40. FILE 40. COVARIANCES FOR PRODUCTION OF RADIOACTIVE NUCLEI

40.1. General Description

File 40 contains the covariances of neutron activation cross-section information appearing in File 10. This file is based on File 33, which should be consulted for further information, and on File 10.

40.2. Formats

The following quantities are defined:

ZA,AWR	Standard material charge and mass parameters.
LIS	Level number of the target.
NS	Number of subsections; one for each LFS.
QM	Mass-difference Q-value based on the ground state of the residual nucleus
QI	Reaction Q-value (eV). (See Chapter 10.)
LFS	Level number of the nuclide (ZAP) produced in the neutron reaction of type MT.
NL	Number of subsections.

Section

File 40 is divided into sections identified by the value of MT. Each section of File 40 starts with a HEAD record, ends with a SEND record, and has the following structure:

```
[MAT,40, MT/  ZA, AWR, LIS,   0, NS,  0] HEAD
     <NS subsections, one for each LFS>
[MAT,40, MT/ 0.0, 0.0,    0,   0,  0,  0] SEND
```

Subsection

Each subsection has the following structure:

```
[MAT,40, MT/  QM,  QI,   0, LFS,  0, NL] CONT
                  <sub-subsection for L=1>
                --------------------------
                --------------------------
                  <sub-subsection for L=NL>
```

Sub-subsections

Each sub-subsection is used to describe a single covariance matrix, the covariance matrix of the energy-dependent cross section given in section (MAT, 10, MT) with given final state (LFS) and the energy-dependent cross sections given in section (MAT1,MF1,MT1) (and for a given final state (LFS1), if MF1=10). The values of MAT1, MF1, MT1, and LSF1 are given in the CONT record that begins every sub-subsection.

Each sub-subsection may contain several sub-sub-subsections. Each sub-sub-subsection describes an independent contribution to the covariance matrix given in the sub-subsection. The total covariance matrix in the sub-subsection is made up of the sum of the contributions of the individual sub-sub-subsections.

The following additional quantities are defined:

XMF1	Floating point form of MF1 (the file number for the 2nd cross section to which the covariance data relates).
XLFS1	Floating point form of LFS1 (the index of the final state for the 2nd cross section to which the covariance data relates).
MAT1	MAT for the 2nd cross section to which the covariance data relates.
MT1	MT for the 2nd cross section to which the covariance data relates.
NC	Number of "NC-type" subsections which follow the CONT record.
NI	Number of "NI-type" subsections which follow the "NC-type" subsections.

The structure of a sub-subsection describing the covariance matrix of the cross sections given in (MAT, 10, MT) LFS and (MAT1,MF1, MT1) LFS1 is:

```
[MAT,40,MT/ XMF1, XLFS1, MAT1, MT1, NC, NI] CONT
```

<sub-sub-subsection for n_c = 1>

<sub-sub-subsection for n_c = NC>

<sub-sub-subsection for n_i = 1>

<sub-sub-subsection for n_i = NI>

The formats of the sub-sub-subsection for File 40 are exactly the same as the formats for the sub-subsections for File 33.

40.3. Procedures

The procedures for File 40 are the same as for File 33 except that File 40 has one more level of indexing corresponding to the LFS and LFS1 flags and as noted below.

40.3.1. Ordering of Sections, Subsections, Sub-subsections, and Sub-sub-subsections

a. Sections: The sections in File 40 are ordered by increasing value of MT.

b. Subsections: Within a section, (MAT,40,MT), the subsections are ordered by increasing value of LFS.

c. Sub-subsections: A sub-subsection of File 40 is uniquely identified by the set of numbers (MAT,MT,LFS; MAT1,MT1,MF1,LFS1); the first two numbers indicate the section, the third indicates the subsection, while the last four indicate the sub-subsection.

1. The sub-subsections within a subsection are ordered by increasing value of MAT1. The value of MAT1=0 shall be used to mean MAT1=MAT.
2. When there are several sub-subsections with the same value of MAT1 in a subsection, these sub-subsections shall be ordered by increasing values of XMF1. When MF1=MF, the XMF1 field shall be entered as blank or zero. Therefore, within a given subsection, the sub-subsections for MF1=MF will always appear before those for other MF1 values.

3. When there are several sub-subsections with the same value of MAT1 and MF1 in a subsection, these sub-subsections shall be ordered by increasing values of MT1. If MAT1=MAT and MF1=MF, then only those sub-subsections for MT≥MT shall be given.
4. When there are several sub-subsections with the same value of (MAT1,MT1,MF1) in a subsection, these sub-subsections shall be ordered by increasing values of LFS1. If MAT1=MAT, MF1=MF, and MT1=MT, then only those sub-subsections for LFS1≥LFS shall be given. (LFS1=0 implies the ground state of the product and does not imply LFS1=LFS).

40.3.2. Completeness

There are no minimum requirements on the number of sections, subsections, and sub-subsections in File 40. However, the presence of certain data blocks in File 40 implies the presence of others, either in File 33 or 40 of a referenced material. In what follows, we shall identify the sub-subsections of File 40 by

(MAT, MT, LFS; MAT1, MT1, MF1, LFS1).

The presence of this data block with MAT1≠MAT or MF1≠10 implies the presence of appropriate data in:

a. (MAT, MT, LFS; MAT, MT, MF=10, LFS), in File 40 of MAT;
b. (MAT1, MT1, LFS1; MAT1, MT1, MF1, LFS1), in File (MF1+30) of MAT1;
c. (MAT1, MT1, LFS1; MAT, MT, MF=10, LFS), also in File (MF1+30) of MAT1.