INTERNATIONAL ATOMIC ENERGY AGENCY
NUCLEAR DATA SERVICES
DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

IAEA-NDS-211
2 September 2004

The JEFF-3.0/A Neutron Activation File - EAF-2003 into ENDF-6 format -

prepared by

J-Ch Sublet, A J Koning[1], R A Forrest[2] and J Kopecky[3]

CEA Cadarache, DEN/DER/SPRC
13108 Saint Paul Lez Durance, France

[1] Nuclear Research and Consultancy Group NRG
NL-1755 ZG Petten, The Netherlands

[2] UKAEA/EURATOM Fusion Association, Culham Science Centre
Abingdon, Oxfordshire, OX14 3 DB, United Kingdom

[3] JUKO Research, Kalmanstraat 4, 1817 HX Alkmaar, The Netherlands

Summary documentation

Abstract: The reasons for the conversion of the European Activation File, EAF into ENDF-6 format are threefold. First to significantly enhance the JEFF-3 release by the addition of an activation file. Second to considerably increase its usage by using a recognised, official file format so allowing existing plug-in processes to be effective and third to move towards a universal nuclear data file in contrast to the current separate general and special purpose files. The format chosen for the JEFF-3.0/A file uses reactions cross sections (MF-3), cross sections (MF-10) and multiplicities (MF-9).

The report is available online on http://www-nds.iaea.org/nds-211.pdf.

The data in ENDF-6 format are available on http://www-nds.iaea.or.at/exfor/endf00.htm

Nuclear Data Section
International Atomic Energy Agency
P.O. Box 100
A-1400 Vienna
Austria

e-mail: services@iaeand.iaea.org
fax: (43-1)26007
cable: INATOM VIENNA
telex: 1-12645
telephone: (43-1)2600-21710

online: TELNET or FTP: iaeand.iaea.org
usernames: IAEANDS for interactive Nuclear Data Information System
ANONYMOUS for FTP file transfer
FENDL2 for FTP file transfer of FENDL-2.0 files
RIPL for FTP file transfer of RIPL
NDSONL for files saved in "NDIS" Telnet session
Web: http://www-nds.iaea.org

Disclaimer

Neither the author nor anybody else makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information disclosed, or represents that its use would not infringe privately owned rights.

The IAEA-NDS would appreciate any comment on this report at: services@iaeand-iaea.org

Vienna, 2004-09-02

JEFF-3.0/A, Fichier d'Activation induite par Neutron - EAF-2003 au format ENDF-6 -

Résumé

La conversion au format ENDF-6 de EAF, Fichier Européen de données d'Activation, répond à plusieurs besoins. Le premier est de joindre un fichier d'activation complet à la distribution de JEFF-3. Le second est de faciliter notablement son exploitation en utilisant un format de stockage officiel et reconnu, permettant l'utilisation d'une plus large connectique et le troisième de se rapprocher sensiblement d'un fichier universel réunissant les fichiers dit généraux et spéciaux. Le format choisit pour JEFF-3.0/A stocke les sections efficaces totales (MF-3), les sections efficaces partielles (MF-10) et les rapports de branchement (MF-9).

The JEFF-3.0/A Neutron Activation File - EAF-2003 into ENDF-6 format -

Abstract

The reasons for the conversion of the European Activation File, EAF into ENDF-6 format are threefold. First to significantly enhance the JEFF-3 release by the addition of an activation file. Second to considerably increase its usage by using a recognised, official file format so allowing existing plug-in processes to be effective and third to move towards a universal nuclear data file in contrast to the current separate general and special purpose files. The format chosen for the JEFF-3.0/A file uses reactions cross sections (MF-3), cross sections (MF-10) and multiplicities (MF-9).

Disclaimer

Neither the authors nor CEA, NRG, UKAEA accept responsibility for consequences arising from any errors either in the present documentation or in the JEFF-3.0/A library.

Acknowledgements

This work was partly funded by the CEA/DEN in the framework of the Nuclear Data and Processing Tools project, the Nuclear Research and Consultancy Group NRG, the UK Engineering and Physical Sciences Research Council and by EURATOM.

The authors acknowledge the support and dedication of many colleagues in the nuclear data community in the EU, RF, Japan and the USA without whom such work would have been impossible, in particular A Filatenkov, M Herman, Y Ikeda, A Ignatjuk, R E MacFarlane, A Mengoni, F Maekawa, W Mannhart, U von Mollendorf, A Pashchenko, M Pillon, K Shibata, K Seidel, S Tagessen, H Vonach, H Weigmann, W B Wilson and K Zolotarev.

Contents

Introduction

The main overall result of the conversion of EAF [1] into ENDF-6 format [2] is that all reactions are combined into one ENDF-6 formatted file by nucleus and so be seamlessly use by many evaluators, codes and applications worldwide. EAF-2003 and JEFF-3.0/A, as the ENDF-6 format conversion is termed, contain neutron data for 98 elements, 774 different target nuclei, including first (m) or second (n) isomeric states, from ^{1}H to ^{257}Fm and 12617 neutron-induced reactions below 20 MeV. In contrast, the JEFF-3.0/GP general-purpose transport file contains data for half that number, 340 nuclei. The latter is sufficient if one wants to concentrate on neutron transport calculations following the neutrons and the major target nuclei but not all the daughter products nor the emitted particles. An activation file, like JEFF-3.0/A allows codes to follow all the target nucleus states, the incident and emitted particles (i.e. charged particles, gas production) as well as the residual nucleus states, as a function of time.

ENDF-6 file format

The JEFF-3.0/A (EAF-2003 into ENDF-6), file layout for each nucleus is as follows:

MF	Description
1	General information, comments
2	Resonance parameters, skeleton
3	Total reaction channels
8	Flag, file pointer, dictionary
9	Isomeric branching ratio
10	Split threshold reaction channels

This layout allows for 23 open reaction channels or MT numbers: 4, 16, 17, 18, 22, 24, 25, 28, 29, 32, 33, 34, 37, 41, 102, 103, 104, 105, 106, 107, 108, 111 and 112, for each nucleus. Each of those channels could be further broken down into three partials leading to the ground, first and/or second isomeric states of the daughter product. Table 1 describes the relation between MT and reaction type, listing the total number of reactions for each type present in JEFF-3.0/A.

The translation of EAF into ENDF-6 format is performed with EAF2ENDF, a code originally developed to produce high-energy activation libraries [3]. First of all, an MF-1 is included for the main information and documentation. The description of MF-3 has been copied directly from the EAF comment lines: including the original EAF MT-numbers, data source, relevant comments and numbers describing the modifications performed on the original evaluation [4].

A trivial MF-2 follows since the original EAF-file does not contain resonance data. Therefore, $r = 1.35x(A^{1/3})$ is computed for the scattering radius and a very small resonance region is used. All the resonant channels (i.e (n,γ), (n,f), (n,a) and (n,p)) are already stored as PENDF in EAF, which is a linearised pointwise format.

For the storage of activation excitation functions, a combination of MF-3, MF-8, MF-9 and MF-10 is used. In this particular case file 8 does not describes radioactive decay and fission yield data but, as approved by the members of the Cross Section Evaluation Working Group CSEWG, at the November 2001 meeting, nuclide production information. When the reaction populates the ground state only, or when the specific population is unknown, MF-3 is used as usual. Reactions to isomeric states are stored in MF-10, using the normal ENDF-6 nomenclature for threshold reaction channels. For the resonant (n,γ) channel the total reaction is stored in MF-3, MT-102 and the branching ratio in MF-9 when it exist. Furthermore, MF-8 specifies where the (isomeric or non-isomeric) information can be found while including the reaction daughter MAT and ZAm number. Hence, for all MT-numbers MF-8 always points to, either MF-3, MF-9 or MF-10. This also means that MF-3 and MF-10 cannot be populated simultaneously for the same MT-number. Consequently the total reaction cross section is not stored when the partials exist and vice versa. Appendix A, with two examples, illustrates this new format and the ENDF-6 manual [2] should be consulted for further details.

Table 1 Reaction types and MT numbers in JEFF-3.0/A

Reaction Type (23)	MT	Number of reactions
(n,n′)	4	262
(n,2n)	16	1010
(n,3n)	17	871
(n,f)	18	90
(n,n′α)	22	907
(n,2nα)	24	4
(n,3nα)	25	2
(n,n′p)	28	922
(n,n2α)	29	1
(n,n′d)	32	904
(n,n′t)	33	791
(n,n′h)	34	208
(n,4n)	37	25
(n,2np)	41	7
(n,γ)	102	1007
(n,p)	103	1016
(n,d)	104	927
(n,t)	105	951
(n,h)	106	862
(n,α)	107	992
(n,2α)	108	2
(n,2p)	111	822
(n,pα)	112	34
Total		**12617**

Normally all the original EAF data remains unchanged and only the file format is modified. This is not entirely true and minor changes can occur when double or very low values are encountered. In EAF format all isomeric cross section are explicitly described, however the ENDF-6 manual requires a branching ratio for all resonant channels, to be accounted for in file 2, and stored in file 9. This means that, when required, the partial capture channels have been, first put on a common energy grid, then summed and their energy dependant branching ratio calculated and finally thinned to a 3-digit accuracy. The outcome of these new processes is a file 9 for 219 reactions, containing capture isomeric branching ratios leading to the ground, first isomer and sometimes (18) the second isomer daughter. The information was there, in the original EAF format, however, storage in this ENDF-6 compliant format will facilitate usage of the energy dependence of the nuclear data.

