LA-UR-20-30460
Approved for public release; distribution is unlimited.

Title: Guide for Using ENDF/B-VIII.0 Nuclear Data with MCNP

Author(s): Brown, Forrest B.
Rising, Michael Evan

Intended for: Report

Issued: 2020-12-23

Guide for Using ENDF/B-VIII.0 Nuclear Data with MCNP

Forrest B. Brown, Michael E. Rising

Monte Carlo Methods, Codes. & Applications Group (XCP-3)
Los Alamos National Laboratory, PO Box 1663, MS A143, Los Alamos NM 87545

December 09, 2020

1.0 Introduction

This report provides guidance for using the ENDF/B-VIII.0 nuclear data that were released in 2018 [1,2] and 2020 [3] with MCNP. The Appendices to this report provide detailed instructions for:

Appendix A: Obtaining and installing the new ENDF/B-VIII.0 ACE nuclear data

Appendix B. Obtaining & using `XSDIR` files that include ENDF/B-VIII.0 data

Appendix C: ENDF/B-VIII.0-based ACE files for neutron cross-sections. A listing of the available temperatures and ZA numbers for neutron cross-sections (ACE files with suffix .nnC)

Appendix D: ENDF/B-VIII.0-based ACE files for thermal scattering law (TSL) data, $S(\alpha,\beta)$. A listing of the available thermal scattering $S(\alpha,\beta)$ data (ACE files with suffix .nnT)

The next section below provides guidance for modifying existing *mcnp* input files to use the ENDF/B-VIII.0 data. Detailed results from running several benchmark suites for nuclear criticality safety with both ENDF/B-VII.1 and ENDF/B-VIII.0 nuclear data are reported in [4].

It is important to note that this report deals only with TSL data released in 2020. With the original release of ENDF/B-VIII.0 in 2018, the ACE files for neutron cross-sections were contained in a directory called `Lib80X` and the ACE files for TSL data were contained in a directory called `ENDF80SaB`. A few years later, it was determined that many of the TSL data files had been generated with faulty data or with incorrect processing, and a new set of ACE files for TSL data was created, with the corrected files contained in directory `ENDF80SaB2` [3].

2.0 Guidance for modifying existing MCNP input files to use ENDF/B-VIII.0 nuclear data

After obtaining and installing the new ACE files as described in Appendices A & B, existing MCNP input files must usually be modified to use the new ENDF/B-VIII.0-based ACE data. Guidance is provided below.

A. Neutron cross-section ZAIDs

If the Appendix B instructions were followed to make the ENDF/B-VIII.0 ACE files the default data, then ZA numbers can be used on material and FM cards without supplying suffixes. The default nuclear data will be the ENDF/B-VIII.0 files at room temperature.

If instead the ENDF/B-VII.1 ACE files were chosen as the default, then explicit suffixes (e.g., .00c) must be supplied to use the ENDF/B-VIII.0 ACE data for materials and FM cards.

If suffixes are needed, refer to the information in Appendices C & D to select the proper suffixes. In general, for room temperature problems, all ENDF/B-VII.1 suffixes of `.80c` should be changed to

`.00c` on all material cards and FM cards in order to use ENDF/B-VIII.0 data. (Also, since ENDF/B-VII.1 data for 1-H-1 was corrected and released as `1001.90c`, use of `1001.90c` shoud be changed to `1001.00c`.)

Also note that the ENDF/B-VIII.0 data includes ACE files for nuclides that were not present in the ENDF/B-VII.1 data. These newly available nuclides are noted in Appendix C.

B. Thermal scattering data

Because the new ENDF/B-VIII.0 ACE data for thermal scattering has significant changes in the ACE file names, all MT cards need to be reviewed and appropriately modified. Appendix C lists the new names to be used on the MT cards. Typical changes might be:

```
lwtr  →    h-h2o
hwtr  →    d-d2o,   o-d2o
poly  →    h-poly
be-o  →    be-beo
o-be  →    o-beo
be    →    be-met
h-zr  →    h-zrh
zr-h  →    zr-zrh
grph  →    grph    or    grph10    or    grph30
```

For room temperature data (if it exists), the suffix to use is `.40t`. (There is no room temperature data for `h-ice`, `o-ice`, `lmeth`, `orthoD`, `orthoH`, `paraD`, `paraH`, or `smeth`.)

