	278
I-127	Elastic Scattering	Total	281
I-127	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	282
I-127	Elastic Scattering	1.0E-4 to 0.002 MeV	283
I-127	Total Absorption	Total	284
I-127	Total Absorption	1.0E-5 to 1.0E-4 MeV	285
I-127	Total Absorption	1.0E-4 to 0.002 MeV	286
I-129	Elastic Scattering	Total	287
I-129	Total Absorption	Total	288
I-135	Elastic Scattering	Total	289
I-135	Total Absorption	Total	290
Xe (natural)	Elastic Scattering	Total	291
Xe (natural)	Total Absorption	Total	292
Xe-131	Elastic Scattering	Total	293
Xe-131	Total Absorption	Total	294
Xe-134	Elastic Scattering	Total	295
Xe-134	Total Absorption	Total	296
Xe-135	Elastic Scattering	Total	297
Xe-135	Total Absorption	Total	298
Cs-133	Elastic Scattering	Total	299
Cs-133	Elastic Scattering	1.0E-5 to 2.0E-4 MeV	300
Cs-133	Elastic Scattering	2.0E-4 to 0.003 MeV	301
Cs-133	Total Absorption	Total	302
Cs-133	Total Absorption	2.0E-6 to 1.0E-4 MeV	303
Cs-133	Total Absorption	1.0E-4 to 0.004 MeV	304
Cs-134	Elastic Scattering	Total	305
Cs-134	Total Absorption	Total	306
Cs-135	Elastic Scattering	Total	307
Cs-135	Total Absorption	Total	308
Cs-136	Elastic Scattering	Total	309
Cs-136	Total Absorption	Total	310
Cs-137	Elastic Scattering	Total	311
Cs-137	Total Absorption	Total	312
Ba-138	Elastic Scattering	Total	313
Ba-138	Elastic Scattering	0.003 to 2.0 MeV	314
Ba-138	Total Absorption	Total	315
Pr-141	Elastic Scattering	Total	316
Pr-141	Total Absorption	Total	317
Nd-143	Elastic Scattering	Total	318
Nd-143	Total Absorption	Total	319
Nd-145	Elastic Scattering	Total	320
Nd-145	Total Absorption	Total	321

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Nd-147	Elastic Scattering	Total	322
Nd-147	Total Absorption	Total	323
Nd-148	Elastic Scattering	Total	324
Nd-148	Total Absorption	Total	325
Pm-147	Elastic Scattering	Total	326
Pm-147	Total Absorption	Total	327
Pm-148	Elastic Scattering	Total	328
Pm-148	Total Absorption	Total	329
Pm-149	Elastic Scattering	Total	330
Pm-149	Total Absorption	Total	331
Sm-147	Elastic Scattering	Total	332
Sm-147	Total Absorption	Total	333
Sm-149	Elastic Scattering	Total	334
Sm-149	Total Absorption	Total	335
Sm-150	Elastic Scattering	Total	336
Sm-150	Total Absorption	Total	337
Sm-151	Elastic Scattering	Total	338
Sm-151	Total Absorption	Total	339
Sm-152	Elastic Scattering	Total	340
Sm-152	Total Absorption	Total	341
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Elastic Scattering	Total	342
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Elastic Scattering	1.0E-6 to 1.0E-5 MeV	343
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	344
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Total Absorption	Total	345
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Total Absorption	1.0E-6 to 1.0E-5 MeV	346
Eu Isotopic Cross Sections in Natural Composition & Natural Eu Cross Sections	Total Absorption	1.0E-5 to 2.0E-4 MeV	347
Eu-151	Elastic Scattering	Total	348
Eu-151	Elastic Scattering	1.0E-6 to 3.0E-5 MeV	349
Eu-151	Elastic Scattering	3.0E-5 to 2.0E-4 MeV	350
Eu-151	Total Absorption	Total	351
Eu-151	Total Absorption	1.0E-6 to 3.0E-5 MeV	352
Eu-151	Total Absorption	3.0E-5 to 2.0E-4 MeV	353
Eu-152	Elastic Scattering	Total	354
Eu-152	Total Absorption	Total	355
Eu-153	Elastic Scattering	Total	356
Eu-153	Elastic Scattering	1.0E-6 to 2.0E-5 MeV	357
Eu-153	Elastic Scattering	2.0E-5 to 2.0E-4 MeV	358
Eu-153	Total Absorption	Total	359
Eu-153	Total Absorption	1.0E-6 to 2.0E-5 MeV	360
Eu-153	Total Absorption	2.0E-5 to 2.0E-4 MeV	361

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Eu-154	Elastic Scattering	Total	362
Eu-154	Total Absorption	Total	363
Eu-155	Elastic Scattering	Total	364
Eu-155	Total Absorption	Total	365
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Elastic Scattering	Total	366
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Elastic Scattering	1.0E-6 to 1.0E-5 MeV	367
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	368
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Elastic Scattering	1.0E-4 to 0.001 MeV	369
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Elastic Scattering	0.001 to 0.02 MeV	370
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Total Absorption	Total	371
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Total Absorption	1.0E-6 to 1.0E-5 MeV	372
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Total Absorption	1.0E-5 to 1.0E-4 MeV	373
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Total Absorption	1.0E-4 to 0.001 MeV	374
Gd Isotopic Cross Sections in Natural Composition & Natural Gd Cross Sections	Total Absorption	0.001 to 0.02 MeV	375
Gd-152	Elastic Scattering	Total	376
Gd-152	Elastic Scattering	2.0E-6 to 3.0E-4 MeV	377
Gd-152	Total Absorption	Total	378
Gd-152	Total Absorption	2.0E-6 to 3.0E-4 MeV	379
Gd-154	Elastic Scattering	Total	380
Gd-154	Elastic Scattering	1.0E-5 to 0.002 MeV	381
Gd-154	Total Absorption	Total	382
Gd-154	Total Absorption	1.0E-5 to 1.0E-4 MeV	383
Gd-154	Total Absorption	1.0E-4 to 0.002 MeV	384
Gd-155	Elastic Scattering	Total	385
Gd-155	Elastic Scattering	1.0E-6 to 3.0E-5 MeV	386
Gd-155	Elastic Scattering	3.0E-5 to 2.0E-4 MeV	387
Gd-155	Total Absorption	Total	388
Gd-155	Total Absorption	1.0E-6 to 2.0E-5 MeV	389
Gd-155	Total Absorption	2.0E-5 to 3.0E-4 MeV	390
Gd-156	Elastic Scattering	Total	391
Gd-156	Elastic Scattering	2.0E-5 to 0.002 MeV	392
Gd-156	Total Absorption	Total	393



**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Gd-156	Total Absorption	2.0E-5 to 0.002 MeV	394
Gd-157	Elastic Scattering	Total	395
Gd-157	Elastic Scattering	2.0E-5 to 8.0E-4 MeV	396
Gd-157	Total Absorption	Total	397
Gd-157	Total Absorption	1.0E-5 to 4.0E-4 MeV	398
Gd-158	Elastic Scattering	Total	399
Gd-158	Elastic Scattering	2.0E-4 to 0.02 MeV	400
Gd-158	Total Absorption	Total	401
Gd-158	Total Absorption	2.0E-4 to 0.004 MeV	402
Gd-158	Total Absorption	0.004 to 0.02 MeV	403
Gd-160	Elastic Scattering	Total	404
Gd-160	Elastic Scattering	2.0E-4 to 0.02 MeV	405
Gd-160	Total Absorption	Total	406
Gd-160	Total Absorption	2.0E-4 to 0.002 MeV	407
Gd-160	Total Absorption	0.002 to 0.02 MeV	408
Ho-165	Elastic Scattering	Total	409
Ho-165	Elastic Scattering	2.0E-6 to 1.0E-4 MeV	410
Ho-165	Elastic Scattering	1.0E-4 to 0.002 MeV	411
Ho-165	Total Absorption	Total	412
Ho-165	Total Absorption	1.0E-6 to 1.0E-4 MeV	413
Ho-165	Total Absorption	1.0E-4 to 0.002 MeV	414
Tm-169	Elastic Scattering	Total	415
Tm-169	Total Absorption	Total	416
Hf (natural)	Elastic Scattering	Total	417
Hf (natural)	Elastic Scattering	1.0E-6 to 1.0E-4 MeV	418
Hf (natural)	Elastic Scattering	1.0E-4 to 0.001 MeV	419
Hf (natural)	Elastic Scattering	0.001 to 0.02 MeV	420
Hf (natural)	Total Absorption	Total	421
Hf (natural)	Total Absorption	1.0E-5 to 3.0E-4 MeV	422
Hf (natural)	Total Absorption	3.0E-4 to 0.003 MeV	423
Hf (natural)	Total Absorption	0.003 to 0.02 MeV	424
Ta-181	Elastic Scattering	Total	425
Ta-181	Elastic Scattering	2.0E-6 to 1.0E-4 MeV	426
Ta-181	Elastic Scattering	1.0E-4 to 0.004 MeV	427
Ta-181	Total Absorption	Total	428
Ta-181	Total Absorption	2.0E-6 to 2.0E-4 MeV	429
Ta-181	Total Absorption	2.0E-4 to 5.0E-4 MeV	430
Ta-182	Elastic Scattering	Total	431
Ta-182	Total Absorption	Total	432
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Elastic Scattering	Total	433
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Elastic Scattering	1.0E-6 to 2.0E-4 MeV	434
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Elastic Scattering	2.0E-4 to 0.001 MeV	435
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Elastic Scattering	0.001 to 0.008 MeV	436