New MAT numbers have been assigned following the strategy used for ENDF/B-VI where the MAT for isotopes of an element are assigned on the basis of increasing mass steps of three, allowing for the ground state and two metastable states:

$$MAT=100 \times Z + 25 + 3 \times (A-A_{min}) + isom$$

The details of the range of reactions contained in EAF-2003 [1], a full JEFF-3.0/A file index and the MAT number are given in Appendix B.

JEFF-3.0/A validation

An important added bonus of having the EAF-2003 data in ENDF-6 format is that the ENDF suite of utilities and checker codes [5] can be used. Although EAF-2003 has been put through several QA processes in SAFEPAQ-II (file format, C/S and C/E cross section validations, EXFOR differential graph comparison, etc.) and validated against experimental data with the EASY-2003 code system and other activation codes, it is an important and required procedure in line with the OECD/NEA nuclear data QA recommendations.

Format (CHECKR) and physics checking (FIZCON and PSYCHE) have been performed with version 6.12 and 6.13 of the code on JEFF-3.0/A and no significant error messages noted. Some trivial messages tend to occur, but are not of concern for an activation file. One has to remember that JEFF-3.0/A is a complex activation file, in

distinction to JEFF-3/GP; a transport file, and so does not need to contained certain physical parameters such as angular distributions, elastic cross sections, emitted particle spectra, nor to obey certain ENDF-6 rules.

The other utility codes such as GETMAT, LISTEF or INTER allows the retrieval of materials, to generates file summary and annotated data listing or calculates selected cross sections and integrals.

File processing

The JEFF-3.0/A file can be processed by the code NJOY-99 [6] (above version 68, in an automatic mode) in contrast to the original EAF-2003 file (in EAF format) which was processed by SAFEPAQ-II for the European Activation System EASY-2003. In the latter, the resulting format of the many original multi-group libraries, is the libout format of the code FOUR ACES (ENEA Bologna), with two additional comment lines, copied from the pointwise EAF file, for each reaction. Groupwise cross section may differ slightly, depending on which processing tools has been used (NJOY-99, CALENDF-2002, PREPRO2002, SAFEPAQ-II etc), Appendix D illustrate such differences.

With NJOY-99, from the original 293.6K ENDF-6 format, JEFF-3.0/A files, multiple temperature PENDF files can be generated with the Doppler-broadening module **broadr**. This step can then be followed by a choice of group processing through the dedicated module **groupr**, producing a GENDF file, and further **matxsr**, or **acer** processing as required.

The 774 single nucleus files that compose JEFF-3.0/A can be automatically processed with the Unix C-shell script detailed in Appendix C. The only prerequisite is to have access to an NJOY executable.

Conclusions

After many years of trials, experiments and proposals a consensus has been found on the file format of a large activation file. This format has, for the first time, been fully implemented in the EAF-2003 into ENDF-6 conversion, leading to the production of JEFF-3.0/A and allowing more exact nuclear data file use and further dissemination. This important milestone brings us a step nearer to a universal evaluated nuclear data file format.

References

[1] R A Forrest, J Kopecky and J-Ch Sublet, *"The European Activation File: EAF-2003 cross section library"*, **UKAEA FUS 486**, 2002. http://www.fusion.org.uk/easy2003/

[2] V McLane, Editor, *"ENDF-102, Data formats and Procedures for the Evaluated Nuclear Data file ENDF-6"*, Revised April 2001, **BNL-NCS-44945-01/04**, 2001. http://www.nndc.bnl.gov/nndcscr/documents/endf/

[3] A J Koning, M B Chadwick and R E Macfarlane, *"Neutron and proton transmutation-activation libraries up to 150 MeV"*, **JEFF-DOC-709**, 1997. http://www.nea.fr/html/dbdata/projects/jeffdoc.html

[4] R A Forrest, *"SAFEPAQ-II: User manual"*, **UKAEA FUS 454**, 2002.

[5] C L Dunford, *"ENDF Utility Codes release 6.13"*, Brookhaven National Laboratory. http://www.nndc.bnl.gov/nndcscr/endf/utility/

[6] R E MacFarlane and D W Muir, *"The NJOY Nuclear Data Processing System"*, Los Alamos National Laboratory**,** **LA-12740-M**, 1994. Oak Ridge National Laboratory, RSICC PSR-480 NJOY-99.0. http://t2.lanl.gov/codes/njoy99/

Appendix A file format

An extract from the JEFF-3.0/A file for ^{23}Na and ^{115}In illustrates the file 1, 8, 9 and 10 formats.

^{23}Na File 1

```
 1.102300+4 2.279228+1          0          0          9          01125 1451    1
 0.000000+0 0.000000+0          0 LIS      0 LISO     0          61125 1451    2
 1.000000+0 2.000000+7          0          0         10          01125 1451    3
 2.936000+2 0.000000+0          0          0         41         271125 1451    4
 11-NA- 23 UKAEA      EVAL-JUL03 Forrest, Kopecky, Sublet, Koning 1125 1451    5
   UKAEA FUS 486      DIST-JUL03                                  1125 1451    6
----JEFF-3.0/A        Material 1125                               1125 1451    7
-----Incident neutron data                                        1125 1451    8
------ENDF-6 Format                                              1125 1451    9
                                                                  1125 1451   10
                                                        (New) MAT
```

……

```
                                                                  1125 1451   28
 MF  MT  DESCRIPTION  DATA SOURCE ; MODIFICATION                   1125 1451   29
-------------------------------------------------------------------- 1125 1451   30
 1  451   Info                                                     1125 1451   31
 2  151   Resonance parameters                                     1125 1451   32
 3   16   N,2N        JENDL-99D   Data origin                      1125 1451   33
 3   22   N,NA        EFF-2.4                                      1125 1451   34
 3   28   N,NP        ADL-3; EXP   [3, 5]                         1125 1451   35
 3   32   N,ND        ADL-3; NUM   [8, 5]                         1125 1451   36
 3   33   N,NT        ADL-3; NUM   [8, 5] Modification type       1125 1451   37
 3  102   N,G         JEF-2.2; PEQ   [9, 2, 4, 6, 4]             1125 1451   38
 3  103   N,P         EFF-2.4; MERGE   [13]                       1125 1451   39
 3  104   N,D         ADL-3; SYST   [2, 5]                        1125 1451   40
 3  105   N,T         ADL-3; EXP   [3, 5]                         1125 1451   41
 3  106   N,H         ADL-3; DEL   [5]                            1125 1451   42
 3  107   N,A         FENDL/A-1; NUM   [8]                        1125 1451   43
 3  111   N,2P        ADL-3; DEL   [5]                            1125 1451   44
 3  402   N,G*        JEF-2.2; PEQ   [9, 2, 7, 4, 6, 4]          1125 1451   45
    ↑     ↑                    1        451         72          01125 1451   46
    ↑   Reaction type         2        151          4          01125 1451   47
  EAF MT's                    3         16          9          01125 1451   48
                              3         22          9          01125 1451   49
                              3         28          9          01125 1451   50
                              3         32          5          01125 1451   51
                              3         33          5          01125 1451   52
                              3        102        992          01125 1451   53
                              3        103         19          01125 1451   54
                              3        104          9          01125 1451   55
                              3        105          9          01125 1451   56
                              3        106          5          01125 1451   57
                              3        107         18          01125 1451   58
                              3        111          4          01125 1451   59
                              8         16          2          01125 1451   60
                              8         22          2          01125 1451   61
                              8         28          2          01125 1451   62
                              8         32          2          01125 1451   63
                              8         33          2          01125 1451   64
                              8        102          3          01125 1451   65
                              8        103          2          01125 1451   66
                              8        104          2          01125 1451   67
                              8        105          2          01125 1451   68
                              8        106          2          01125 1451   69
                              8        107          2          01125 1451   70
                              8        111          2          01125 1451   71
                              9        102         43          01125 1451   72
                                                                  1125 1  099999
```