For the TSL data for pairs of nuclides, such as `be-beo` & `o-beo`, it is important to use both datasets on MT cards. Using just one of the nuclides (and not the other paired nuclide) may lead to significant reactivity differences.

There are new ACE data files for H and O in ice, H in lucite, and Si and C in silicon carbide. The carbon data (`grph`) are also now available for graphite at 10% porosity, 30% porosity, or solid.

C. Special treatment for Carbon

The previous ENDF/B-VII.1 ACE data included data for natural, elemental carbon only, with ZA = `6000`. The new ENDF/B-VIII.0 ACE data does <u>not</u> include data for elemental carbon – the specific carbon isotopes `6012` and `6013` must be used.

Material and FM cards that previously used `6000` or `6000.80c` must be changed to use `6012` or `6012.00c` or a mixture of `6012.00c` (98.93 atom %) plus `6013.00c` (1.07 atom %). These changes should be made to both material and FM cards.

D. Testing

After installing the ENDF/B-VIII.0 data, updating the `XSDIR` file, and modifying mcnp input files, it is essential to run a few simple mcnp problems to test & verify that the procedures were followed correctly. For a few test problems, the listing in the mcnp output file of cross-section data used in the problem should be examined, including the tables summarizing how the $S(\alpha,\beta)$ data were assigned to particular nuclides. Be sure to examine *mcnp6* `"print table 100"` and `"print table 102"`.

ACKNOWLEDGMENTS

This work was supported by the US DOE-NNSA Nuclear Criticality Safety Program.

REFERENCES

1. J.L. Conlin, W. Haeck, et al., “Release of ENDF/B-VIII.0-Based ACE Data Files”, LA-UR-18-24034 (2018).
2. J.L. Conlin, et al., web pages at nucleardata.lanl.gov
3. D.K. Parsons, “NJOY Processing of ENDF/B-VIII.0 Thermal Scattering Files”, LA-UR-18-25096 (2018).
4. J.L. Alwin, F.B. Brown, M.E. Rising, "Verification of MCNP6.2 with ENDF/B-VIII.0 Nuclear Data for Nuclear Criticality Safety Applications", LA-UR-19-23348 (2019).

Appendix A. Obtaining and installing the new ENDF/B-VIII.0 ACE nuclear data

The new ACE files based on ENDF/B-VIII.0 nuclear data are available from the website **`nucleardata.lanl.gov`**. While that website has instructions for installing the data on your computer, it is suggested that NCS users instead follow the directions below. (For Windows systems, use the mcnp-command-window where terminal window commands are noted below.)

(1) On your computer, create a temporary folder (directory) for downloading and decompressing the data files. Make sure that about 50 GB of disk space is available to handle the new data.

In the discussion below, this temporary folder will be called *scratch*; replace references to *scratch* by the name of the folder you created.

(2) Go to the website `nucleardata.lanl.gov`, and then download these files into your *scratch* folder:

Windows: `Lib80X.zip` (~ 7 GB), `ENDF80SaB.zip` (~ 2.5 GB)

Linux/Mac: `Lib80X.tgz` (~ 7 GB), `ENDF80SaB.tgz` (~ 2.5 GB)

(3) In a terminal window, decompress the downloaded files:

Windows:
```
cd scratch
unzip     Lib80X.zip
unzip     ENDF80SaB2.zip
```

Linux/Mac:
```
cd scratch
tar  xfz  Lib80X.tgz
tar  xfz  ENDF80SaB2.tgz
```

The expanded data files require about 45 GB of disk storage space. There will be folders created in *scratch* called `Lib80X` and `ENDF80SaB2`.

(4) In the terminal window, move the new data folders into your existing *mcnp* data storage folder:

Windows:
```
move  Lib80X      %DATAPATH%\xdata
move  ENDF80SaB2  %DATAPATH%\xdata
```

Linux/Mac:
```
mv    Lib80X      $DATAPATH/xdata
mv    ENDF80SaB2  $DATAPATH/xdata
```

Note that the instructions in this step differ from the instructions on the nucleardata website. The new data are moved into *`xdata`* folder, rather than the higher-level main data folder.