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Total Absorption	Total	437
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Total Absorption	1.0E-6 to 3.0E-4 MeV	438
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Total Absorption	3.0E-4 to 0.001 MeV	439
W Isotopic Cross Sections in Natural Composition & Natural W Cross Sections	Total Absorption	0.001 to 0.01 MeV	440
W-182	Elastic Scattering	Total	441
W-182	Elastic Scattering	2.0E-4 to 0.004 MeV	442
W-182	Total Absorption	Total	443
W-182	Total Absorption	2.0E-4 to 0.001 MeV	444
W-182	Total Absorption	0.001 to 0.08 MeV	445
W-183	Elastic Scattering	Total	446
W-183	Elastic Scattering	1.0E-5 to 0.002 MeV	447
W-183	Total Absorption	Total	448
W-183	Total Absorption	1.0E-4 to 0.002 MeV	449
W-184	Elastic Scattering	Total	450
W-184	Elastic Scattering	1.0E-4 to 0.003 MeV	451
W-184	Total Absorption	Total	452
W-184	Total Absorption	1.0E-4 to 0.003 MeV	453
W-186	Elastic Scattering	Total	454
W-186	Elastic Scattering	1.0E-4 to 0.005 MeV	455
W-186	Total Absorption	Total	456
W-186	Total Absorption	1.0E-4 to 0.008 MeV	457
Re-185	Elastic Scattering	Total	458
Re-185	Elastic Scattering	1.0E-6 to 1.0E-4 MeV	459
Re-185	Elastic Scattering	1.0E-4 to 0.003 MeV	460
Re-185	Total Absorption	Total	461
Re-185	Total Absorption	1.0E-6 to 1.0E-4 MeV	462
Re-185	Total Absorption	1.0E-4 to 0.003 MeV	463
Re-187	Elastic Scattering	Total	464
Re-187	Elastic Scattering	1.0E-6 to 1.0E-4 MeV	465
Re-187	Elastic Scattering	1.0E-4 to 0.003 MeV	466
Re-187	Total Absorption	Total	467
Re-187	Total Absorption	1.0E-6 to 1.0E-4 MeV	468
Re-187	Total Absorption	1.0E-4 to 0.003 MeV	469
Ir (natural)	Elastic Scattering	Total	470
Ir (natural)	Total Absorption	Total	471
Pt (natural)	Elastic Scattering	Total	472
Pt (natural)	Total Absorption	Total	473
Au-197	Elastic Scattering	Total	474
Au-197	Elastic Scattering	3.0E-6 to 2.0E-4 MeV	475
Au-197	Elastic Scattering	2.0E-4 to 0.002 MeV	476
Au-197	Elastic Scattering	0.002 to 0.01 MeV	477
Au-197	Total Absorption	Total	478
Au-197	Total Absorption	1.0E-6 to 0.001 MeV	479
Au-197	Total Absorption	0.001 to 0.006 MeV	480

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Elastic Scattering	Total	481
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Elastic Scattering	0.001 to 0.1 MeV	482
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Elastic Scattering	0.1 to 1.0 MeV	483
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Elastic Scattering	1.0 to 10.0 MeV	484
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Total Absorption	Total	485
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Total Absorption	0.001 to 0.1 MeV	486
Pb Isotopic Cross Sections in Natural Composition & Natural Pb Cross Sections	Total Absorption	0.1 to 1.0 MeV	487
Pb-206	Elastic Scattering	Total	488
Pb-206	Total Absorption	Total	489
Pb-207	Elastic Scattering	Total	490
Pb-207	Total Absorption	Total	491
Pb-208	Elastic Scattering	Total	492
Pb-208	Total Absorption	Total	493
Bi-209	Elastic Scattering	Total	494
Bi-209	Elastic Scattering	7.0E-4 to 0.1 MeV	495
Bi-209	Elastic Scattering	0.1 to 2.0 MeV	496
Bi-209	Total Absorption	Total	497
Bi-209	Total Absorption	7.0E-4 to 0.02 MeV	498
Bi-209	Total Absorption	0.02 to 0.2 MeV	499
Th-230	Elastic Scattering	Total	500
Th-230	Total Absorption	Total	501
Th-230	Total Fission	Total	672
Th-231	Elastic Scattering	Total	502
Th-231	Total Absorption	Total	503
Th-231	Total Fission	Total	673
Th-232	Elastic Scattering	Total	504
Th-232	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	505
Th-232	Elastic Scattering	1.0E-4 to 0.001 MeV	506
Th-232	Elastic Scattering	0.001 to 0.005 MeV	507
Th-232	Total Absorption	Total	508
Th-232	Total Absorption	1.0E-5 to 3.0E-4 MeV	509
Th-232	Total Absorption	3.0E-4 to 0.001 MeV	510
Th-232	Total Absorption	0.001 to 0.005 MeV	511
Th-232	Total Fission	Total	674
Th-233	Elastic Scattering	Total	512
Th-233	Total Absorption	Total	513
Th-233	Total Fission	Total	675
Pa-231	Elastic Scattering	Total	514

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Pa-231	Total Absorption	Total	515
Pa-231	Total Fission	Total	676
Pa-233	Elastic Scattering	Total	516
Pa-233	Elastic Scattering	1.0E-6 to 6.0E-5 MeV	517
Pa-233	Total Absorption	Total	518
Pa-233	Total Absorption	1.0E-6 to 8.0E-5 MeV	519
Pa-233	Total Fission	Total	677
U-232	Elastic Scattering	Total	520
U-232	Total Absorption	Total	521
U-232	Total Fission	Total	678
U-233	Elastic Scattering	Total	522
U-233	Elastic Scattering	1.0E-6 to 1.0E-4 MeV	523
U-233	Total Absorption	Total	524
U-233	Total Absorption	1.0E-6 to 1.0E-5 MeV	525
U-233	Total Absorption	1.0E-5 to 1.0E-4 MeV	526
U-233	Total Fission	Total	679
U-233	Total Fission	1.0E-6 to 1.0E-4 MeV	680
U-234	Elastic Scattering	Total	527
U-234	Elastic Scattering	1.0E-6 to 1.0E-5 MeV	528
U-234	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	529
U-234	Elastic Scattering	1.0E-4 to 0.001 MeV	530
U-234	Elastic Scattering	0.001 to 0.01 MeV	531
U-234	Total Absorption	Total	532
U-234	Total Absorption	1.0E-5 to 3.0E-4 MeV	533
U-234	Total Absorption	3.0E-4 to 0.002 MeV	534
U-234	Total Fission	Total	681
U-234	Total Fission	1.0E-5 to 0.002 MeV	682
U-235	Elastic Scattering	Total	535
U-235	Elastic Scattering	1.0E-6 to 1.0E-5 MeV	536
U-235	Elastic Scattering	1.0E-5 to 1.0E-4 MeV	537
U-235	Elastic Scattering	1.0E-4 to 7.0E-4 MeV	538
U-235	Elastic Scattering	7.0E-4 to 0.003 MeV	539
U-235	Total Absorption	Total	540
U-235	Total Absorption	1.0E-6 to 4.0E-5 MeV	541
U-235	Total Absorption	4.0E-5 to 4.0E-4 MeV	542
U-235	Total Absorption	4.0E-4 to 0.001 MeV	543
U-235	Total Absorption	0.001 to 0.003 MeV	544
U-235	Total Fission	Total	683
U-235	Total Fission	1.0E-6 to 1.0E-5 MeV	684
U-235	Total Fission	1.0E-5 to 1.0E-4 MeV	685
U-235	Total Fission	1.0E-4 to 0.003 MeV	686
U-236	Elastic Scattering	Total	545
U-236	Elastic Scattering	1.0E-6 to 3.0E-4 MeV	546
U-236	Elastic Scattering	3.0E-4 to 0.002 MeV	547
U-236	Total Absorption	Total	548
U-236	Total Absorption	1.0E-6 to 3.0E-4 MeV	549
U-236	Total Absorption	3.0E-4 to 0.005 MeV	550
U-236	Total Fission	Total	687
U-236	Total Fission	3.0E-5 to 4.0E-4 MeV	688
U-236	Total Fission	4.0E-4 to 0.002 MeV	689
U-236	Total Fission	0.002 to 0.005 MeV	690

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
U-237	Elastic Scattering	Total	551
U-237	Elastic Scattering	9.0E-6 to 2.0E-4 MeV	552
U-237	Total Absorption	Total	553
U-237	Total Absorption	4.0E-6 to 2.0E-4 MeV	554
U-237	Total Fission	Total	691
U-237	Total Fission	9.0E-6 to 2.0E-4 MeV	692
U-238	Elastic Scattering <sup>2</sup>	Total	555
U-238	Elastic Scattering <sup>2</sup>	1.0E-6 to 1.0E-4 MeV	556
U-238	Elastic Scattering <sup>2</sup>	1.0E-4 to 0.001 MeV	557
U-238	Elastic Scattering <sup>2</sup>	0.001 to 0.005 MeV	558
U-238	Elastic Scattering <sup>2</sup>	0.005 to 0.02 MeV	559
U-238	Total Absorption <sup>2</sup>	Total	560
U-238	Total Absorption <sup>2</sup>	7.0E-6 to 1.0E-4 MeV	561
U-238	Total Absorption <sup>2</sup>	1.0E-4 to 0.001 MeV	562
U-238	Total Absorption <sup>2</sup>	0.001 to 0.005 MeV	563
U-238	Total Absorption <sup>2</sup>	0.005 to 0.02 MeV	564
U-238	Total Fission <sup>2</sup>	Total	693
U-238	Total Fission <sup>2</sup>	7.0E-6 to 0.001 MeV	694
U-238	Total Fission <sup>2</sup>	0.001 to 0.3 MeV	695
U-239	Elastic Scattering	Total	565
U-239	Total Absorption	Total	566
U-239	Total Fission	Total	696
U-240	Elastic Scattering	Total	567
U-240	Total Absorption	Total	568
U-240	Total Fission	Total	697
Np-235	Elastic Scattering	Total	569
Np-235	Total Absorption	Total	570
Np-235	Total Fission	Total	698
Np-236	Elastic Scattering	Total	571
Np-236	Total Absorption	Total	572
Np-236	Total Fission	Total	699
Np-237	Elastic Scattering	Total	573
Np-237	Elastic Scattering	2.0E-6 to 1.0E-5 MeV	574
Np-237	Elastic Scattering	1.0E-5 to 2.0E-4 MeV	575
Np-237	Total Absorption	Total	576
Np-237	Total Absorption	2.0E-6 to 1.0E-5 MeV	577
Np-237	Total Absorption	1.0E-5 to 2.0E-4 MeV	578
Np-237	Total Fission	Total	700
Np-237	Total Fission	1.0E-7 to 1.0E-5 MeV	701
Np-237	Total Fission	1.0E-5 to 1.0E-4 MeV	702
Np-237	Total Fission	1.0E-4 to 0.001 MeV	703
Np-237	Total Fission	0.001 to 0.008 MeV	704
Np-238	Elastic Scattering	Total	579
Np-238	Total Absorption	Total	580
Np-238	Total Fission	Total	705
Np-239	Elastic Scattering	Total	581
Np-239	Total Absorption	Total	582
Np-239	Total Fission	Total	706
Pu-236	Elastic Scattering	Total	583
Pu-236	Total Absorption	Total	584
Pu-236	Total Fission	Total	707