……

^{23}Na File-8

```
                                                                  MF-8(n,n't)
1.102300+4 2.279228+1          0          0          1          11125 8 33    1
1.002000+4 0.000000+0          3          0          0       10251125 8 33    2
                            MF-3                             MATP1125 8  099999
                                                                  MF-8(n,γ))
1.102300+4 2.279228+1          0          0          2          11125 8102    1
1.102400+4 0.000000+0          9          0          0       11281125 8102    2
1.102400+4 4.721580+5          9          1          0       11291125 8102    3
                            MF-9        LFS             MATP1125 8  099999
```

……

^{23}Na File-9

```
 ZA                                                                MF-9(n,γ)
1.102300+4 2.279228+1          0          0          2           01125 9102    1
6.959300+6 6.959300+6      11024          0          1          571125 9102    2
        57          2        ZAP        LFS                      1125 9102    3
1.000000-5 2.320000-1 3.797639+5 2.330000-1 4.095278+5 2.340000-11125 9102    4
4.560417+5 2.360000-1 4.876047+5 2.370000-1 5.242152+5 2.380000-11125 9102    5
5.744346+5 2.390000-1 5.995444+5 2.400000-1 6.330240+5 2.410000-11125 9102    6
6.708495+5 2.430000-1 7.024780+5 2.440000-1 7.551921+5 2.450000-11125 9102    7
7.973634+5 2.470000-1 8.865306+5 2.500000-1 1.000000+6 2.530000-11125 9102    8
1.095445+6 2.560000-1 1.200000+6 2.600000-1 1.400000+6 2.660000-11125 9102    9
1.600000+6 2.730000-1 1.800000+6 2.790000-1 2.000000+6 2.860000-11125 9102   10
2.167500+6 2.910000-1 2.199998+6 2.920000-1 2.374178+6 2.980000-11125 9102   11
2.495800+6 3.020000-1 2.600000+6 3.050000-1 2.755620+6 3.100000-11125 9102   12
2.822320+6 3.120000-1 3.000000+6 3.180000-1 3.113250+6 3.220000-11125 9102   13
3.500000+6 3.340000-1 3.855321+6 3.460000-1 4.016830+6 3.510000-11125 9102   14
4.086460+6 3.530000-1 4.626450+6 3.710000-1 4.985130+6 3.820000-11125 9102   15
5.000000+6 3.830000-1 5.616040+6 4.030000-1 5.778890+6 4.080000-11125 9102   16
6.018980+6 4.160000-1 6.326860+6 4.260000-1 6.385380+6 4.270000-11125 9102   17
6.462630+6 4.300000-1 6.509600+6 4.310000-1 7.003183+6 4.470000-11125 9102   18
7.202730+6 4.540000-1 7.989036+6 4.790000-1 9.000000+6 5.120000-11125 9102   19
1.000000+7 5.440000-1 1.100000+7 5.770000-1 1.200000+7 6.090000-11125 9102   20
1.300000+7 6.410000-1 1.349074+7 6.570000-1 1.400000+7 6.740000-11125 9102   21
1.442902+7 6.880000-1 1.490360+7 6.900000-1 2.000000+7 6.900000-11125 9102   22
6.959300+6 6.487142+6      11024          1          1          571125 9102   23
        57          2        ZAP        LFS                      1125 9102   24
1.000000-5 7.680000-1 3.797639+5 7.670000-1 4.095278+5 7.660000-11125 9102   25
4.560417+5 7.640000-1 4.876047+5 7.630000-1 5.242152+5 7.620000-11125 9102   26
5.744346+5 7.610000-1 5.995444+5 7.600000-1 6.330240+5 7.590000-11125 9102   27
6.708495+5 7.570000-1 7.024780+5 7.560000-1 7.551921+5 7.550000-11125 9102   28
7.973634+5 7.530000-1 8.865306+5 7.500000-1 1.000000+6 7.470000-11125 9102   29
1.095445+6 7.440000-1 1.200000+6 7.400000-1 1.400000+6 7.340000-11125 9102   30
1.600000+6 7.270000-1 1.800000+6 7.210000-1 2.000000+6 7.140000-11125 9102   31
2.167500+6 7.090000-1 2.199998+6 7.080000-1 2.374178+6 7.020000-11125 9102   32
2.495800+6 6.980000-1 2.600000+6 6.950000-1 2.755620+6 6.900000-11125 9102   33
2.822320+6 6.880000-1 3.000000+6 6.820000-1 3.113250+6 6.780000-11125 9102   34
3.500000+6 6.660000-1 3.855321+6 6.540000-1 4.016830+6 6.490000-11125 9102   35
4.086460+6 6.470000-1 4.626450+6 6.290000-1 4.985130+6 6.180000-11125 9102   36
5.000000+6 6.170000-1 5.616040+6 5.970000-1 5.778890+6 5.920000-11125 9102   37
6.018980+6 5.840000-1 6.326860+6 5.740000-1 6.385380+6 5.730000-11125 9102   38
6.462630+6 5.700000-1 6.509600+6 5.690000-1 7.003183+6 5.530000-11125 9102   39
7.202730+6 5.460000-1 7.989036+6 5.210000-1 9.000000+6 4.880000-11125 9102   40
1.000000+7 4.560000-1 1.100000+7 4.230000-1 1.200000+7 3.910000-11125 9102   41
1.300000+7 3.590000-1 1.349074+7 3.430000-1 1.400000+7 3.260000-11125 9102   42
1.442902+7 3.120000-1 1.490360+7 3.100000-1 2.000000+7 3.100000-11125 9102   43
                                                                  1125 9  099999
```

……

.....

^{115}In File-10

```
  ZA                                                                MF-10(n,3n)
 4.911500+4 1.139170+2          0          0          2          0493110 17    1
-1.632120+7-1.632120+7      49113          0          1          5493110 17    2
          5          2        ZAP        LFS                     493110 17    3
 1.646450+7 0.000000+0 1.700000+7 7.536992-3 1.800000+7 1.465688-1493110 17    4
 1.900000+7 3.850304-1 2.000000+7 5.890168-1                     493110 17    5
-1.632120+7-1.670509+7      49113          1          1          4493110 17    6
          4          2        ZAP        LFS                     493110 17    7
 1.685171+7 0.000000+0 1.800000+7 3.664220-2 1.900000+7 9.625760-2493110 17    8
 2.000000+7 1.472542-1                                           493110 17    9
                                                                 493110  099999
```

Glossary

ZAP	Designation of the product nuclide
MATP	Material number of the reaction product
ZA	Designation of the original nuclide
MAT	Material number
LFS	Indicator that specifies the final exited state of the residual
LIS	State number of the target nucleus
LISO	Isomeric state number

Appendix B JEFF-3.0/A file index

Index of JEFF-3.0/A reactions, a listing of all 98 elements, 774 isotopes (file names) and MAT number are given. The suffix m describes the first isomeric state, and n the second.

H	
H1	125
H2	128
H3	131
He	
He3	225
Li	
Li6	325
Li7	328
Be	
Be7	419
Be9	425
Be10	428
B	
B10	525
B11	528
C	
C12	625
C13	628
C14	631
N	
N14	725
N15	728
O	
O16	825
O17	828
O18	831
F	
F19	925
Ne	
Ne20	1025
Ne21	1028
Ne22	1031
Na	
Na22	1122
Na23	1125
Na24	1128
Mg	
Mg24	1225
Mg25	1228
Mg26	1231
Mg28	1237
Al	
Al26	1322
Al27	1325
Si	
Si28	1425
Si29	1428
Si30	1431
Si31	1434
Si32	1437
P	
P31	1525
P32	1528
P33	1531
S	
S32	1625
S33	1628
S34	1631
S35	1634
S36	1637
Cl	
Cl35	1725
Cl36	1728
Cl37	1731
Ar	
Ar36	1825
Ar37	1828
Ar38	1831
Ar39	1834
Ar40	1837
Ar41	1840
Ar42	1843
K	
K39	1925
K40	1928
K41	1931
K42	1934
K43	1937
Ca	
Ca40	2025
Ca41	2028
Ca42	2031
Ca43	2034
Ca44	2037
Ca45	2040
Ca46	2043
Ca47	2046
Ca48	2049
Sc	
Sc44m	2123
Sc45	2125
Sc46	2128
Sc47	2131
Sc48	2134
Ti	
Ti44	2219
Ti45	2222
Ti46	2225
Ti47	2228
Ti48	2231
Ti49	2234
Ti50	2237
V	
V48	2319
V49	2322
V50	2325
V51	2328
Cr	
Cr48	2419
Cr50	2425
Cr51	2428
Cr52	2431
Cr53	2434
Cr54	2437
Mn	
Mn52	2516
Mn53	2519
Mn54	2522
Mn55	2525
Fe	
Fe54	2625
Fe55	2628
Fe56	2631
Fe57	2634
Fe58	2637
Fe59	2640
Fe60	2643
Co	
Co55	2713
Co56	2716
Co57	2719
Co58	2722
Co58m	2723
Co59	2725
Co60	2728
Ni	
Ni56	2819
Ni57	2822
Ni58	2825
Ni59	2828
Ni60	2831
Ni61	2834
Ni62	2837
Ni63	2840
Ni64	2843
Ni66	2849
Cu	
Cu63	2925
Cu64	2928
Cu65	2931
Cu67	2937
Zn	
Zn64	3025
Zn65	3028
Zn66	3031
Zn67	3034
Zn68	3037
Zn69m	3041
Zn70	3043
Zn72	3049
Ga	
Ga67	3119
Ga69	3125
Ga71	3131
Ga72	3134
Ge	
Ge68	3219
Ge69	3222
Ge70	3225
Ge71	3228
Ge72	3231
Ge73	3234
Ge74	3237
Ge76	3243
Ge77	3246
As	
As71	3313
As72	3316
As73	3319
As74	3322
As75	3325
As76	3328
As77	3331
Se	
Se72	3419
Se73	3422
Se74	3425
Se75	3428
Se76	3431
Se77	3434
Se78	3437
Se79	3440
Se80	3443
Se82	3449
Br	
Br76	3516
Br77	3519
Br79	3525
Br81	3531
Br82	3534
Kr	
Kr76	3619
Kr78	3625
Kr79	3628
Kr80	3631
Kr81	3634
Kr82	3637
Kr83	3640
Kr84	3643
Kr85	3646
Kr86	3649
Rb	
Rb83	3719
Rb84	3722
Rb85	3725
Rb86	3728
Rb87	3731
Sr	
Sr82	3819
Sr83	3822
Sr84	3825
Sr85	3828
Sr86	3831
Sr87	3834
Sr88	3837
Sr89	3840
Sr90	3843
Y	
Y86	3916
Y87	3919
Y87m	3920
Y88	3922
Y89	3925
Y90	3928
Y91	3931
Zr	
Zr86	4013
Zr88	4019
Zr89	4022
Zr90	4025
Zr91	4028
Zr92	4031
Zr93	4034
Zr94	4037
Zr95	4040
Zr96	4043
Zr97	4046
Nb	
Nb90	4116
Nb91	4119
Nb91m	4120