Appendix B. Obtaining & using XSDIR files that include ENDF/B-VIII.0 data

(1) Download these files from the **mcnp.lanl.gov** website into your *scratch* folder. They are found in the Reference Collection, in the section for "Nuclear Data & Physics" :

```
xsdir_mcnp6.2_endf71,80.txt
xsdir_mcnp6.2_endf80,71.txt
```

(2) In a terminal window, rename the files in *scratch* to remove the .txt suffix.

Windows:
```
rename xsdir_mcnp6.2_endf71,80.txt  xsdir_mcnp6.2_endf71,80
rename xsdir_mcnp6.2_endf80,71.txt  xsdir_mcnp6.2_endf80,71
```

Linux/Mac:
```
mv     xsdir_mcnp6.2_endf71,80.txt  xsdir_mcnp6.2_endf71,80
mv     xsdir_mcnp6.2_endf80,71.txt  xsdir_mcnp6.2_endf80,71
```

(3) In a terminal window, move the 2 files into the existing MCNP data storage folder:

Windows:
```
move  xsdir_mcnp6.2_endf71,80   %DATAPATH%
move  xsdir_mcnp6.2_endf80,71   %DATAPATH%
```

Linux/Mac:
```
mv    xsdir_mcnp6.2_endf71,80   $DATAPATH
mv    xsdir_mcnp6.2_endf80,71   $DATAPATH
```

(4) In a terminal window, rename the existing `xsdir_mcnp6.2` (to save the original):

Windows:
```
cd %DATAPATH%
rename   xsdir_mcnp6.2    xsdir_mcnp6.2_old
```

Linux/Mac:
```
cd $DATAPATH
mv       xsdir_mcnp6.2    xsdir_mcnp6.2_old
```

(5) Decide what the default data should be and recreate the `xsdir_mcnp6.2` file:

Both `xsdir` files (`xsdir_mcnp6.2_endf71,80` and `xsdir_mcnp6.2_endf80,71`) contain entries that include the ENDF/B-VII.1 and ENDF/B-VIII.0 data, but provide different defaults:

- `xsdir_mcnp6.2_endf71,80`:
  - This file defaults ZAIDs without suffixes to the ENDF/B-VII.1 ACE data at room temperature.
  - The ENDF/B-VIII.0 data are available, but are not the defaults.
- `xsdir_mcnp6.2_endf80,71`:
  - This file defaults ZAIDs without suffixes to the ENDF/B-VIII.0 ACE data at room temperature.
  - The ENDF/B-VII.1 data are available, but are not the defaults.

It is up to the user (or their site) to decide whether the default data for ZAIDs without suffixes should be the ENDF/B-VII.1 or ENDF/B-VIII.0 ACE files.

In a terminal window, to make the default data be ENDF/B-VII.1:

Windows:
```
cd %DATAPATH%
copy  xsdir_mcnp6.2_endf71,80  xsdir_mcnp6.2
```

Linux/Mac:
```
cd $DATAPATH
cp    xsdir_mcnp6.2_endf71,80  xsdir_mcnp6.2
```

In a terminal window, to make the default data be ENDF/B-VIII.0:

Windows:
```
cd %DATAPATH%
copy  xsdir_mcnp6.2_endf80,71  xsdir_mcnp6.2
```

Linux/Mac:
```
cd $DATAPATH
cp    xsdir_mcnp6.2_endf80,71  xsdir_mcnp6.2
```

(6) Run a test problem to verify that the data files were installed and configured correctly:

For each run, examine the *mcnp6.2* output file to check that the correct ACE data files were used. Make sure that the Default case uses the correct versions (VII.1 or VIII.0, as per Step (5).)

Default

```
Godiva - simple case
1 1 -18.74 -1 imp:n=1
2 0         1 imp:n=0

1    so 8.741

kcode 10000 1.0 10 110
ksrc  0. 0. 0.
m1  92235    -94.73
    92238     -5.27
```

Explicit ENDF/B-VII.1

```
Godiva - simple case
1 1 -18.74 -1 imp:n=1
2 0         1 imp:n=0

1    so 8.741

kcode 10000 1.0 10 110
ksrc  0. 0. 0.
m1  92235.80c -94.73
    92238.80c  -5.27
```

Explicit ENDF/B-VIII.0

```
Godiva - simple case
1 1 -18.74 -1 imp:n=1
2 0         1 imp:n=0

1    so 8.741

kcode 10000 1.0 10 110
ksrc  0. 0. 0.
m1  92235.00c  -94.73
    92238.00c   -5.27
```

Appendix C. ENDF/B-VIII.0-based ACE files for neutron cross-sections

The release of ACE files based on ENDF/B-VIII.0 includes neutron cross-section data for 556 isotopes and thermal scattering $S(\alpha,\beta)$ data for 33 materials [7,8]. No data is provided for elements; the elemental carbon data provided in ENDF/B-VII.1 is not supported in ENDF/B-VIII.0.