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Pu-237	Elastic Scattering	Total	585
Pu-237	Total Absorption	Total	586
Pu-237	Total Fission	Total	708
Pu-238	Elastic Scattering	Total	587
Pu-238	Elastic Scattering	3.0E-6 to 1.0E-4 MeV	588
Pu-238	Elastic Scattering	1.0E-4 to 3.0E-4 MeV	589
Pu-238	Total Absorption	Total	590
Pu-238	Total Absorption	1.0E-6 to 1.0E-4 MeV	591
Pu-238	Total Absorption	1.0E-4 to 4.0E-4 MeV	592
Pu-238	Total Fission	Total	709
Pu-238	Total Fission	1.0E-6 to 1.0E-4 MeV	710
Pu-238	Total Fission	1.0E-4 to 4.0E-4 MeV	711
Pu-239	Elastic Scattering	Total	593
Pu-239	Elastic Scattering	7.0E-6 to 1.0E-4 MeV	594
Pu-239	Elastic Scattering	1.0E-4 to 0.001 MeV	595
Pu-239	Elastic Scattering	0.001 to 0.004 MeV	596
Pu-239	Total Absorption	Total	597
Pu-239	Total Absorption	5.0E-6 to 1.0E-4 MeV	598
Pu-239	Total Absorption	1.0E-4 to 0.001 MeV	599
Pu-239	Total Absorption	0.001 to 0.004 MeV	600
Pu-239	Total Fission	Total	712
Pu-239	Total Fission	1.0E-5 to 1.0E-4 MeV	713
Pu-239	Total Fission	1.0E-4 to 0.001 MeV	714
Pu-239	Total Fission	0.001 to 0.004 MeV	715
Pu-240	Elastic Scattering	Total	601
Pu-240	Elastic Scattering	1.0E-5 to 0.001 MeV	602
Pu-240	Elastic Scattering	0.001 to 0.01 MeV	603
Pu-240	Total Absorption	Total	604
Pu-240	Total Absorption	2.0E-5 to 0.001 MeV	605
Pu-240	Total Absorption	0.001 to 0.01 MeV	606
Pu-240	Total Fission	Total	716
Pu-240	Total Fission	2.0E-5 to 0.001 MeV	717
Pu-240	Total Fission	0.001 to 0.007 MeV	718
Pu-241	Elastic Scattering	Total	607
Pu-241	Elastic Scattering	1.0E-6 to 1.0E-4 MeV	608
Pu-241	Elastic Scattering	1.0E-4 to 4.0E-4 MeV	609
Pu-241	Total Absorption	Total	610
Pu-241	Total Absorption	1.0E-6 to 5.0E-5 MeV	611
Pu-241	Total Absorption	5.0E-5 to 2.0E-4 MeV	612
Pu-241	Total Absorption	2.0E-4 to 0.001 MeV	613
Pu-241	Total Fission	Total	719
Pu-241	Total Fission	3.0E-6 to 3.0E-5 MeV	720
Pu-241	Total Fission	3.0E-5 to 6.0E-4 MeV	721
Pu-242	Elastic Scattering	Total	614
Pu-242	Elastic Scattering	4.0E-5 to 0.002 MeV	615
Pu-242	Total Absorption	Total	616
Pu-242	Total Absorption	1.0E-5 to 3.0E-4 MeV	617
Pu-242	Total Absorption	3.0E-4 to 0.002 MeV	618
Pu-242	Total Fission	Total	722
Pu-242	Total Fission	2.0E-5 to 0.002 MeV	723
Pu-243	Elastic Scattering	Total	619

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Pu-243	Elastic Scattering	1.0E-6 to 2.0E-4 MeV	620
Pu-243	Total Absorption	Total	621
Pu-243	Total Absorption	1.0E-6 to 2.0E-4 MeV	622
Pu-243	Total Fission	Total	724
Pu-243	Total Fission	1.0E-6 to 2.0E-4 MeV	725
Pu-244	Elastic Scattering	Total	623
Pu-244	Total Absorption	Total	624
Pu-244	Total Fission	Total	726
Am-241	Elastic Scattering	Total	625
Am-241	Elastic Scattering	1.0E-7 to 1.0E-5 MeV	626
Am-241	Elastic Scattering	1.0E-5 to 2.0E-4 MeV	627
Am-241	Total Absorption	Total	628
Am-241	Total Absorption	1.0E-7 to 1.0E-5 MeV	629
Am-241	Total Absorption	1.0E-5 to 2.0E-4 MeV	630
Am-241	Total Fission	Total	727
Am-241	Total Fission	1.0E-7 to 1.0E-5 MeV	728
Am-241	Total Fission	1.0E-5 to 2.0E-4 MeV	729
Am-242m	Elastic Scattering	Total	631
Am-242m	Total Absorption	Total	632
Am-242m	Total Fission	Total	730
Am-243	Elastic Scattering	Total	633
Am-243	Elastic Scattering	1.0E-6 to 3.0E-5 MeV	634
Am-243	Elastic Scattering	3.0E-5 to 3.0E-4 MeV	635
Am-243	Total Absorption	Total	636
Am-243	Total Absorption	1.0E-6 to 1.0E-5 MeV	637
Am-243	Total Absorption	1.0E-5 to 1.0E-4 MeV	638
Am-243	Total Absorption	1.0E-4 to 3.0E-4 MeV	639
Am-243	Total Fission	Total	731
Am-243	Total Fission	1.0E-7 to 1.0E-5 MeV	732
Am-243	Total Fission	1.0E-5 to 3.0E-4 MeV	733
Cm-241	Elastic Scattering	Total	640
Cm-241	Total Absorption	Total	641
Cm-241	Total Fission	Total	734
Cm-242	Elastic Scattering	Total	642
Cm-242	Elastic Scattering	5.0E-6 to 8.0E-4 MeV	643
Cm-242	Total Absorption	Total	644
Cm-242	Total Absorption	1.0E-5 to 4.0E-4 MeV	645
Cm-242	Total Fission	Total	735
Cm-243	Elastic Scattering	Total	646
Cm-243	Total Absorption	Total	647
Cm-243	Total Fission	Total	736
Cm-243	Total Fission	1.0E-6 to 2.0E-4 MeV	737
Cm-244	Elastic Scattering	Total	648
Cm-244	Elastic Scattering	9.0E-5 to 0.001 MeV	649
Cm-244	Total Absorption	Total	650
Cm-244	Total Absorption	1.0E-5 to 0.001 MeV	651
Cm-244	Total Fission	Total	738
Cm-244	Total Fission	3.0E-6 to 9.0E-4 MeV	739
Cm-245	Elastic Scattering	Total	652
Cm-245	Total Absorption	Total	653
Cm-245	Total Fission	Total	740

**Table 5-10. MCNP Continuous-Energy Cross Section Plot Index**

Element or Isotope	Neutron Reaction	Energy Range	Plot Number <sup>1</sup>
Cm-245	Total Fission	1.0E-6 to 2.0E-4 MeV	741
Cm-246	Elastic Scattering	Total	654
Cm-246	Total Absorption	Total	655
Cm-246	Total Fission	Total	742
Cm-247	Elastic Scattering	Total	656
Cm-247	Total Absorption	Total	657
Cm-247	Total Fission	Total	743
Cm-247	Total Fission	3.0E-6 to 5.0E-5 MeV	744
Cm-247	Total Fission	5.0E-5 to 0.002 MeV	745
Cm-248	Elastic Scattering	Total	658
Cm-248	Total Absorption	Total	659
Cm-248	Total Absorption	4.0E-6 to 0.004 MeV	660
Cm-248	Total Fission	Total	746
Cm-248	Total Fission	2.0E-6 to 2.0E-4 MeV	747
Cm-248	Total Fission	2.0E-4 to 0.003 MeV	748
Bk-249	Elastic Scattering	Total	661
Bk-249	Total Absorption	Total	662
Bk-249	Total Fission	Total	749
Cf-249	Elastic Scattering	Total	663
Cf-249	Total Absorption	Total	664
Cf-249	Total Fission	Total	750
Cf-249	Total Fission	2.0E-6 to 4.0E-5 MeV	751
Cf-249	Total Fission	4.0E-5 to 3.0E-4 MeV	752
Cf-249	Total Fission	3.0E-4 to 0.003 MeV	753
Cf-250	Elastic Scattering	Total	665
Cf-250	Total Absorption	Total	666
Cf-250	Total Fission	Total	754
Cf-251	Elastic Scattering	Total	667
Cf-251	Total Absorption	Total	668
Cf-251	Total Fission	Total	755
Cf-252	Elastic Scattering	Total	669
Cf-252	Total Absorption	Total	670
Cf-252	Total Absorption	1.0E-5 to 0.001 MeV	671
Cf-252	Total Fission	Total	756
Cf-252	Total Fission	1.0E-5 to 4.0E-4 MeV	757

<sup>1</sup> The plot number refers to the # in the corresponding cross section plot filenames ("p#.gif") as contained on Attachment I (CD-ROM).