Nb92	4122
Nb92m	4123
Nb93	4125
Nb93m	4126
Nb94	4128
Nb95	4131
Nb95m	4132
Nb96	4134
Mo	
Mo92	4225
Mo93	4228
Mo94	4231
Mo95	4234
Mo96	4237
Mo97	4240
Mo98	4243
Mo99	4246
Mo100	4249
Tc	
Tc95	4313
Tc95m	4314
Tc96	4316
Tc97	4319
Tc97m	4320
Tc98	4322
Tc99	4325
Ru	
Ru96	4425
Ru97	4428
Ru98	4431
Ru99	4434
Ru100	4437
Ru101	4440
Ru102	4443
Ru103	4446
Ru104	4449
Ru105	4452
Ru106	4455
Rh	
Rh99	4513
Rh99m	4514
Rh100	4516
Rh101	4519
Rh101m	4520
Rh102	4522
Rh102m	4523
Rh103	4525
Rh105	4531
Pd	
Pd100	4619
Pd101	4622
Pd102	4625
Pd103	4628
Pd104	4631
Pd105	4634
Pd106	4637
Pd107	4640
Pd108	4643
Pd109	4646
Pd110	4649
Pd112	4655
Ag	
Ag105	4719
Ag106m	4723
Ag107	4725
Ag108m	4729
Ag109	4731
Ag110m	4735
Ag111	4737
Cd	
Cd106	4825
Cd108	4831
Cd109	4834
Cd110	4837
Cd111	4840
Cd112	4843
Cd113	4846
Cd113m	4847
Cd114	4849
Cd115	4852
Cd115m	4853
Cd116	4855
In	
In111	4919
In113	4925
In114m	4929
In115	4931
Sn	
Sn112	5025
Sn113	5028
Sn114	5031
Sn115	5034
Sn116	5037
Sn117	5040
Sn117m	5041
Sn118	5043
Sn119	5046
Sn119m	5047
Sn120	5049
Sn121	5052
Sn121m	5053
Sn122	5055
Sn123	5058
Sn124	5061
Sn125	5064
Sn126	5067
Sb	
Sb119	5119
Sb120m	5123
Sb121	5125
Sb122	5128
Sb123	5131
Sb124	5134
Sb125	5137
Sb126	5140
Sb127	5143
Te	
Te118	5219
Te119	5222
Te119m	5223
Te120	5225
Te121	5228
Te121m	5229
Te122	5231
Te123	5234
Te123m	5235
Te124	5237
Te125	5240
Te125m	5241
Te126	5243
Te127	5246
Te127m	5247
Te128	5249
Te129	5252
Te129m	5253
Te130	5255
Te131m	5259
Te132	5261
I	
I123	5313
I124	5316
I125	5319
I126	5322
I127	5325
I128	5328
I129	5331
I130	5334
I131	5337
I133	5343
Xe	
Xe122	5419
Xe124	5425
Xe125	5428
Xe126	5431
Xe127	5434
Xe128	5437
Xe129	5440
Xe129m	5441
Xe130	5443
Xe131	5446
Xe131m	5447
Xe132	5449
Xe133	5452
Xe133m	5453
Xe134	5455
Xe135	5458
Xe136	5461
Cs	
Cs129	5513
Cs131	5519
Cs132	5522
Cs133	5525
Cs134	5528
Cs135	5531
Cs136	5534
Cs137	5537
Ba	
Ba128	5619
Ba129	5622
Ba130	5625
Ba131	5628
Ba132	5631
Ba133	5634
Ba133m	5635
Ba134	5637
Ba135	5640
Ba135m	5641
Ba136	5643
Ba137	5646
Ba138	5649
Ba139	5652
Ba140	5655
La	
La135	5716
La137	5722
La138	5725
La139	5728
La140	5731
La141	5734
Ce	
Ce134	5819
Ce135	5822
Ce136	5825
Ce137m	5829
Ce138	5831
Ce139	5834
Ce140	5837
Ce141	5840
Ce142	5843
Ce143	5846
Ce144	5849
Pr	
Pr141	5925
Pr142	5928
Pr143	5931
Nd	
Nd140	6019
Nd141	6022
Nd142	6025
Nd143	6028
Nd144	6031
Nd145	6034
Nd146	6037
Nd147	6040
Nd148	6043
Nd149	6046
Nd150	6049
Pm	
Pm143	6137
Pm144	6140
Pm145	6143
Pm146	6146
Pm147	6149
Pm148	6152
Pm148m	6153
Pm149	6155
Pm150	6158
Pm151	6161
Sm	
Sm144	6225
Sm145	6228
Sm146	6231
Sm147	6234
Sm148	6237
Sm149	6240
Sm150	6243
Sm151	6246
Sm152	6249
Sm153	6252
Sm154	6255
Eu	
Eu145	6307
Eu146	6310
Eu147	6313
Eu148	6316
Eu149	6319
Eu150	6322
Eu150m	6323
Eu151	6325
Eu152	6328
Eu152m	6329
Eu153	6331
Eu154	6334
Eu155	6337
Eu156	6340
Eu157	6343
Gd	
Gd146	6407
Gd147	6410
Gd148	6413
Gd149	6416
Gd150	6419
Gd151	6422
Gd152	6425
Gd153	6428
Gd154	6431
Gd155	6434
Gd156	6437
Gd157	6440
Gd158	6443
Gd159	6446
Gd160	6449
Tb	
Tb151	6501