The ACE files for neutron cross-section data are provided at 7 temperatures. The temperatures and ZAID extensions are:

Temperature (K)	ZAID Extension
293.6	.00c
600	.01c
900	.02c
1200	.03c
2500	.04c
0.1	.05c
250	.06c

The ACE files for neutron cross-section data are available for the ZA numbers listed below, where ZA = Z*1000 + A. For metastable isotopes, ZA = Z*1000 + A + S*100, where S is the excited state number. (There is an exception to this for ^{242}Am. For historical reasons 95242 is for the first metastable state of ^{242}Am and 95642 is for ground-state ^{242}Am.)

The available ZAs are (see footnotes at end of table):

1001	1002	1003	2003	2004	3006	3007	4007	4009	5010
5011	6012*	6013*	7014	7015	8016	8017	8018*	9019	10020*
10021*	10022*	11022	11023	12024	12025	12026	13426†	13027	14028
14029	14030	14031*	14032*	15031	16032	16033	16034	16035*	16036
17035	17036*	17037	18036	18037*	18038	18039*	18040	18041*	19039
19040	19041	20040	20041*	20042	20043	20044	20045*	20046	20047*
20048	21045	22046	22047	22048	22049	22050	23049*	23050	23051
24050	24051*	24052	24053	24054	25054*	25055			
26054	26055*	26056	26057	26058	27058	27458†	27059	28058	28059
28060	28061	28062	28063*	28064	29063	29064*	29065	30064	30065
30066	30067	30068	30069*	30070	31069	31070*	31071	32070	32071*
32072	32073	32074	32075*	32076	33073*	33074	33075	34074	34075*
34076	34077	34078	34079	34080	34081*	34082	35079	35080*	35081
36078	36079*	36080	36081*	36082	36083	36084	36085	36086	37085

37086	37087	38084	38085*	38086	38087	38088	38089	38090	39089
39090	39091	40090	40091	40092	40093	40094	40095	40096	41093
41094	41095	42092	42093*	42094	42095	42096	42097	42098	42099
42100	43098*	43099	44096	44097*	44098	44099	44100	44101	44102
44103	44104	44105	44106	45103	45104*	45105	46102	46103*	46104
46105	46106	46107	46108	46109*	46110	47107	47108*	47109	47510†
47111	47112*	47113*	47114*	47115*	47116*	47117*	47518†	48106	48107*
48108	48109*	48110	48111	48112	48113	48114	48515†	48116	49113
49114*	49115	50112	50113	50114	50115	50116	50117	50118	50119
50120	50521†	50122	50123	50124	50125	50126	51121	51122*	51123
51124	51125	51126	52120	52121*	52521†	52122	52123	52124	52125
52126	52527†	52128	52529†	52130	52131*	52531†	52132	53127	53128*
53129	53130	53131	53132*	53532†	53133*	53134*	53135	54123	54124
54125*	54126	54127*	54128	54129	54130	54131	54132	54133	54134
54135	54136	55133	55134	55135	55136	55137	56130	56131*	56132
56133	56134	56135	56136	56137	56138	56139*	56140	57138	57139
57140	58136	58137*	58537†	58138	58139	58140	58141	58142	58143
58144	59141	59142	59143	60142	60143	60144	60145	60146	60147
60148	60149*	60150	61143*	61144*	61145*	61146*	61147	61148	61548†
61149	61150*	61151	62144	62145*	62146*	62147	62148	62149	62150
62151	62152	62153	62154	63151	63152	63153	63154	63155	63156
63157	64152	64153	64154	64155	64156	64157	64158	64159	64160
65158*	65159	65160	65161*	66154*	66155*	66156	66157*	66158	66159*
66160	66161	66162	66163	66164	67165	67566†	68162	68163*	68164
68165*	68166	68167	68168	68169*	68170	69168	69169	69170	69171*
70168*	70169*	70170*	70171*	70172*	70173*	70174*	70175*	70176*	71175
71176	72174	72175*	72176	72177	72178	72179	72180	72181*	72182*
73180	73181	73182	74180	74181*	74182	74183	74184	74185*	74186
75185	75586†	75187	76184*	76185*	76186*	76187*	76188*	76189*	76190*
76191*	76192*	77191	77192*	77193	77594†	78190*	78191*	78192*	78193*
78194*	78195*	78196*	78197*	78198*	79197	80196	80197*	80597†	80198
80199	80200	80201	80202	80203*	80204	81203	81204*	81205	82204
82205*	82206	82207	82208	83209	83610†	84208*	84209*	84210*	88223
88224	88225	88226							