<sup>2</sup> The MCNP cross section library identified as 92238.21c was not included in the various plots for U-238 due to a limitation in the number of cross section representations that may be shown on a single plot and still maintain unique line styles and colors.



**Sr-151, Sr-153 in Natural Sr**

**Neutron Elastic Scattering Cross Section**

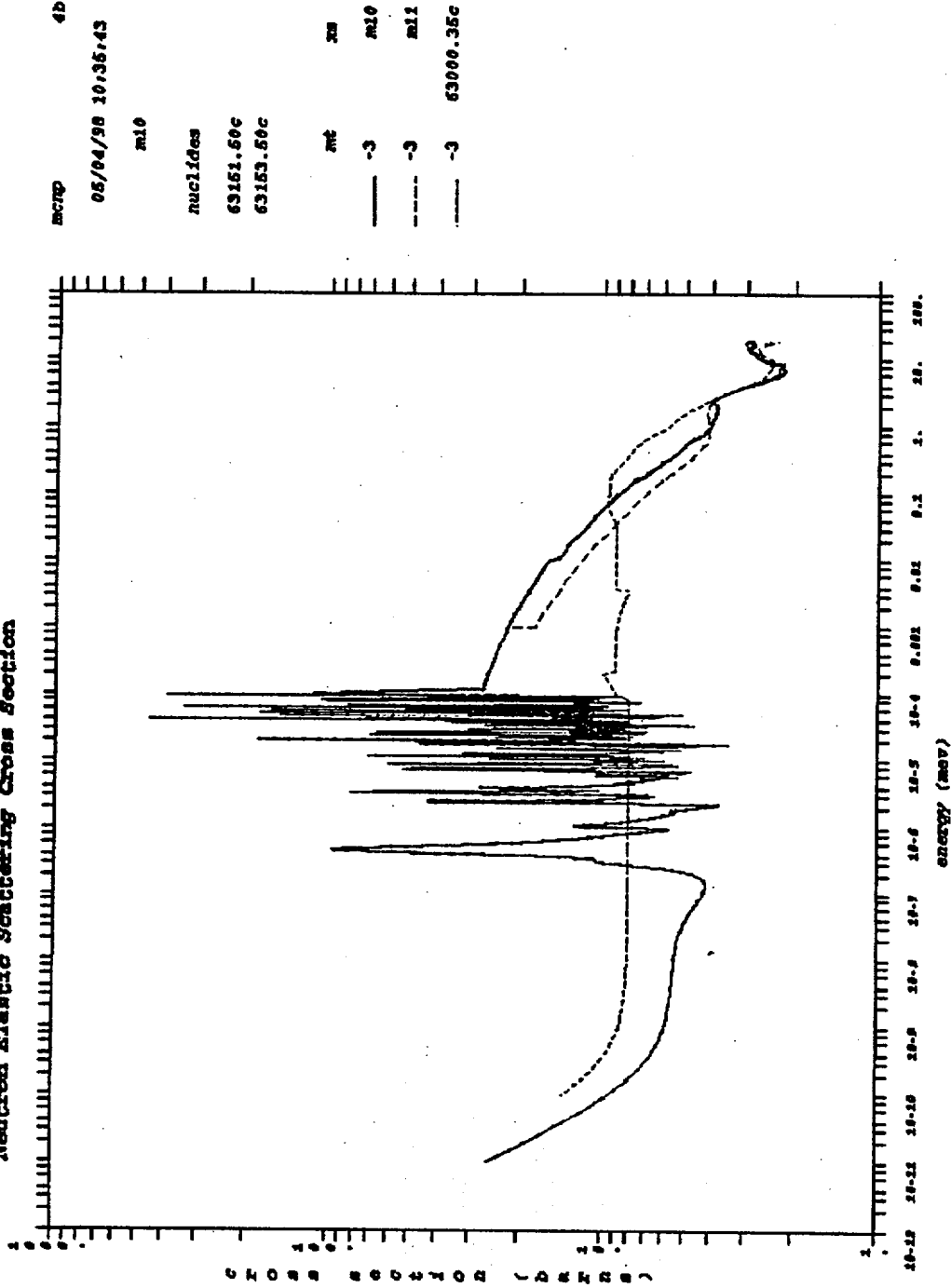
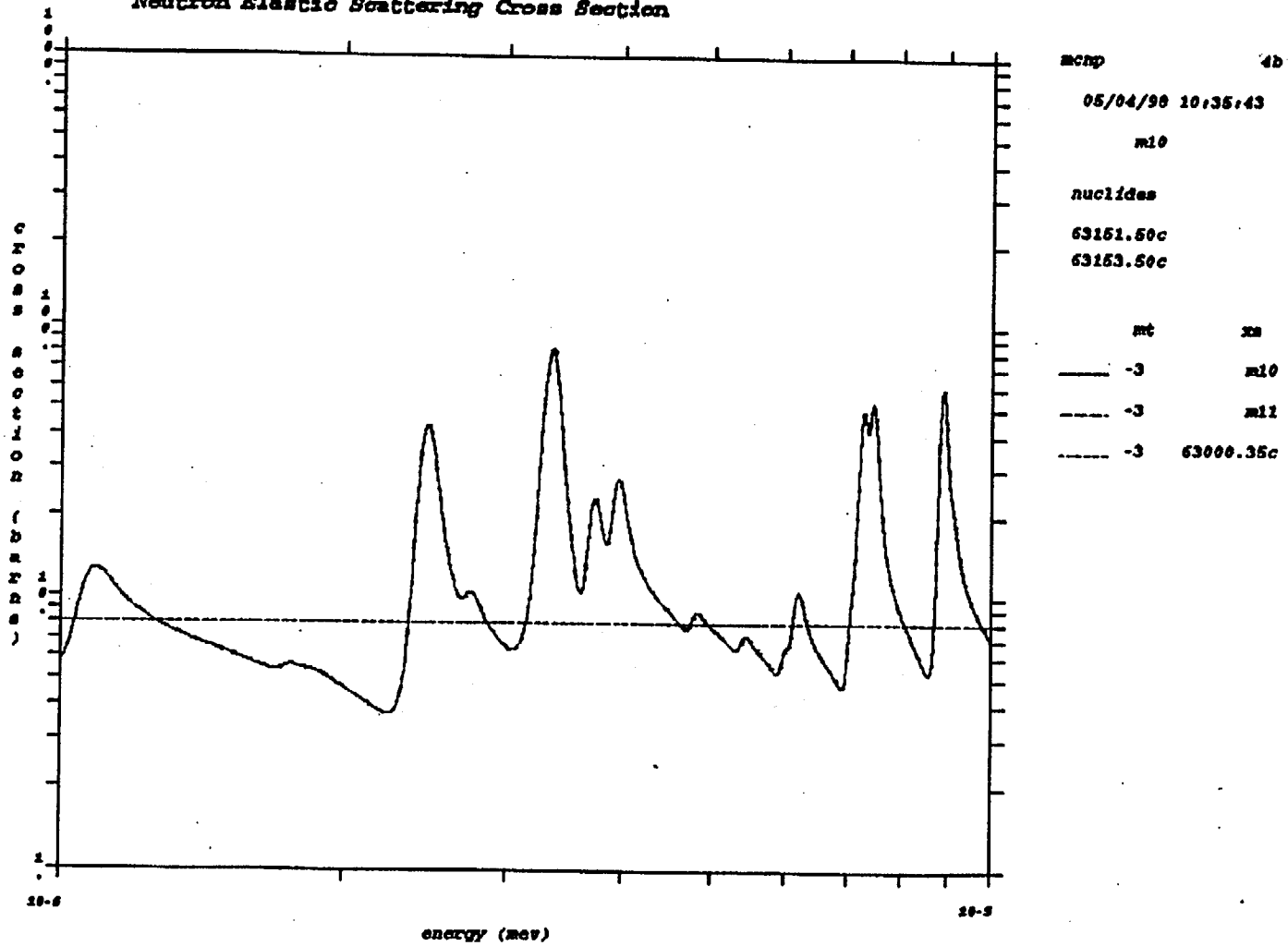


Figure S-1. p342.gif (plot number 342 in Table S-10)

