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1. MATXS-J50

MATXS-J50 is a set of MATXS format multigroup libraries for multigroup transport calculations such as DOORS produced from JENDL-5 neutron, thermal scattering law (TSL) and photo-atomic sublibraries. It has two group structures; one is neutron 200 group and gamma 42 group, and the other is neutron 48 group and gamma 20 group.

2. Directory structure of MATXS-J50

The directory structure of MATXS-J50 is as follows:

MATXS-J50
- |- README_en.pdf : this file
- |- J5TSL-MATXS.xlsx : Description of TSL MATXS files
- |- j50.200.42.n250 : MATXS files of neutron 200 group and gamma 48 group at 250 K from JENDL-5
- |- j50.200.42.n300 : MATXS files of neutron 200 group and gamma 48 group at 300 K from JENDL-5
- |- j50.200.42.n600 : MATXS files of neutron 200 group and gamma 48 group at 600 K from JENDL-5
- |- j50.200.42.n900 : MATXS files of neutron 200 group and gamma 48 group at 900 K from JENDL-5
- |- j50.200.42.n1200 : MATXS files of neutron 200 group and gamma 48 group at 1200 K from JENDL-5
- |- j50.200.42.n1800 : MATXS files of neutron 200 group and gamma 48 group at 1800 K from JENDL-5
- |- j50.tsl.200.42 : MATXS files of neutron 200 group and gamma 48 group with TSL from JENDL-5 (all temperatures in TSL are included.)
- |- j50.48.20.n250 : MATXS files of neutron 48 group and gamma 20 group at 250 K from JENDL-5
- |- j50.48.20.n300 : MATXS files of neutron 48 group and gamma 20 group at 300 K from JENDL-5
- |- j50.48.20.n600 : MATXS files of neutron 48 group and gamma 20 group at 600 K from JENDL-5
- |- j50.48.20.n900 : MATXS files of neutron 48 group and gamma 20 group at 900 K from JENDL-5
- |- j50.48.20.n1200 : MATXS files of neutron 48 group and gamma 20 group at 1200 K from JENDL-5
- |- j50.48.20.n1800 : MATXS files of neutron 48 group and gamma 20 group at 1800 K from JENDL-5

|- j50.tsl.48.20 : MATXS files of neutron 48 group and gamma 20 group with TSL from JENDL-5 (all temperatures in TSL are included.)

3. How to produce MATXS-J50

The specification of MATXS-J50 is as follows.

- Group structure : neutron 200 group + gamma 48 group, neutron 48 group + gamma 20 group
- Weighting function : VITAMIN-E (neutron) , 1/E spectrum (gamma)
- Legendre expansion order : P_6
- Background cross section : 10^{10}, 10^4, 10^3, 300, 100, 30, 10, 1, 0.1, 10^{-5}
- Temperature : 250, 300, 600, 900, 1200, 1800 K except for TSL. All temperatures in TSL for TSL.
- Maximum energy for thermal neutrons : 10 eV
- KERMA factor : calculated with the kinematics method (same as ACR-J50)

The production method of MATXS-J50 is as follows.

A) Neutron ACE files (temperature : 250, 300, 600, 900, 1200, 1800 K) are produced from JENDL-5 neutron sublibrary with FRENDY(20241030) modified as shown in Appendix 1 and NJOY2016.65 modified for JENDL-5 (see https://rpg.jaea.go.jp/download/ace_lib/acej50/20221205/NJOY2016.65.modification.r2.pdf). The input files for this process are as follows (Fe56 at 300 K).

First FRENDY input

```
reconr
  20 22
 'pendf tape for jendl-5    n_026-Fe-056 '/
  2631 3 0 /
 .001 /
 'n_026-Fe-056 from jendl-5'/
 'processed with the frendy nuclear data processing system'/
 'see original jendl-5 tape for details of evaluation'/
 0/
broadr
  20 22 23
  2631 1 0 0 0/
 .001 /
 300 /
 0/
 stop
```

Next NJOY input

```
moder
 20 -21
 moder
 23 -25
heatr
 -21 -25 -26    0 /
 2631    5    0 0 0 2 0 1 /
 302 318 402 443 444 /
moder
 -26 24
 stop
```

Next FRENDY input

```
gaspr
  20 24 28
 acer
  20    28    0    29 30
  1    1    1    .20/
 'n_026-Fe-056 jendl-5 frendy njoy 2025.5'/
  2631    300 /
  1    1 /
 /
 stop
```

B) GENDF files are produced from the ACE files with FRENDY(20241030). The input file for this process is as follows (Fe56 at 300 K).

FRENDY inoput

```
mg_neutron_mode    //Process mode
  ace_file_name    ( n_026-Fe-056.ace )
  mg_edit_option ( GENDF )
  mg_file_name       n_026-Fe-056

  mg_structure                ( ign102 ) //VITAMIN-B6 200
  mg_structure_gam            ( igg10    ) //VITAMIN-J      42
  mg_weighting_spectrum ( iwt11    ) //VITAMIN-E weight function (ORNL-5505)
```

```
legendre_order          6

mg_mat_no ( 2631 )
```

C) Gamma GENDF files are produced from JENDL-5 photo-atomic sublibrary with NJOY2016.65 GAMINR module. The input file for this process is as follows (Fe56 at 300 K).

```
NJOY input
    reconr
     30 31
    'pendf tape from jendl-5'/
     2600 1 0 /
     .001 0. 7 /
    'n_026-Fe-056 from jendl-5'/
     0/
     gaminr
     30 31 0 32
     2600 10 3 6 0
    '42-group photon interaction library'/
     -1 0 /
     0/
    stop
```