Tb152	6504
Tb153	6507
Tb154	6510
Tb154n	6512
Tb155	6513
Tb156	6516
Tb156m	6517
Tb156n	6518
Tb157	6519
Tb158	6522
Tb159	6525
Tb160	6528
Tb161	6531
Dy	
Dy154	6619
Dy155	6622
Dy156	6625
Dy157	6628
Dy158	6631
Dy159	6634
Dy160	6637
Dy161	6640
Dy162	6643
Dy163	6646
Dy164	6649
Dy165	6652
Dy166	6655
Ho	
Ho163	6719
Ho164	6722
Ho164m	6723
Ho165	6725
Ho166	6728
Ho166m	6729
Er	
Er160	6819
Er161	6822
Er162	6825
Er164	6831
Er165	6834
Er166	6837
Er167	6840
Er168	6843
Er169	6846
Er170	6849
Er171	6852
Er172	6855
Tm	
Tm165	6913
Tm166	6916
Tm167	6919
Tm168	6922
Tm169	6925
Tm170	6928
Tm171	6931
Tm172	6934
Yb	
Yb166	7019
Yb168	7025
Yb169	7028
Yb170	7031
Yb171	7034
Yb172	7037
Yb173	7040
Yb174	7043
Yb175	7046
Yb176	7049
Lu	
Lu169	7107
Lu170	7110
Lu171	7113
Lu172	7116
Lu173	7119
Lu174	7122
Lu174m	7123
Lu175	7125
Lu176	7128
Lu177	7131
Lu177m	7132
Hf	
Hf170	7213
Hf171	7216
Hf172	7219
Hf173	7222
Hf174	7225
Hf175	7228
Hf176	7231
Hf177	7234
Hf178	7237
Hf178n	7239
Hf179	7240
Hf179n	7242
Hf180	7243
Hf180m	7244
Hf181	7246
Hf182	7249
Ta	
Ta177	7316
Ta179	7322
Ta180	7325
Ta180m	7326
Ta181	7328
Ta182	7331
Ta183	7334
W	
W178	7419
W180	7425
W181	7428
W182	7431
W183	7434
W184	7437
W185	7440
W186	7443
W187	7446
W188	7449
Re	
Re181	7513
Re182	7516
Re182m	7517
Re183	7519
Re184	7522
Re184m	7523
Re185	7525
Re186	7528
Re186m	7529
Re187	7531
Re188	7534
Re189	7537
Os	
Os182	7619
Os183	7622
Os184	7625
Os185	7628
Os186	7631
Os187	7634
Os188	7637
Os189	7640
Os190	7643
Os191	7646
Os191m	7647
Os192	7649
Os193	7652
Os194	7655
Ir	
Ir185	7707
Ir186	7710
Ir188	7716
Ir189	7719
Ir190	7722
Ir191	7725
Ir192	7728
Ir192n	7730
Ir193	7731
Ir193m	7732
Ir194	7734
Ir194m	7735
Ir196m	7741
Pt	
Pt188	7819
Pt189	7822
Pt190	7825
Pt191	7828
Pt192	7831
Pt193	7834
Pt193m	7835
Pt194	7837
Pt195	7840
Pt195m	7841
Pt196	7843
Pt197	7846
Pt198	7849
Pt200	7855
Pt202	7861
Au	
Au193	7913
Au194	7916
Au195	7919
Au196	7922
Au197	7925
Au198	7928
Au198m	7929
Au199	7931
Au200m	7935
Hg	
Hg193	8016
Hg193m	8017
Hg194	8019
Hg195	8022
Hg195m	8023
Hg196	8025
Hg197	8028
Hg197m	8029
Hg198	8031
Hg199	8034
Hg200	8037
Hg201	8040
Hg202	8043
Hg203	8046
Hg204	8049
Tl	
Tl200	8116
Tl201	8119
Tl202	8122
Tl203	8125
Tl204	8128
Tl205	8131
Pb	
Pb200	8213
Pb202	8219
Pb203	8222
Pb204	8225
Pb205	8228
Pb206	8231
Pb207	8234
Pb208	8237
Pb209	8240
Pb210	8243
Bi	
Bi203	8307
Bi205	8313
Bi206	8316
Bi207	8319
Bi208	8322
Bi209	8325
Bi210	8328
Bi210m	8329
Po	
Po206	8425
Po207	8428
Po208	8431
Po209	8434
Po210	8437
Rn	
Rn211	8625
Rn222	8658
Ra	
Ra223	8825
Ra224	8828
Ra225	8831
Ra226	8834
Ra228	8840
Ac	
Ac225	8925
Ac226	8928
Ac227	8931
Th	
Th227	9025
Th228	9028
Th229	9031
Th230	9034
Th231	9037
Th232	9040
Th234	9046
Pa	
Pa228	9122
Pa229	9125
Pa230	9128
Pa231	9131
Pa232	9134
Pa233	9137
U	
U230	9213
U231	9216
U232	9219
U233	9222
U234	9225
U235	9228
U236	9231
U237	9234
U238	9237
U240	9243
Np	
Np234	9337
Np235	9340
Np236	9343
Np237	9346
Np238	9349
Np239	9352
Pu	
Pu236	9428
Pu237	9431
Pu238	9434
Pu239	9437
Pu240	9440

Pu241 9443
Pu242 9446
Pu244 9452
Pu246 9458
Pu247 9461
Am
Am240 9540
Am241 9543
Am242 9546
Am242m 9547
Am243 9549
Cm
Cm240 9625
Cm241 9628
Cm242 9631
Cm243 9634
Cm244 9637
Cm245 9640
Cm246 9643
Cm247 9646
Cm248 9649
Cm249 9652
Cm250 9655
Bk
Bk245 9740
Bk246 9743
Bk247 9746
Bk248 9749
Bk248m 9750
Bk249 9752
Bk250 9755
Cf
Cf246 9843
Cf248 9849
Cf249 9852
Cf250 9855
Cf251 9858
Cf252 9861
Cf253 9864
Cf254 9867
Es
Es251 9911
Es252 9912
Es253 9913
Es254 9914
Es254m 9915
Es255 9916
Fm
Fm252 9933
Fm253 9934
Fm255 9936
Fm257 9938

Appendix C C-shell script

Linked to the JEFF-3.0/A MAT and Isotopes File name index the following Unix C-shell script allows the consecutive processing of the 774 isotopes of JEFF-3.0/A.

```
#!/bin/csh
#
# iso-mat.jeff-3.0a = filename-isotope MAT index
#
#                           H1      125
#                           H2      128
#                           H3      131
#                           He3     225
#                            ..........
#
set isma = (`cat iso-mat.jeff-3.0a`)
#
set nbriso = $#isma
@ nbriso/=2
#
#
set count = 1
set c1 = 1
set c2 = 2
#
#
while ($count <= $nbriso)
     echo 'NJOY-99 JEFF-3.0/A' $isma[$c1] $isma[$c2]
#
      ln -sf ../Isotopes/$isma[$c1]  tape20
#
#     Link the single isotope JEFF-3.0/A file
#     with the NJOY-99 unit for endf/b tape
#
echo 'running njoy'
cat>input <<EOF
moder
20 -21
reconr
-21 -22
'pendf $isma[$c1] JEFF-3.0/A'/
$isma[$c2]/
.001 293.6/ reconstruct pendf at 293.6 K
0/
broadr
-21 -22 -23
$isma[$c2] 2 1 0 293.6/ restart broadening
.001/ thinning tolerance
573.6 873.6/ add two new temperatures
0/
groupr
-21 -23 0 24
$isma[$c2] 17 0 4 0 1 1 1/ VIT-J 175 groups, P1, 293.6 K
'gendf $isma[$c1] JEFF-3.0/A'/
293.6/    temperature
1e+10/    sigma zero
0.1 0.0253 1.32e6 1.29e6/ micro-flux weighting options
10/ do all isotope productions using MF-8
0/
0/
moder
-23 25
acer
-21 -23 0 26 27
3 0 1 .30 0/ MCNP Ace Dosimetry data
'Dos. Ace $isma[$c1] JEFF-3.0/A'/
$isma[$c2] 293.6/
stop
EOF
```

```
     /opt/CODE/NJOY/N9981/xnjoy<input
     echo 'saving output, pendf, gendf files'
     mv tape24 gendf/$isma[$c1]g.asc
     mv tape25 pendf/$isma[$c1]p.asc
     mv tape26 ace/$isma[$c1]
     mv tape27 ace/$isma[$c1].dir
     mv output njoy-out/out$isma[$c1]
     mv input njoy-in/in$isma[$c1]
#
     rm tape*
#
  @ count++
  @ c1+=2
  @ c2+=2
end
#
#
```

Appendix D groupwise processing

The processing of evaluated nuclear data file can impact on the results of calculations using the data. Depending on certain, often ignored, input parameters and on the numerical recipes used the results may differ slightly. As an example, SAFEPAQ-II and NJOY-99.81 172 groups XMAS processing for two isotopes, ^{23}Na and ^{54}Fe, are compared. In both case the micro-flux weighting options are identical, following a thermal Maxwellian at low energy, a 1/E function at intermediate energies and a fission spectrum with a fast dropping tail at higher energies.

Comparison of the results shows excellent agreement but in the first groups of threshold reactions differences of up to a few percent occur. Such differences are not uncommon between nuclear data processing codes, particularly in energy regions where the excitation curve contains high gradients. Furthermore, NJOY-99 may change the reaction threshold following its own set of rules.