**Eu-151, Eu-153 in Natural Eu**

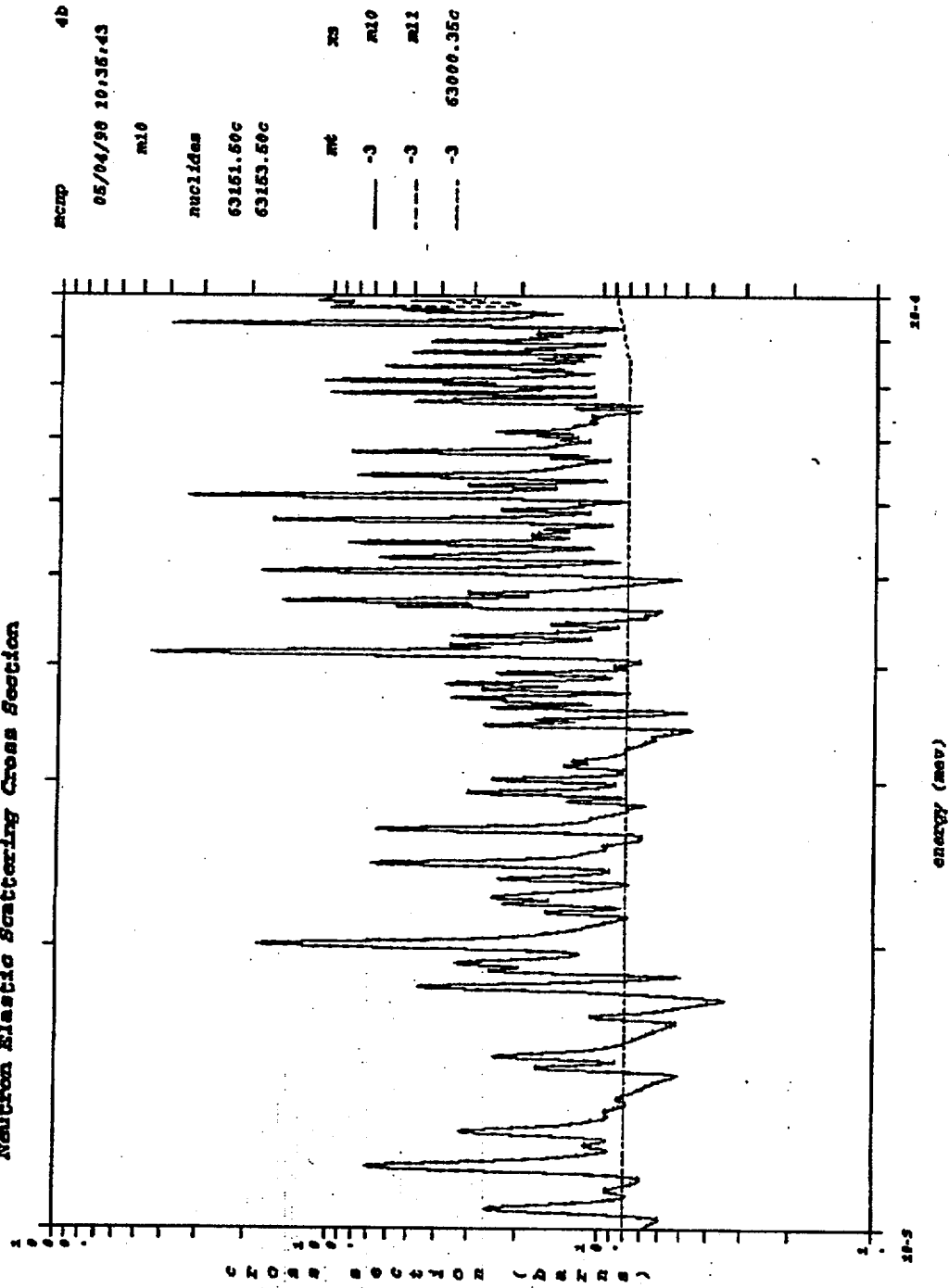
**Neutron Elastic Scattering Cross Section**



**Figure 5-2. p343.gif (plot number 343 in Table 5-10)**

**Eu-151, Eu-153 in Natural Eu**

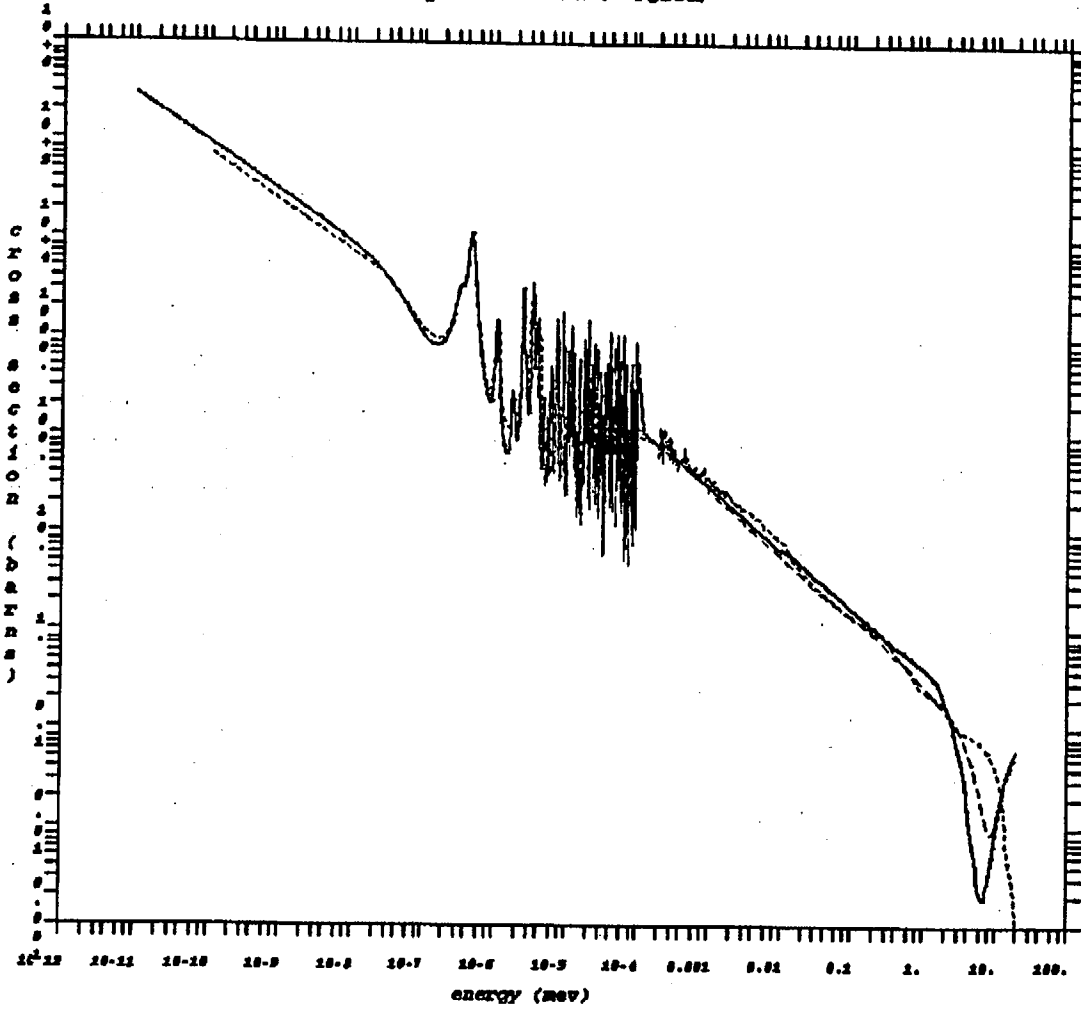
**Neutron Elastic Scattering Cross Section**



**Figure 5-3. p344.gif (plot number 344 in Table 5-10)**

**Eu-151, Eu-153 in Natural Eu**

**Total Neutron Absorption Cross Section**



mcnp 4b  
 05/04/98 10:35:43  
 m10  
 nuclides  
 63151.50c  
 63153.50c  
 mt m  
 -2 m10  
 -2 m11  
 -2 63000.35c

Figure 5-4. p345.gif (plot number 345 in Table 5-10)