89225	89226	89227	90227	90228	90229	90230	90231	90232	90233
90234	91229	91230	91231	91232	91233	92230	92231	92232	92233
92234	92235	92236	92237	92238	92239	92240	92241	93234	93235
93236	93636†	93237	93238	93239	94236	94237	94238	94239	94240
94241	94242	94243	94244	94245*	94246	95240	95241	95642†	95242

95243	95244	95644†	96240	96241	96242	96243	96244	96245	96246
96247	96248	96249	96250	97245	97246	97247	97248	97249	97250
98246	98247*	98248	98249	98250	98251	98252	98253	98254	99251
99252	99253	99254	99654†	99255	100255				

* New evaluations in ENDF/B-VIII.0.
† Excited state evaluations

Appendix D. ENDF/B-VIII.0-based ACE files for thermal scattering data, S(alpha,beta)

The thermal scattering law (TSL) data from ENDF/B-VIII.0 are available as ACE files from the **nucleardata.lanl.gov** website, in the ENDF80SaB2.tar or ENDF80SaB2.zip files. Previous TSL data files obtained from ENDF80SaB should not be used, since there were some files with incorrect data or processing. The TSL data from ENDF80SaB2 files include:

h-h2o	hydrogen in light water
h-ice	hydrogen in solid light water (ice)
o-ice	oxygen in solid light water (ice)
h-luci	hydrogen in Lucite
h-poly	hydrogen in polyethylene
h-yh2	hydrogen in yttrium-hydride
y-yh2	yttrium in yttrium-hydride
h-zrh	hydrogen in zirconium-hydride
zr-zrh	zirconium in zirconium-hydride
d-d2o	deuterium in heavy water
o-d2o	oxygen in heavy water
be-beo	beryllium in beryllium-oxide
o-beo	oxygen in beryllium-oxide
be-met	beryllium metal
grph10	10% porous graphite
grph30	30% porous graphite
grph	crystalline graphite
sio2	silicon-dioxide
si-sic	silicon in silicon-carbide
c-sic	carbon in silicon carbide
benz	benzene
n-un	nitrogen in uranium-nitride
u-un	uranium in uranium-nitride
o-uo2	oxygen in uranium-dioxide
u-uo2	uranium in uranium-dioxide
al-27	aluminum-27 metal
fe-56	iron-56 metal
lmeth	hydrogen in liquid methane
smeth	hydrogen in solid methane
paraD	liquid para-deuterium
paraH	liquid para-hydrogen
orthoD	liquid ortho-deuterium
orthoH	liquid ortho-hydrogen

For room temperature data (if it exists), the suffix to use is .40t. (There is no room temperature data for h-ice, o-ice, lmeth, orthoD, orthoH, paraD, paraH, or smeth.)

The TSL data for u-uo2 and u-un can be used with *mcnp6.3*, but should **not** be used with previous versions, *mcnp5*, *mcnp6.1*, *mcnp6.1.1*, *mcnp6.2*. These previous versions of *mcnp* were not designed to handle TSL data for fissionable nuclides, and U-235 is identified in the ENDF80SaB2 data as one of the nuclides that should use the TSL data. Modifications were made to *mcnp6.3* to correctly handle TSL data for fissionable nuclides.