JEFF-3.0/A XMAS 172Group processing

		NJOY-99	SAFEPAQ-II	Diff. %	NJOY-99	SAFEPAQ-II	Diff. %
	Groups	**XS Ground**			**XS Metastable**		
1125			**Na23**				
(n,2n)	169	9.66226E-04	1.00868E-03	**4.21**			
	170	2.66830E-02	2.68302E-02	**0.55**			
	171	5.97306E-02	5.98661E-02	**0.23**			
	172	9.75587E-02	9.75331E-02	**-0.03**			
(n,na)	168	8.04236E-09	8.35329E-09	**3.72**			
	169	1.02138E-03	1.05420E-03	**3.11**			
	170	1.32867E-02	1.33692E-02	**0.62**			
	171	4.99188E-02	5.03675E-02	**0.89**			
	172	1.27871E-01	1.28060E-01	**0.15**			
(n,np)	167	2.24478E-03	2.32910E-03	**3.62**			
	168	3.77029E-02	3.80598E-02	**0.94**			
	169	1.42951E-01	1.43583E-01	**0.44**			
	170	2.24927E-01	2.24994E-01	**0.03**			
	171	2.39107E-01	2.38534E-01	**-0.24**			
	172	2.40283E-01	2.39713E-01	**-0.24**			
(n,nd)	172	1.71193E-04	1.79007E-04	**4.37**			
(n,nt)	172	2.37665E-06	2.51001E-06	**5.31**			
(n,g)	1	4.81423E-01	4.81700E-01	**0.06**	1.59367E+00	1.59332E+00	**-0.02**
	2	3.09933E-01	3.10126E-01	**0.06**	1.02599E+00	1.02580E+00	**-0.02**
	3	2.54359E-01	2.54517E-01	**0.06**	8.42016E-01	8.41864E-01	**-0.02**
	4	2.13553E-01	2.13686E-01	**0.06**	7.06934E-01	7.06806E-01	**-0.02**
	5	1.75783E-01	1.75892E-01	**0.06**	5.81903E-01	5.81797E-01	**-0.02**
	6	1.48559E-01	1.48650E-01	**0.06**	4.91780E-01	4.91690E-01	**-0.02**
	7	1.30998E-01	1.31079E-01	**0.06**	4.33648E-01	4.33568E-01	**-0.02**
	8	1.18474E-01	1.18547E-01	**0.06**	3.92191E-01	3.92117E-01	**-0.02**
	9	1.08963E-01	1.09030E-01	**0.06**	3.60705E-01	3.60637E-01	**-0.02**
	10	1.00189E-01	1.00251E-01	**0.06**	3.31661E-01	3.31598E-01	**-0.02**
	11	9.16843E-02	9.17402E-02	**0.06**	3.03507E-01	3.03448E-01	**-0.02**
	12	8.45996E-02	8.46510E-02	**0.06**	2.80054E-01	2.79999E-01	**-0.02**
	13	7.86500E-02	7.86975E-02	**0.06**	2.60359E-01	2.60307E-01	**-0.02**
	14	7.32854E-02	7.33295E-02	**0.06**	2.42600E-01	2.42552E-01	**-0.02**

15	7.00626E-02	7.01046E-02	**0.06**	2.31932E-01	2.31885E-01	**-0.02**
16	6.66106E-02	6.66504E-02	**0.06**	2.20504E-01	2.20459E-01	**-0.02**
17	6.28718E-02	6.29089E-02	**0.06**	2.08127E-01	2.08083E-01	**-0.02**
18	5.99469E-02	6.00921E-02	**0.24**	1.98445E-01	1.98766E-01	**0.16**
19	5.57145E-02	5.59047E-02	**0.34**	1.84434E-01	1.84915E-01	**0.26**
20	5.30202E-02	5.30670E-02	**0.09**	1.75515E-01	1.75529E-01	**0.01**
21	5.07425E-02	5.09201E-02	**0.35**	1.67975E-01	1.68428E-01	**0.27**
22	4.76541E-02	4.78115E-02	**0.33**	1.57751E-01	1.58146E-01	**0.25**
23	4.57116E-02	4.57631E-02	**0.11**	1.51321E-01	1.51370E-01	**0.03**
24	4.34763E-02	4.37511E-02	**0.63**	1.43922E-01	1.44715E-01	**0.55**
25	4.06171E-02	4.06418E-02	**0.06**	1.34457E-01	1.34431E-01	**-0.02**
26	3.82369E-02	3.82601E-02	**0.06**	1.26577E-01	1.26553E-01	**-0.02**
27	3.64602E-02	3.64823E-02	**0.06**	1.20696E-01	1.20672E-01	**-0.02**
28	3.54157E-02	3.54372E-02	**0.06**	1.17238E-01	1.17215E-01	**-0.02**
29	3.48501E-02	3.48713E-02	**0.06**	1.15366E-01	1.15344E-01	**-0.02**
30	3.39383E-02	3.39589E-02	**0.06**	1.12348E-01	1.12326E-01	**-0.02**
31	3.22792E-02	3.22988E-02	**0.06**	1.06855E-01	1.06834E-01	**-0.02**
32	3.12177E-02	3.12367E-02	**0.06**	1.03342E-01	1.03322E-01	**-0.02**
33	3.04315E-02	3.04500E-02	**0.06**	1.00739E-01	1.00719E-01	**-0.02**
34	2.90034E-02	2.90210E-02	**0.06**	9.60112E-02	9.59926E-02	**-0.02**
35	2.79712E-02	2.79882E-02	**0.06**	9.25943E-02	9.25763E-02	**-0.02**
36	2.72350E-02	2.72515E-02	**0.06**	9.01571E-02	9.01396E-02	**-0.02**
37	2.57609E-02	2.57766E-02	**0.06**	8.52775E-02	8.52610E-02	**-0.02**
38	2.41068E-02	2.41214E-02	**0.06**	7.98018E-02	7.97863E-02	**-0.02**
39	2.28050E-02	2.28188E-02	**0.06**	7.54922E-02	7.54776E-02	**-0.02**
40	2.21616E-02	2.21751E-02	**0.06**	7.33625E-02	7.33484E-02	**-0.02**
41	2.16935E-02	2.17067E-02	**0.06**	7.18130E-02	7.17990E-02	**-0.02**
42	2.12354E-02	2.12483E-02	**0.06**	7.02964E-02	7.02829E-02	**-0.02**
43	2.08821E-02	2.08948E-02	**0.06**	6.91270E-02	6.91136E-02	**-0.02**
44	2.04669E-02	2.04794E-02	**0.06**	6.77526E-02	6.77395E-02	**-0.02**
45	2.02536E-02	2.02659E-02	**0.06**	6.70463E-02	6.70333E-02	**-0.02**
46	2.00348E-02	2.00470E-02	**0.06**	6.63221E-02	6.63093E-02	**-0.02**
47	1.98470E-02	1.98590E-02	**0.06**	6.57003E-02	6.56876E-02	**-0.02**
48	1.97219E-02	1.97338E-02	**0.06**	6.52861E-02	6.52735E-02	**-0.02**
49	1.95544E-02	1.95664E-02	**0.06**	6.47319E-02	6.47195E-02	**-0.02**
50	1.93749E-02	1.93867E-02	**0.06**	6.41376E-02	6.41252E-02	**-0.02**
51	1.92604E-02	1.92720E-02	**0.06**	6.37584E-02	6.37460E-02	**-0.02**
52	1.90959E-02	1.91075E-02	**0.06**	6.32140E-02	6.32018E-02	**-0.02**
53	1.88579E-02	1.88694E-02	**0.06**	6.24262E-02	6.24141E-02	**-0.02**
54	1.86896E-02	1.87009E-02	**0.06**	6.18689E-02	6.18569E-02	**-0.02**
55	1.85856E-02	1.85876E-02	**0.01**	6.15248E-02	6.14820E-02	**-0.07**
56	1.84261E-02	1.84278E-02	**0.01**	6.09966E-02	6.09535E-02	**-0.07**
57	1.82380E-02	1.82491E-02	**0.06**	6.03740E-02	6.03623E-02	**-0.02**
58	1.79126E-02	1.79235E-02	**0.06**	5.92970E-02	5.92855E-02	**-0.02**
59	1.74522E-02	1.74628E-02	**0.06**	5.77728E-02	5.77617E-02	**-0.02**
60	1.71106E-02	1.71210E-02	**0.06**	5.66419E-02	5.66309E-02	**-0.02**
61	1.68928E-02	1.69031E-02	**0.06**	5.59209E-02	5.59101E-02	**-0.02**
62	1.65776E-02	1.65734E-02	**-0.03**	5.48776E-02	5.48198E-02	**-0.11**
63	1.62765E-02	1.62727E-02	**-0.02**	5.38807E-02	5.38251E-02	**-0.10**
64	1.61130E-02	1.61228E-02	**0.06**	5.33397E-02	5.33294E-02	**-0.02**
65	1.58091E-02	1.58187E-02	**0.06**	5.23337E-02	5.23235E-02	**-0.02**
66	1.53937E-02	1.54030E-02	**0.06**	5.09583E-02	5.09484E-02	**-0.02**
67	1.50164E-02	1.50256E-02	**0.06**	4.97096E-02	4.97000E-02	**-0.02**
68	1.46590E-02	1.46679E-02	**0.06**	4.85262E-02	4.85168E-02	**-0.02**
69	1.43136E-02	1.43223E-02	**0.06**	4.73830E-02	4.73738E-02	**-0.02**
70	1.39827E-02	1.39912E-02	**0.06**	4.62876E-02	4.62786E-02	**-0.02**