**Eu-151, Eu-153 in Natural Eu**

**Total Neutron Absorption Cross Section**

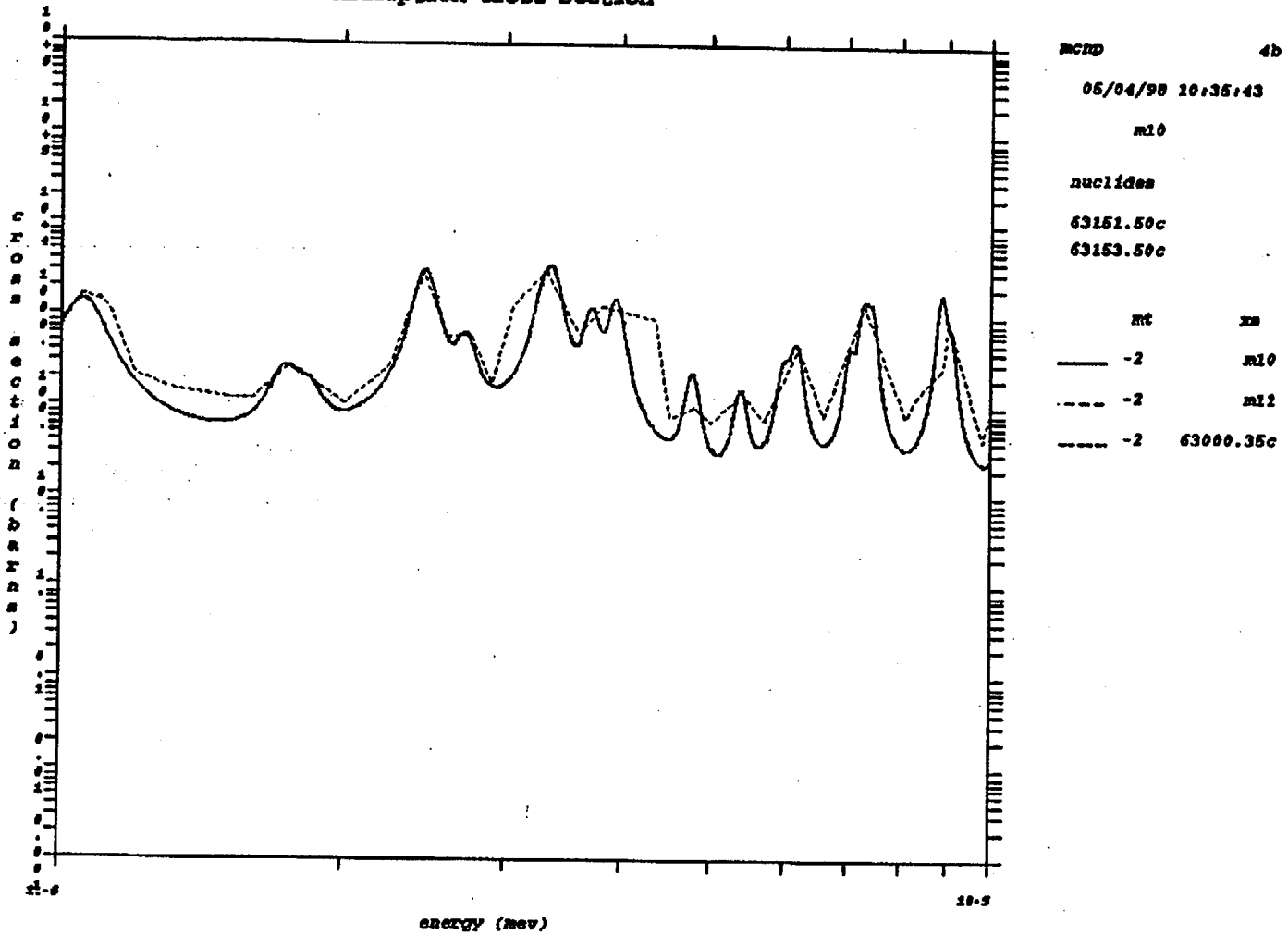
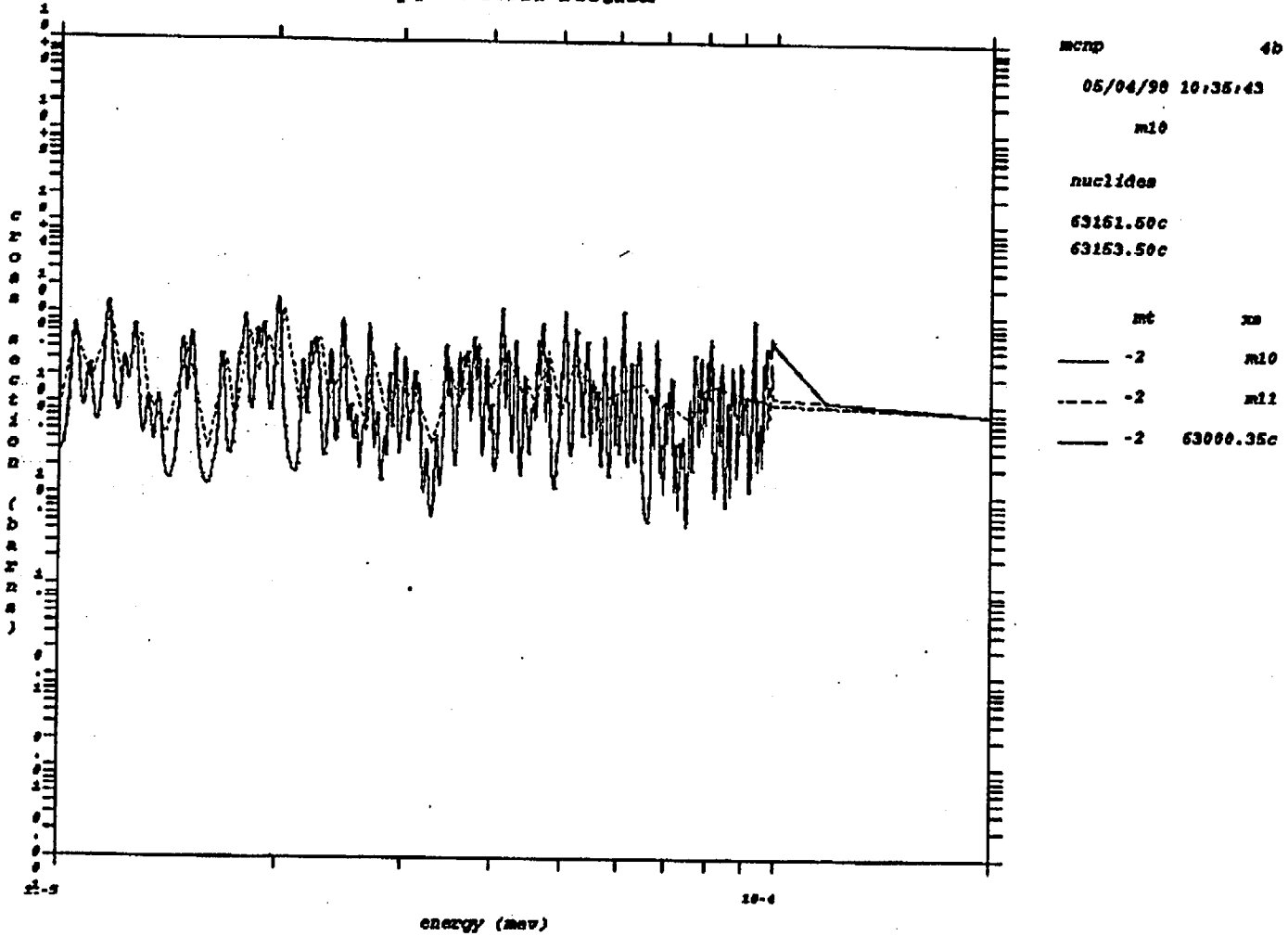


Figure 5-5. p346.gif (plot number 346 in Table 5-10)

**Eu-151, Eu-153 in Natural Eu**

**Total Neutron Absorption Cross Section**



**Figure 5-6. p347.gif (plot number 347 in Table 5-10)**

## 6. Selected MCNP Cross Section Libraries

Table 6.1 presents the cross section libraries that have been selected for use in the criticality benchmark and design calculations of the WPDD. The selection of the specific libraries presented in Table 6.1 does not infer that these libraries are more correct than the other available libraries. Rather, the selection of the specific libraries presented in Table 6.1 establishes a set that will assist in ensuring consistent cross section library utilization throughout the criticality benchmark and design calculations of the WPDD.

As previously stated in Section 3, the following criteria were used to select the continuous-energy cross section libraries, as shown in Table 6.1, for use with MCNP:

- ENDF/B-V based cross section libraries were selected for use when available with the exceptions of H-2, B-11, Zr (natural), Ag-107, Ag-109, Eu-151, and Eu-153
- either ENDF/B-VI, T-2, or LLNL based cross section libraries were selected for use when ENDF/B-V based libraries were not available or selected
- parameters compared when selecting between ENDF/B-VI, T-2, or LLNL based cross section libraries included the following: number of energy points included in the main energy grid, date of cross section library processing, and availability of certain data.

The selected non-ENDF/B-V based cross section libraries are presented in Table 6.2. The following discussion provides a description of how the above criteria were used to select the non-ENDF/B-V based cross section libraries.

Fifty-five out of the seventy-nine non-ENDF/B-V based cross section libraries were selected because they were the only available cross section libraries distributed to the WPDD for the various elements and isotopes. The elements and isotopes to which this applies include the following: Be-7, C-13, O-17, S (natural), Ca-40, Sc-45, Cr-50, Cr-52, Cr-53, Cr-54, Fe-54, Fe-56, Fe-57, Fe-58, Ni-60, Ni-61, Ni-62, Ni-64, Cu-63, Cu-65, As-74, Br-79, Br-81, Rb-85, Rb-87, Y-88, In (natural), Sn (natural), I-129, Xe (natural), Xe-134, Cs-134, Cs-136, Cs-137, Tm-169, Ta-182, Ir (natural), Pt (natural), Pb-206, Pb-207, Pb-208, Th-230, Th-231, Th-233, Pa-231, U-232, U-239, U-240, Np-235, Np-236, Np-238, Np-239, Pu-236, Pu-244, Cm-241.

Non-ENDF/B-V based cross section libraries were selected for seven elements and isotopes for which ENDF/B-V cross section libraries were available. These elements and isotopes include the following: H-2, B-11, Zr (natural), Ag-107, Ag-109, Eu-151, and Eu-153.

For H-2, there are no significant differences between the neutron scattering cross section of the selected cross section library (1002.55c) and the ENDF/B-V based cross section library (1002.50c). There are also no significant differences between the total neutron absorption cross section of the selected cross section library and the ENDF/B-V based cross section library. At neutron energies below  $3.0E-10$  MeV, the selected cross section library shows a maximum total neutron absorption cross section difference of 0.001 barns with respect to the ENDF/B-V based cross section library.

For B-11, there are some differences in the resonance region between the selected cross section library (5011.56c) and the ENDF/B-V based cross section library (5011.55c). There are no significant differences between the total neutron absorption cross section of the selected cross section library and the ENDF/B-V based cross section library. The 5011.56c cross section library was processed more recently than 5011.55c. The 5011.56c cross section library has more than two times the number of energy points on the main energy grid than 5011.55c.

For Zr (natural), the ENDF/B-VI based cross section library (40000.60c) is selected because it contains corrections for a problem that is present in the previously released ENDF/B-V based cross section library. The corrected problem is that the ENDF/B-V based cross section library provides a secondary neutron energy greater than the incident neutron energy for some scattering interactions.

For Ag-107, the ENDF/B-VI based cross section library (47107.60c) is selected over the ENDF/B-V based cross section library (47107.50c) because it contains more detail in the resonance region of both the neutron elastic scattering and total neutron absorption cross sections. In the neutron elastic scattering cross section, the increased detail is primarily between energies of  $2.0E-5$  MeV and 0.003 MeV. In the total neutron absorption cross section, the increased detail is primarily between the energies of  $2.0E-5$  MeV and 0.003 MeV. Also, the ENDF/B-VI based cross section library contains more than six times the number of energy points on the main energy grid than the ENDF/B-V based cross section library.

For Ag-109, the ENDF/B-VI based cross section library (47109.60c) is selected over the ENDF/B-V based cross section library (47109.50c) because it contains more detail in the resonance region of both the neutron elastic scattering and total neutron absorption cross sections. In the neutron elastic scattering cross section, the increased detail is primarily between energies of  $2.0E-4$  MeV and 0.003 MeV. In the total neutron absorption cross section, the increased detail is primarily between the energies of  $8.0E-4$  MeV and 0.003 MeV. Also, the ENDF/B-VI based cross section library contains more than five times the number of energy points on the main energy grid than the ENDF/B-V based cross section library.