D) The neutron GENDF file produced in B) and the gamma GENDF file produced in A) are merged to a MATXS file with NJOY2016.65 MATXS module. The input file for this process is as follows (Fe56 at 300 K).

```
NJOY input
    moder
       27 -28
     matxsr
     -28 32 33/
     15 'jendl-5 frendy'/
     2 4 1 1/
     'jendl-5 n_026-Fe-056 300K frendy'/
     'n'
     'g'/
     200 42/
```

```
 'nscat'   'ng'   'gscat'   'ntherm' /
    1       1       2       1 /
    1       2       2       1 /
'fe056' 2631 2600/
 stop
```

4. Notes on TSL files in MATXS-J50

- TSL MATXS files has no KERMA and damage energy production cross section data.
- TSL SiO2 MATXS file was not produced because TSL SiO2 is a mixed file of Si and O.
- Names of TSL MATXS files were set to mt249 and mt250 except for thermal data specified in MATXSR (see Table 1). See J5TSL-MATXS.xlsx in detail.
- Graphite in TSL is only C12 and N in UN is only N14.

Table 1 Thermal Material Names

Name	MT	Description
free	221	free-gas scattering
hh2o	222	H in H_2O
poly	223	H in polyethylene (CH_2) incoherent
poly$	224	H in polyethylene (CH_2) coherent
hzrh	225	H in ZrH incoherent
hzrh$	226	H in ZrH coherent
benz	227	Benzene incoherent
dd2o	228	D in D_2O
graph	229	C in graphite incoherent
graph$	230	C in graphite coherent
be	231	Be metal incoherent
be$	232	Be metal coherent
bebeo	233	Be in BeO incoherent

Name	MT	Description
zrzrh	235	Zr in ZrH incoherent
zrzrh$	236	Zr in ZrH coherent
obeo	237	O in BeO incoherent
obeo$	238	O in BeO coherent
ouo2	239	O in UO_2 incoherent
ouo2$	240	O in UO_2 coherent
uuo2	241	U in UO_2 incoherent
uuo2$	242	U in UO_2 coherent
al	243	Al metal incoherent
al	244	Al metal coherent
fe	245	Fe metal incoherent
fe	246	Fe metal coherent

5. Download site of MATXS-J50

https://rpg.jaea.go.jp/main/en/MATXS-J50/

6. References of MATXS-J50

A report or paper writing is in progress.

The reference of JENDL-5 is

(1) O. Iwamoto, et al., “Japanese Evaluated Nuclear Data Library version 5: JENDL-5,” J. Nucl. Sci. and Technol., 60 pp.1-60 (2022).

7. Contact

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8. Appendix 1

FRENDY(20241030) was modified as follows for MATXS-J50.

Line 12 in frendy/UnresoUtils/ProbabilityTableCalculator.cpp

```
const Real8 ProbabilityTableCalculator::min_xs_coef                 = 1.0E-2;
→
const Real8 ProbabilityTableCalculator::min_xs_coef                 = 1.0E-1;
```

Line 2369 in frendy/UnresoUtils/ProbabilityTableCalculator.cpp

```
                xs_val[j][k] = min_sig_val;
→               xs_val[j][k] = min_sig_val;
               if( k == fission_xs && fis_flg == 0 )
               {
                  xs_val[j][k] = 0.0;
               }
            }
         }

         //Modify small cross section data to appropriately calculate P1 bondarenko cross section
         //When the back ground cross section and sampled total cross section are so small,
         //this small total cross section affects p1 total Bondarenko self-shilding cross section.
        //To avoid such problem, small cross section is modified.
           if( xs_val[j][total_xs] < xs_data_back[total_xs] * min_xs_coef )
           {
              for(int k=0; k<xs_type_no; k++)
              {
                 xs_val[j][k] = xs_data_back[k] * min_xs_coef;
```

9. Appendix 2

New NJOY2016.65 bugs (multiple temperature bug and fission spectrum bug) were specified and corrected as follows, though they were not necessary for MATXS-J50.

Line 15 in matxsr.f90

```
      integer::mult=2               ! used for counting 8-byte entries
→     integer::mult=2                  ! used for counting 8-byte entries
      real(kr)::a0(200000)
```

Line 445 in matxsr.f90

```
 character(16)::word
→     character(16)::word
      integer::i
```

Line 463 in matxsr.f90

```
ngen8=0
```

→

```
ngen8=0
do i=1,200000
a0(i)=0.0
enddo
```

Line 2217 in matxsr.f90

```
a(icdat-1+jg2)=b(irinp+lz+ik-1)
```

→

```
a(icdat-1+noutg+jg1)=b(irinp+lz+1)-a0(icdat-1+noutg+jg1)
if (iref.eq.0) a0(icdat-1+noutg+jg1)=b(irinp+lz+1)
```

Line 2222 in matxsr.f90

```
a(icdat-1+noutg+jg1)=b(irinp+lz+1)
```

→

```
a a(icdat-1+noutg+jg1)=b(irinp+lz+1)-a0(icdat-1+noutg+jg1)
if (iref.eq.0) a0(icdat-1+noutg+jg1)=b(irinp+lz+1)
```

Line 5718 in groupr.f90

```
if (mfd.eq.6.and.mtd.eq.18) nz=nsigz
```

→ delete