71	1.36946E-02	1.37029E-02	**0.06**	4.53338E-02	4.53250E-02	**-0.02**
72	1.35157E-02	1.35239E-02	**0.06**	4.47415E-02	4.47329E-02	**-0.02**
73	1.31264E-02	1.31344E-02	**0.06**	4.34528E-02	4.34444E-02	**-0.02**
74	1.25489E-02	1.25565E-02	**0.06**	4.15412E-02	4.15331E-02	**-0.02**
75	1.22461E-02	1.22536E-02	**0.06**	4.05388E-02	4.05310E-02	**-0.02**
76	1.20576E-02	1.20650E-02	**0.06**	3.99149E-02	3.99072E-02	**-0.02**
77	1.18741E-02	1.18813E-02	**0.06**	3.93074E-02	3.92998E-02	**-0.02**
78	1.13174E-02	1.13243E-02	**0.06**	3.74644E-02	3.74572E-02	**-0.02**
79	1.07609E-02	1.07675E-02	**0.06**	3.56223E-02	3.56155E-02	**-0.02**
80	1.02627E-02	1.02689E-02	**0.06**	3.39730E-02	3.39664E-02	**-0.02**
81	9.76058E-03	9.76651E-03	**0.06**	3.23109E-02	3.23046E-02	**-0.02**
82	9.21839E-03	9.22399E-03	**0.06**	3.05160E-02	3.05101E-02	**-0.02**
83	8.64144E-03	8.64670E-03	**0.06**	2.86062E-02	2.86006E-02	**-0.02**
84	8.22830E-03	8.23329E-03	**0.06**	2.72385E-02	2.72332E-02	**-0.02**
85	7.56039E-03	7.56499E-03	**0.06**	2.50275E-02	2.50226E-02	**-0.02**
86	7.01628E-03	7.02054E-03	**0.06**	2.32263E-02	2.32218E-02	**-0.02**
87	6.67823E-03	6.68229E-03	**0.06**	2.21072E-02	2.21029E-02	**-0.02**
88	6.39457E-03	6.39846E-03	**0.06**	2.11682E-02	2.11641E-02	**-0.02**
89	6.09020E-03	6.09390E-03	**0.06**	2.01607E-02	2.01567E-02	**-0.02**
90	5.62384E-03	5.62725E-03	**0.06**	1.86168E-02	1.86132E-02	**-0.02**
91	5.15919E-03	5.16232E-03	**0.06**	1.70787E-02	1.70754E-02	**-0.02**
92	4.73655E-03	4.73943E-03	**0.06**	1.56796E-02	1.56766E-02	**-0.02**
93	4.34960E-03	4.35225E-03	**0.06**	1.43987E-02	1.43959E-02	**-0.02**
94	4.09399E-03	4.09648E-03	**0.06**	1.35525E-02	1.35499E-02	**-0.02**
95	3.90158E-03	3.90395E-03	**0.06**	1.29156E-02	1.29131E-02	**-0.02**
96	3.71810E-03	3.72036E-03	**0.06**	1.23082E-02	1.23058E-02	**-0.02**
97	3.54355E-03	3.54571E-03	**0.06**	1.17304E-02	1.17281E-02	**-0.02**
98	3.37862E-03	3.38068E-03	**0.06**	1.11844E-02	1.11822E-02	**-0.02**
99	3.24116E-03	3.24313E-03	**0.06**	1.07294E-02	1.07273E-02	**-0.02**
100	3.09301E-03	3.09489E-03	**0.06**	1.02389E-02	1.02369E-02	**-0.02**
101	2.96193E-03	2.96373E-03	**0.06**	9.80501E-03	9.80312E-03	**-0.02**
102	2.87865E-03	2.88040E-03	**0.06**	9.52933E-03	9.52749E-03	**-0.02**
103	2.78512E-03	2.78681E-03	**0.06**	9.21970E-03	9.21792E-03	**-0.02**
104	2.61504E-03	2.61663E-03	**0.06**	8.65668E-03	8.65501E-03	**-0.02**
105	2.43787E-03	2.43936E-03	**0.06**	8.07019E-03	8.06864E-03	**-0.02**
106	2.28274E-03	2.28413E-03	**0.06**	7.55665E-03	7.55520E-03	**-0.02**
107	2.01151E-03	2.01274E-03	**0.06**	6.65879E-03	6.65751E-03	**-0.02**
108	1.81944E-03	1.82055E-03	**0.06**	6.02296E-03	6.02181E-03	**-0.02**
109	1.68758E-03	1.68861E-03	**0.06**	5.58647E-03	5.58540E-03	**-0.02**
110	1.49331E-03	1.49421E-03	**0.06**	4.94334E-03	4.94240E-03	**-0.02**
111	1.37359E-03	1.37442E-03	**0.06**	4.54703E-03	4.54617E-03	**-0.02**
112	1.31926E-03	1.32007E-03	**0.06**	4.36719E-03	4.36637E-03	**-0.02**
113	1.28492E-03	1.28570E-03	**0.06**	4.25348E-03	4.25270E-03	**-0.02**
114	1.30068E-03	1.30147E-03	**0.06**	4.30566E-03	4.30488E-03	**-0.02**
115	1.34876E-03	1.34958E-03	**0.06**	4.46480E-03	4.46401E-03	**-0.02**
116	1.43108E-03	1.43196E-03	**0.06**	4.73730E-03	4.73647E-03	**-0.02**
117	1.57965E-03	1.58062E-03	**0.06**	5.22911E-03	5.22821E-03	**-0.02**
118	1.87593E-03	1.87710E-03	**0.06**	6.20986E-03	6.20887E-03	**-0.02**
119	2.14946E-03	2.15080E-03	**0.06**	7.11530E-03	7.11419E-03	**-0.02**
120	3.25247E-03	3.25452E-03	**0.06**	1.07665E-02	1.07650E-02	**-0.01**
121	6.49960E-03	6.50384E-03	**0.07**	2.15152E-02	2.15127E-02	**-0.01**
122	3.13874E-02	3.14059E-02	**0.06**	1.03899E-01	1.03881E-01	**-0.02**
123	6.88517E-03	6.88870E-03	**0.05**	2.27911E-02	2.27857E-02	**-0.02**
124	1.74530E-03	1.74614E-03	**0.05**	5.77720E-03	5.77570E-03	**-0.03**
125	3.77212E-04	3.77401E-04	**0.05**	1.24861E-03	1.24833E-03	**-0.02**
126	1.67723E-04	1.67806E-04	**0.05**	5.55170E-04	5.55049E-04	**-0.02**