For Eu-151, there are no significant differences between the neutron scattering cross section of the selected cross section library (63151.55c) and the ENDF/B-V based cross section library (63151.50c). The total neutron absorption cross section of the 63151.55c and 63151.50c cross section libraries are generally the same. The 63151.55c total neutron absorption cross section is a maximum of 0.2 barns less than 63151.50c between the energies of 0.01 MeV and 3.0 MeV. Also, the 63151.55c total neutron absorption cross section is a maximum of 0.02 barns greater than 63151.50c between the energies of 3.0 MeV and 10.0 MeV. The 63151.55c cross section library was processed more recently than the 63151.50c cross section library.

For Eu-153, the neutron scattering cross section of the selected cross section library (63153.55c) and the ENDF/B-V based cross section library (63153.50c) are generally the same. The 63153.55c neutron elastic scattering cross section is a maximum of 0.005 barns less than 63153.50c between the energies of 0.001 MeV and 0.2 MeV. The total neutron absorption cross section of the 63153.55c and 63153.50c cross section libraries are generally the same. The 63153.55c total neutron absorption cross section is a maximum of 0.003 barns less than



63153.50c between the energies of 0.001 MeV and 2.0 MeV. Also, the 63153.55c total neutron absorption cross section is a maximum of 0.007 barns greater than 63153.50c between the energies of 2.0 MeV and 10.0 MeV. The 63153.55c cross section library was processed more recently than the 63153.50c cross section library.

The remaining elements and isotopes for which non-ENDF/B-V based cross section libraries were selected include the following: N-15, Ar (natural), Ni-58, I-127, Ho-165, Pu-237, Pu-243, Cm-243, Cm-245, Cm-246, Cm-247, Cm-248, Bk-249, Cf-249, Cf-250, Cf-251, Cf-252. There are no ENDF/B-V based cross section libraries available for these elements and isotopes. However, there are multiple non-ENDF/B-V based cross section libraries available for each of these elements and isotopes. The following discussion provides a description of how the previously identified selection criteria were used to select the various cross section libraries.

For N-15, there are two cross section libraries available (7015.55c and 7015.60c). The 7015.55c cross section library was selected. There are no significant differences between the neutron scattering cross section of 7015.55c and 7015.60c. There are no significant differences between the total neutron absorption cross section of 7015.55c and 7015.60c. The 7015.55c cross section library contains the largest number of energy points on the main energy grid.

For Ar (natural), the selected cross section library (18000.59c) is processed at 294 K rather than 0 K at which the other available cross section library (18000.35c) is processed.

For Ni-58, the selected cross section library (28058.60c) is processed at 294 K rather than 0 K at which the other available cross section library (28058.35c) is processed. The 28058.60c neutron elastic scattering cross section shows much more detail in the resonance region between the energies of 0.01 MeV and 6.0 MeV than 28058.35c. The 28058.60c total neutron absorption cross section shows much more detail in the resonance region between the energies of 0.08 MeV and 0.8 MeV than 28058.35c. The 28058.60c cross section library contains more than three times the number of energy points on the main energy grid than 28058.35c.

For I-127, the selected cross section library (53127.60c) is an update of the only other available cross section library (53127.55c). Also, the 53127.60c cross section library contains photon production data and the 53127.55c cross section library does not.

For Ho-165, the selected cross section library (67165.55c) was selected and used prior to the receipt of the ENDF/B-VI based cross section library (67165.60c) by WPDD. The other available cross section library is the LLNL based 67165.35c. The 67165.55c cross section library is processed at 294 K, and the 67165.35c cross section library is processed at 0 K.

For Pu-237, the selected cross section library (94237.35c) was selected and used prior to the receipt of the ENDF/B-VI based cross section library (94237.60c) by WPDD. Prior to the receipt of 94237.60c, the only available cross section library was 94237.35c. Additionally, the 94237.35c cross section library contains photon production data and the 94237.60c cross section library does not.

For Pu-243, the selected cross section library (94243.60c) is processed at 294 K rather than 0 K at which the other available cross section library (94243.35c) is processed. The 94243.60c cross section library also contains total nu data, and 94243.35c only contains prompt nu data. The 94243.60c cross section library contains more than nine times the number of energy points on the main energy grid than 94243.35c.

For Cm-243, Cm-245, Cm-246, and Cm-247, the selected cross section libraries (96243.35c, 96245.35c, 96246.35c, and 96247.35c, respectively) were selected and used prior to the receipt of the ENDF/B-VI based cross section libraries. The 96243.35c, 96245.35c, 96246.35c, and 96247.35c cross section libraries were the only available libraries for WPDD prior to the receipt of the ENDF/B-VI based libraries.

For Cm-248, the selected cross section library (96248.60c) is processed at 294 K rather than 0 K at which the other available cross section library (96248.35c) is processed. The 96248.60c cross section library contains total nu data, and 96248.35c only contains prompt nu data. The 96248.60c cross section library contains more than six times the number of energy points on the main energy grid than 96248.35c. Unlike the Cm-243, Cm-245, Cm-246, and Cm-247 isotopes, the Cm-248 isotope had not been used in a model prior to the receipt of the ENDF/B-VI based cross section libraries. Therefore, the 96248.60c cross section library could be selected with minimal impact.

For Bk-249, the selected cross section library (97249.60c) is processed at 294 K rather than 0 K at which the other available cross section library (97249.35c) is processed. The 97249.60c cross section library contains both prompt and total nu data, and 97249.35c only contains prompt nu data. The 97249.60c cross section library contains more than eight times the number of energy points on the main energy grid than 97249.35c.

For Cf-249, the selected cross section library (98249.60c) is processed at 294 K rather than 0 K at which the other available cross section library (98249.35c) is processed. The 98249.60c cross section library contains both prompt and total nu data, and 98249.35c only contains prompt nu data. The 98249.60c cross section library contains more than one and a half times the number of energy points on the main energy grid than 98249.35c.

For Cf-250, the selected cross section library (98250.60c) is processed at 294 K rather than 0 K at which the other available cross section library (98250.35c) is processed. The 98250.60c cross section library contains total nu data, and 98250.35c only contains prompt nu data. The 98250.60c cross section library contains more than twelve times the number of energy points on the main energy grid than 98250.35c.

For Cf-251, the selected cross section library (98251.60c) is processed at 294 K rather than 0 K at which the other available cross section library (98251.35c) is processed. The 98251.60c cross section library contains both prompt and total nu data, and 98251.35c only contains prompt nu data. The 98251.60c cross section library contains more than eight times the number of energy points on the main energy grid than 98251.35c.

For Cf-252, the selected cross section library (98252.60c) is processed at 294 K rather than 0 K at which the other available cross section library (98252.35c) is processed. The 98252.60c cross section library contains both prompt and total nu data, and 98252.35c only contains prompt nu data. The 98252.60c cross section library contains more than three times the number of energy point on the main energy grid than 98252.35c.

**Table 6-1. Selected Continuous-Energy MCNP Cross Section Libraries**

Element	Isotope	Selected Cross Section Library ZAIID
Hydrogen	H-1	1001.50c
	H-2	1002.55c
	H-3	1003.50c
Helium	He-3	2003.50c
	He-4	2004.50c
Lithium	Li-6	3006.50c
	Li-7	3007.55c
Beryllium	Be-7	4007.35c
	Be-9	4009.50c
Boron	B-10	5010.50c
	B-10	5010.53c
	B-11	5011.56c
Carbon	C (natural)	6000.50c
	C-12	6012.50c
	C-13	6013.35c
Nitrogen	N-14	7014.50c
	N-15	7015.55c
Oxygen	O-16	8016.50c
	O-16	8016.53c
	O-16	8016.54c
	O-17	8017.60c
Fluorine	F-19	9019.50c
Sodium	Na-23	11023.50c
Magnesium	Mg (natural)	12000.50c
Aluminum	Al-27	13027.50c
Silicon	Si (natural)	14000.50c
Phosphorus	P-31	15031.50c
Sulfur	S (natural)	16000.60c
	S-32	16032.50c
Chlorine	Cl (natural)	17000.50c
Argon	Ar (natural)	18000.59c
Potassium	K (natural)	19000.50c
Calcium	Ca (natural)	20000.50c
	Ca-40	20040.21c
Scandium	Sc-45	21045.60c
Titanium	Ti (natural)	22000.50c
Vanadium	V (natural)	23000.50c
Chromium	Cr-50	24050.60c
	Cr-52	24052.60c
	Cr-53	24053.60c
	Cr-54	24054.60c
Manganese	Mn-55	25055.50c
Iron	Fe-54	26054.60c
	Fe-56	26056.60c

**Table 6-1. Selected Continuous-Energy MCNP Cross Section Libraries**

Element	Isotope	Selected Cross Section Library ZAIID
	Fe-57	26057.60c
	Fe-58	26058.60c
Cobalt	Co-59	27059.50c
Nickel	Ni-58	28058.60c
	Ni-60	28060.60c
	Ni-61	28061.60c
	Ni-62	28062.60c
	Ni-64	28064.60c
Copper	Cu-63	29063.60c
	Cu-65	29065.60c
Gallium	Ga (natural)	31000.50c
Arsenic	As-74	33074.35c
	As-75	33075.35c
Bromine	Br-79	35079.55c
	Br-81	35081.55c
Krypton	Kr-78	36078.50c
	Kr-80	36080.50c
	Kr-82	36082.50c
	Kr-83	36083.50c
	Kr-84	36084.50c
	Kr-86	36086.50c
Rubidium	Rb-85	37085.55c
	Rb-87	37087.55c
Yttrium	Y-88	39088.35c
	Y-89	39089.50c
Zirconium	Zr (natural)	40000.60c
	Zr-93	40093.50c
Niobium	Nb-93	41093.50c
Molybdenum	Mo (natural)	42000.50c
	Mo-95	42095.50c
Technetium	Tc-99	43099.50c
Ruthenium	Ru-101	44101.50c
	Ru-103	44103.50c
Rhodium	Rh-103	45103.50c
	Rh-105	45105.50c
Palladium	Pd-105	46105.50c
	Pd-108	46108.50c
Silver	Ag-107	47107.60c
	Ag-109	47109.60c
Cadmium	Cd (natural)	48000.50c
Indium	In (natural)	49000.60c
Tin	Sn (natural)	50000.35c
Iodine	I-127	53127.60c
	I-129	53129.60c
	I-135	53135.50c
Xenon	Xe (natural)	54000.35c
	Xe-131	54131.50c
	Xe-134	54134.35c
	Xe-135	54135.50c
	Xe-135	54135.53c
	Xe-135	54135.54c