The set of available S(alpha,beta) ACE files are listed below, with names and temperatures. In the list below, the datasets highlighted in blue should only be used with *mcnp6.3*, and not with older versions of *mcnp*. Since TSL data for u-uo2 & o-uo2 and for u-un & n-un should be used together, the TSL data for o-uo2 and n-un are also highlighted in blue below:

h-h2o.40t	294 K
h-h2o.41t	284 K
h-h2o.42t	300 K
h-h2o.43t	324 K
h-h2o.44t	350 K
h-h2o.45t	374 K
h-h2o.46t	400 K
h-h2o.47t	424 K
h-h2o.48t	450 K
h-h2o.49t	474 K
h-h2o.50t	500 K
h-h2o.51t	524 K
h-h2o.52t	550 K
h-h2o.53t	574 K
h-h2o.54t	600 K
h-h2o.55t	624 K
h-h2o.56t	650 K
h-h2o.57t	800 K
h-ice.40t	115 K
h-ice.41t	188 K
h-ice.42t	208 K
h-ice.43t	228 K
h-ice.44t	233 K
h-ice.45t	248 K
h-ice.46t	253 K
h-ice.47t	268 K
h-ice.48t	273 K
o-ice.40t	115 K
o-ice.41t	188 K
o-ice.42t	208 K
o-ice.43t	228 K
o-ice.44t	233 K
o-ice.45t	248 K
o-ice.46t	253 K
o-ice.47t	268 K
o-ice.48t	273 K
d-d2o.40t	294 K
d-d2o.41t	284 K
d-d2o.42t	300 K
d-d2o.43t	324 K
d-d2o.44t	350 K
d-d2o.45t	374 K
d-d2o.46t	400 K
d-d2o.47t	424 K
d-d2o.48t	450 K
d-d2o.49t	474 K
d-d2o.50t	500 K
d-d2o.51t	524 K
d-d2o.52t	550 K
d-d2o.53t	574 K
d-d2o.54t	600 K
d-d2o.55t	624 K
d-d2o.56t	650 K
o-d2o.40t	294 K
o-d2o.41t	284 K
o-d2o.42t	300 K
o-d2o.43t	324 K
o-d2o.44t	350 K
o-d2o.45t	374 K
o-d2o.46t	400 K
o-d2o.47t	424 K
o-d2o.48t	450 K
o-d2o.49t	474 K
o-d2o.50t	500 K
o-d2o.51t	524 K
o-d2o.52t	550 K
o-d2o.53t	574 K
o-d2o.54t	600 K
o-d2o.55t	624 K
o-d2o.56t	650 K
be-beo.40t	294 K
be-beo.41t	400 K
be-beo.42t	500 K
be-beo.43t	600 K
be-beo.44t	700 K
be-beo.45t	800 K
be-beo.46t	1000 K
be-beo.47t	1200 K
o-beo.40t	294 K
o-beo.41t	400 K
o-beo.42t	500 K
o-beo.43t	600 K
o-beo.44t	700 K
o-beo.45t	800 K
o-beo.46t	1000 K
o-beo.47t	1200 K
be-met.40t	296 K
be-met.41t	400 K
be-met.42t	500 K
be-met.43t	600 K
be-met.44t	700 K
be-met.45t	800 K
be-met.46t	1000 K
be-met.47t	1200 K
c-sic.40t	300 K
c-sic.41t	400 K
c-sic.42t	500 K
c-sic.43t	600 K
c-sic.44t	700 K
c-sic.45t	800 K
c-sic.46t	1000 K
c-sic.47t	1200 K
si-sic.40t	300 K
si-sic.41t	400 K
si-sic.42t	500 K
si-sic.43t	600 K
si-sic.44t	700 K
si-sic.45t	800 K
si-sic.46t	1000 K
si-sic.47t	1200 K
grph.40t	296 K
grph.41t	400 K
grph.42t	500 K
grph.43t	600 K
grph.44t	700 K
grph.45t	800 K
grph.46t	1000 K
grph.47t	1200 K
grph.48t	1600 K
grph.49t	1999 K
grph10.40t	296 K
grph10.41t	400 K
grph10.42t	500 K
grph10.43t	600 K
grph10.44t	700 K
grph10.45t	800 K
grph10.46t	1000 K
grph10.47t	1200 K
grph10.48t	1600 K
grph10.49t	1999 K
grph30.40t	296 K
grph30.41t	400 K
grph30.42t	500 K
grph30.43t	600 K
grph30.44t	700 K
grph30.45t	800 K
grph30.46t	1000 K
grph30.47t	1200 K
grph30.48t	1600 K
grph30.49t	1999 K
h-luci.40t	300 K
h-poly.40t	294 K