**Table 6-1. Selected Continuous-Energy MCNP Cross Section Libraries**

Element	Isotope	Selected Cross Section Library ZAID
Cesium	Cs-133	55133.50c
	Cs-134	55134.60c
	Cs-135	55135.50c
	Cs-136	55136.60c
	Cs-137	55137.60c
Barium	Ba-138	56138.50c
Praseodymium	Pr-141	59141.50c
Neodymium	Nd-143	60143.50c
	Nd-145	60145.50c
	Nd-147	60147.50c
	Nd-148	60148.50c
Promethium	Pm-147	61147.50c
	Pm-148	61148.50c
	Pm-149	61149.50c
Samarium	Sm-147	62147.50c
	Sm-149	62149.50c
	Sm-150	62150.50c
	Sm-151	62151.50c
	Sm-152	62152.50c
Europium	Eu-151	63151.55c
	Eu-152	63152.50c
	Eu-153	63153.55c
	Eu-154	63154.50c
	Eu-155	63155.50c
Gadolinium	Gd-152	64152.50c
	Gd-154	64154.50c
	Gd-155	64155.50c
	Gd-156	64156.50c
	Gd-157	64157.50c
	Gd-158	64158.50c
	Gd-160	64160.50c
Holmium	Ho-165	67165.55c
Thulium	Tm-169	69169.55c
Hafnium	Hf (natural)	72000.50c
Tantalum	Ta-181	73181.50c
	Ta-182	73182.60c
Tungsten	W (natural)	74000.55c
	W-182	74182.55c
	W-183	74183.55c
	W-184	74184.55c
	W-186	74186.55c
Rhenium	Re-185	75185.50c
	Re-187	75187.50c
Iridium	Ir (natural)	77000.55c
Platinum	Pt (natural)	78000.35c
Gold	Au-197	79197.50c
Lead	Pb (natural)	82000.50c
	Pb-206	82206.60c
	Pb-207	82207.60c
	Pb-208	82208.60c
Bismuth	Bi-209	83209.50c

**Table 6-1. Selected Continuous-Energy MCNP Cross Section Libraries**

Element	Isotope	Selected Cross Section Library ZAIID
Thorium	Th-230	90230.60c
	Th-231	90231.35c
	Th-232	90232.50c
	Th-233	90233.35c
Protactinium	Pa-231	91231.60c
	Pa-233	91233.50c
Uranium	U-232	92232.60c
	U-233	92233.50c
	U-234	92234.50c
	U-235	92235.50c
	U-235	92235.53c
	U-235	92235.54c
	U-236	92236.50c
	U-237	92237.50c
	U-238	92238.50c
	U-238	92238.53c
	U-238	92238.54c
	U-239	92239.35c
	U-240	92240.35c
	Neptunium	Np-235
Np-236		93236.35c
Np-237		93237.50c
Np-238		93238.35c
Np-239		93239.60c
Plutonium	Pu-236	94236.60c
	Pu-237	94237.35c
	Pu-238	94238.50c
	Pu-239	94239.55c
	Pu-240	94240.50c
	Pu-241	94241.50c
	Pu-242	94242.50c
	Pu-243	94243.60c
Pu-244	94244.60c	
Americium	Am-241	95241.50c
	Am-242	95242.50c
	Am-243	95243.50c
Curium	Cm-241	96241.60c
	Cm-242	96242.50c
	Cm-243	96243.35c
	Cm-244	96244.50c
	Cm-245	96245.35c
	Cm-246	96246.35c
	Cm-247	96247.35c
	Cm-248	96248.60c
Berkelium	Bk-249	97249.60c
Californium	Cf-249	98249.60c
	Cf-250	98250.60c
	Cf-251	98251.60c
	Cf-252	98252.60c

<b>Table 6-2. Selected Non-ENDF/B-V-Based MCNP Cross Section Libraries</b>		
<b>Element or Isotope</b>	<b>MCNP ZAID</b>	<b>Evaluated Data Source</b>
H-2	1002.55c	T-2
Be-7	4007.35c	LLNL
B-11	5011.56c	T-2
C-13	6013.35c	LLNL
N-15	7015.55c	T-2
O-17	8017.60c	B-VI.0
S (natural)	16000.60c	B-VI.0
Ar (natural)	18000.59c	T-2
Ca-40	20040.21c	T-2:XTM
Sc-45	21045.60c	B-VI.2
Cr-50	24050.60c	B-VI.1
Cr-52	24052.60c	B-VI.1
Cr-53	24053.60c	B-VI.1
Cr-54	24054.60c	B-VI.1
Fe-54	26054.60c	B-VI.1
Fe-56	26056.60c	B-VI.1
Fe-57	26057.60c	B-VI.1
Fe-58	26058.60c	B-VI.1
Ni-58	28058.60c	B-VI.1
Ni-60	28060.60c	B-VI.1
Ni-61	28061.60c	B-VI.1
Ni-62	28062.60c	B-VI.1
Ni-64	28064.60c	B-VI.1
Cu-63	29063.60c	B-VI.2
Cu-65	29065.60c	B-VI.2
As-74	33074.35c	LLNL
Br-79	35079.55c	T-2
Br-81	35081.55c	T-2
Rb-85	37085.55c	T-2
Rb-87	37087.55c	T-2
Y-88	39088.35c	LLNL
Zr (natural)	40000.60c	B-VI.1
Ag-107	47107.60c	B-VI.0
Ag-109	47109.60c	B-VI.0
In (natural)	49000.60c	B-VI.0
Sn (natural)	50000.35c	LLNL
I-127	53127.60c	T-2
I-129	53129.60c	B-VI.0
Xe (natural)	54000.35c	LLNL
Xe-134	54134.35c	LLNL
Cs-134	55134.60c	B-VI.0
Cs-136	55136.60c	B-VI.0
Cs-137	55137.60c	B-VI.0
Eu-151	63151.55c	T-2
Eu-153	63153.55c	T-2
Ho-165	67165.55c	T-2
Tm-169	69169.55c	T-2
Ta-182	73182.60c	B-VI.0
Ir (natural)	77000.55c	T-2
Pt (natural)	78000.35c	LLNL
Pb-206	82206.60c	B-VI.0

<b>Table 6-2. Selected Non-ENDF/B-V-Based MCNP Cross Section Libraries</b>		
<b>Element or Isotope</b>	<b>MCNP ZAID</b>	<b>Evaluated Data Source</b>
Pb-207	82207.60c	B-VI.1
Pb-208	82208.60c	B-VI.0
Th-230	90230.60c	B-VI.0
Th-231	90231.35c	LLNL
Th-233	90233.35c	LLNL
Pa-231	91231.60c	B-VI.0
U-232	92232.60c	B-VI.0
U-239	92239.35c	LLNL
U-240	92240.35c	LLNL
Np-235	93235.35c	LLNL
Np-236	93236.35c	LLNL
Np-238	93238.35c	LLNL
Np-239	93239.60c	B-VI.0
Pu-236	94236.60c	B-VI.0
Pu-237	94237.35c	LLNL
Pu-243	94243.60c	B-VI.2
Pu-244	94244.60c	B-VI.0
Cm-241	96241.60c	B-VI.0
Cm-243	96243.35c	LLNL
Cm-245	96245.35c	LLNL
Cm-246	96246.35c	LLNL
Cm-247	96247.35c	LLNL
Cm-248	96248.60c	B-VI.0
Bk-249	97249.60c	B-VI:XTM
Cf-249	98249.60c	B-VI:XTM
Cf-250	98250.60c	B-VI.2
Cf-251	98251.60c	B-VI.2
Cf-252	98252.60c	B-VI.2

## 7. Conclusions

This report documents the selection of continuous-energy cross section libraries to be used with MCNP in criticality benchmark and design calculations. The various cross section libraries were selected using the following criteria:

- ENDF/B-V based cross section libraries were selected for use when available with the exceptions of H-2, B-11, Zr (natural), Ag-107, Ag-109, Eu-151, and Eu-153
- either ENDF/B-VI, T-2, or LLNL based cross section libraries were selected for use when ENDF/B-V based libraries were not available or selected
- parameters compared when selecting between ENDF/B-VI, T-2, or LLNL based cross section libraries included the following: number of energy points included in the main energy grid, date of cross section library processing, and availability of certain data.

The application of the above criteria in the selection of the various cross section libraries is presented in Section 6. Table 6.1 presents the cross section libraries selected for use in MCNP criticality benchmark and design calculations.



All of the various continuous-energy MCNP cross section libraries available for use by the WPDD are considered acceptable. However, all MCNP criticality benchmark and design calculations performed by the WPDD should adhere to the selected set of cross section libraries, as presented in Table 6.1, to ensure consistency throughout the various benchmarks and design calculations.

The data reported herein is acceptable for quality affecting activities and for use in analyses affecting procurement, construction, or fabrication. The classification for the repository (which includes the waste package) carries TBV-228 because of the preliminary status of the basis for the Mined Geologic Repository design. This report conservatively assumes that the resolution of TBV-228 will find the waste package to be quality affecting; consequently, use of any of the data reported herein does not need to carry TBV-228.

## 8. References

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