h-poly.41t 77 K	zr-zrh.41t 400 K	orthod.40t 19 K
h-poly.42t 196 K	zr-zrh.42t 500 K	
h-poly.43t 233 K	zr-zrh.43t 600 K	orthoh.40t 20 K
h-poly.44t 300 K	zr-zrh.44t 700 K	
h-poly.45t 303 K	zr-zrh.45t 800 K	parad.40t 19 K
h-poly.46t 313 K	zr-zrh.46t 1000 K	
h-poly.47t 323 K	zr-zrh.47t 1200 K	parah.40t 20 K
h-poly.48t 333 K		
h-poly.49t 343 K	sio2.40t 294 K	u-un.40t 296 K
h-poly.50t 350 K	sio2.41t 350 K	u-un.41t 400 K
	sio2.42t 400 K	u-un.42t 500 K
h-yh2.40t 294 K	sio2.43t 500 K	u-un.43t 600 K
h-yh2.41t 400 K	sio2.44t 800 K	u-un.44t 700 K
h-yh2.42t 500 K	sio2.45t 1000 K	u-un.45t 800 K
h-yh2.43t 600 K	sio2.46t 1100 K	u-un.46t 1000 K
h-yh2.44t 700 K		u-un.47t 1200 K
h-yh2.45t 800 K	al-27.40t 294 K	
h-yh2.46t 1000 K	al-27.41t 20 K	n-un.40t 296 K
h-yh2.47t 1200 K	al-27.42t 80 K	n-un.41t 400 K
h-yh2.48t 1399 K	al-27.43t 400 K	n-un.42t 500 K
h-yh2.49t 1600 K	al-27.44t 600 K	n-un.43t 600 K
	al-27.45t 800 K	n-un.44t 700 K
y-yh2.40t 294 K		n-un.45t 800 K
y-yh2.41t 400 K	benz.40t 296 K	n-un.46t 1000 K
y-yh2.42t 500 K	benz.41t 350 K	n-un.47t 1200 K
y-yh2.43t 600 K	benz.42t 400 K	
y-yh2.44t 700 K	benz.43t 450 K	u-uo2.40t 296 K
y-yh2.45t 800 K	benz.44t 500 K	u-uo2.41t 400 K
y-yh2.46t 1000 K	benz.45t 600 K	u-uo2.42t 500 K
y-yh2.47t 1200 K	benz.46t 800 K	u-uo2.43t 600 K
y-yh2.48t 1399 K	benz.47t 1000 K	u-uo2.44t 700 K
y-yh2.49t 1600 K		u-uo2.45t 800 K
	fe-56.40t 294 K	u-uo2.46t 1000 K
h-zrh.40t 296 K	fe-56.41t 20 K	u-uo2.47t 1200 K
h-zrh.41t 400 K	fe-56.42t 80 K	
h-zrh.42t 500 K	fe-56.43t 400 K	o-uo2.40t 296 K
h-zrh.43t 600 K	fe-56.44t 600 K	o-uo2.41t 400 K
h-zrh.44t 700 K	fe-56.45t 800 K	o-uo2.42t 500 K
h-zrh.45t 800 K		o-uo2.43t 600 K
h-zrh.46t 1000 K	lmeth.40t 100 K	o-uo2.44t 700 K
h-zrh.47t 1200 K		o-uo2.45t 800 K
	smeth.40t 22 K	o-uo2.46t 1000 K
zr-zrh.40t 296 K		o-uo2.47t 1200 K

SabID's highlighted in blue are commented-out and not available in the `xsdir_mcnp6.2_endf71,80` and `xsdir_mcnp6.2_endf80,71` files. They should not be used with *mcnp6.2* or earlier versions.

The SabID's in blue should be used only with *mcnp6.3* and later versions. The forthcoming release of *mcnp6.3* will include an `xsdir_mcnp6.3` file that makes those SabID's available. Users who have access to the pre-release *mcnp6.3* can uncomment the associated lines in the `xsdir_mcnp6.2_endf71,80` and `xsdir_mcnp6.2_endf80,71` files, simply by changing the leading # symbol to a blank on the associated lines.