	127	1.02239E-03	1.02294E-03	**0.05**	3.38408E-03	3.38357E-03	**-0.02**
	128	3.26909E-05	3.27057E-05	**0.05**	1.08202E-04	1.08180E-04	**-0.02**
	129	1.61324E-05	1.61386E-05	**0.04**	5.33938E-05	5.33816E-05	**-0.02**
	130	9.56561E-06	9.56945E-06	**0.04**	3.16581E-05	3.16528E-05	**-0.02**
	131	6.23214E-06	6.23442E-06	**0.04**	2.06244E-05	2.06215E-05	**-0.01**
	132	4.90503E-06	4.90660E-06	**0.03**	1.62311E-05	1.62295E-05	**-0.01**
	133	5.00603E-06	5.00755E-06	**0.03**	1.65648E-05	1.65634E-05	**-0.01**
	134	1.00858E-03	1.00884E-03	**0.03**	3.33699E-03	3.33694E-03	**0.00**
	135	1.07988E-05	1.08013E-05	**0.02**	3.57273E-05	3.57273E-05	**0.00**
	136	6.64272E-04	6.64295E-04	**0.00**	2.19726E-03	2.19728E-03	**0.00**
	137	7.23658E-05	7.23622E-05	**0.00**	2.39351E-04	2.39352E-04	**0.00**
	138	7.05559E-06	7.05343E-06	**-0.03**	2.33312E-05	2.33306E-05	**0.00**
	139	3.23181E-06	3.23024E-06	**-0.05**	1.06834E-05	1.06846E-05	**0.01**
	140	4.60790E-05	4.48771E-05	**-2.68**	1.52281E-04	1.48440E-04	**-2.59**
	141	1.52086E-04	1.50883E-04	**-0.80**	5.02420E-04	4.99076E-04	**-0.67**
	142	2.33770E-04	2.33340E-04	**-0.18**	7.71401E-04	7.71816E-04	**0.05**
	143	2.22027E-05	2.21524E-05	**-0.23**	7.32215E-05	7.32732E-05	**0.07**
	144	1.90271E-04	1.89742E-04	**-0.28**	6.27096E-04	6.27608E-04	**0.08**
	145	6.43495E-05	6.42838E-05	**-0.10**	2.11642E-04	2.11661E-04	**0.01**
	146	1.09737E-04	1.09704E-04	**-0.03**	3.57594E-04	3.57779E-04	**0.05**
	147	9.29463E-05	9.27946E-05	**-0.16**	3.00058E-04	3.00247E-04	**0.06**
	148	6.92870E-05	6.92311E-05	**-0.08**	2.21928E-04	2.21978E-04	**0.02**
	149	6.15276E-05	6.15944E-05	**0.11**	1.95643E-04	1.95571E-04	**-0.04**
	150	5.15154E-05	5.14874E-05	**-0.05**	1.59847E-04	1.59872E-04	**0.02**
	151	4.49709E-05	4.48658E-05	**-0.23**	1.35501E-04	1.35517E-04	**0.01**
	152	4.20333E-05	4.19862E-05	**-0.11**	1.24921E-04	1.24861E-04	**-0.05**
	153	3.98723E-05	3.98991E-05	**0.07**	1.16671E-04	1.16610E-04	**-0.05**
	154	3.91597E-05	3.91362E-05	**-0.06**	1.12245E-04	1.12246E-04	**0.00**
	155	4.03732E-05	4.03728E-05	**0.00**	1.13341E-04	1.13366E-04	**0.02**
	156	4.32269E-05	4.32105E-05	**-0.04**	1.17157E-04	1.17179E-04	**0.02**
	157	4.70177E-05	4.69982E-05	**-0.04**	1.20745E-04	1.20774E-04	**0.02**
	158	5.02810E-05	5.02551E-05	**-0.05**	1.23293E-04	1.23317E-04	**0.02**
	159	4.78140E-05	4.77623E-05	**-0.11**	1.13198E-04	1.13240E-04	**0.04**
	160	4.72552E-05	4.72395E-05	**-0.03**	1.05701E-04	1.05699E-04	**0.00**
	161	4.68456E-05	4.68269E-05	**-0.04**	9.57635E-05	9.57815E-05	**0.02**
	162	5.30543E-05	5.30456E-05	**-0.02**	9.75888E-05	9.76153E-05	**0.03**
	163	6.24336E-05	6.24743E-05	**0.07**	1.01296E-04	1.01348E-04	**0.05**
	164	7.82179E-05	7.81916E-05	**-0.03**	1.13664E-04	1.13736E-04	**0.06**
	165	8.86908E-05	8.87103E-05	**0.02**	1.19131E-04	1.19136E-04	**0.00**
	166	9.97240E-05	9.98211E-05	**0.10**	1.18236E-04	1.18122E-04	**-0.10**
	167	1.12456E-04	1.12489E-04	**0.03**	1.08626E-04	1.08447E-04	**-0.17**
	168	1.25703E-04	1.25742E-04	**0.03**	9.65696E-05	9.64543E-05	**-0.12**
	169	1.46571E-04	1.46619E-04	**0.03**	8.84579E-05	8.81546E-05	**-0.34**
	170	1.73631E-04	1.73648E-04	**0.01**	8.10424E-05	8.10636E-05	**0.03**
	171	1.96862E-04	1.96659E-04	**-0.10**	8.84452E-05	8.83540E-05	**-0.10**
	172	2.22536E-04	2.21974E-04	**-0.25**	9.99797E-05	9.97273E-05	**-0.25**
(n,p)	162	2.32597E-04	2.35046E-04	**1.04**			
	163	2.93190E-03	2.95533E-03	**0.79**			
	164	1.77625E-02	1.78084E-02	**0.26**			
	165	3.58700E-02	3.58426E-02	**-0.08**			
	166	4.36048E-02	4.37232E-02	**0.27**			
	167	5.61389E-02	5.61815E-02	**0.08**			
	168	7.80068E-02	7.77706E-02	**-0.30**			
	169	5.42763E-02	5.40328E-02	**-0.45**			
	170	3.74202E-02	3.73863E-02	**-0.09**			

	171	2.94502E-02	2.93016E-02	**-0.51**
	172	2.13373E-02	2.12492E-02	**-0.41**
(n,d)	166	1.65410E-04	1.68901E-04	**2.07**
	167	1.55488E-03	1.56132E-03	**0.41**
	168	3.89700E-03	3.90885E-03	**0.30**
	169	6.60747E-03	6.61698E-03	**0.14**
	170	9.52726E-03	9.53623E-03	**0.09**
	171	1.23369E-02	1.23323E-02	**-0.04**
	172	1.54808E-02	1.54630E-02	**-0.12**
(n,t)	168	1.49859E-06	1.57514E-06	**4.86**
	169	7.86808E-04	8.09837E-04	**2.84**
	170	5.21852E-03	5.23026E-03	**0.22**
	171	8.22682E-03	8.23459E-03	**0.09**
	172	1.17377E-02	1.17340E-02	**-0.03**
(n,h)	171	8.98721E-09	1.00282E-08	**10.38**
	172	5.11369E-06	5.30546E-06	**3.61**
(n,a)	162	4.66589E-05	4.71754E-05	**1.09**
	163	3.81960E-04	3.83193E-04	**0.32**
	164	7.28835E-04	7.29376E-04	**0.07**
	165	1.36521E-03	1.37073E-03	**0.40**
	166	1.52468E-02	1.53977E-02	**0.98**
	167	6.17741E-02	6.20551E-02	**0.45**
	168	1.18924E-01	1.19109E-01	**0.16**
	169	1.50002E-01	1.49817E-01	**-0.12**
	170	1.50372E-01	1.50312E-01	**-0.04**
	171	1.27845E-01	1.27184E-01	**-0.52**
	172	7.84759E-02	7.79469E-02	**-0.68**

		NJOY-99	SAFEPAQ-II	Diff. %	NJOY-99	SAFEPAQ-II	Diff. %
	Groups	XS Ground			XS Metastable		
2625			Fe54				
(n,2n)	169	8.88932E-06	9.35399E-06	**4.97**			
	170	2.86211E-03	2.89229E-03	**1.04**			
	171	2.60038E-02	2.62949E-02	**1.11**	9.57528E-04	1.00323E-03	**4.56**
	172	7.35334E-02	7.35422E-02	**0.01**	1.34884E-02	1.34900E-02	**0.01**
(n,na)	168	2.32258E-09	2.46550E-09	**5.80**			
	169	2.09912E-05	2.17068E-05	**3.30**			
	170	6.77457E-04	6.83673E-04	**0.91**			
	171	8.35497E-03	8.49549E-03	**1.65**			
	172	4.32545E-02	4.34182E-02	**0.38**			
(n,np)	167	9.39541E-06	9.74823E-06	**3.62**			
	168	1.66220E-02	1.69598E-02	**1.99**			
	169	1.31113E-01	1.31943E-01	**0.63**			
	170	2.50125E-01	2.50306E-01	**0.07**			
	171	2.99102E-01	2.98656E-01	**-0.15**			
	172	3.30103E-01	3.29436E-01	**-0.20**			
(n,g)	1	8.79201E+00	8.79166E+00	**0.00**			
	2	5.66016E+00	5.66019E+00	**0.00**			
	3	4.64518E+00	4.64521E+00	**0.00**			
	4	3.90039E+00	3.90041E+00	**0.00**			
	5	3.21062E+00	3.21063E+00	**0.00**			
	6	2.71328E+00	2.71329E+00	**0.00**			
	7	2.39247E+00	2.39247E+00	**0.00**			
	8	2.16381E+00	2.16377E+00	**0.00**			
	9	1.99018E+00	1.98998E+00	**-0.01**			
	10	1.82961E+00	1.82960E+00	**0.00**			
	11	1.67428E+00	1.67426E+00	**0.00**			
	12	1.54504E+00	1.54502E+00	**0.00**			
	13	1.43641E+00	1.43639E+00	**0.00**			
	14	1.33833E+00	1.33832E+00	**0.00**			
	15	1.27940E+00	1.27938E+00	**0.00**			
	16	1.21636E+00	1.21634E+00	**0.00**			
	17	1.14819E+00	1.14816E+00	**0.00**			
	18	1.09484E+00	1.09682E+00	**0.18**			
	19	1.01752E+00	1.02037E+00	**0.28**			
	20	9.68244E-01	9.68502E-01	**0.03**			
	21	9.26545E-01	9.29224E-01	**0.29**			
	22	8.70084E-01	8.72419E-01	**0.27**			
	23	8.34703E-01	8.35127E-01	**0.05**			
	24	7.93995E-01	7.98516E-01	**0.57**			
	25	7.41774E-01	7.41768E-01	**0.00**			
	26	6.98268E-01	6.98262E-01	**0.00**			
	27	6.65768E-01	6.65763E-01	**0.00**			
	28	6.46637E-01	6.46632E-01	**0.00**			
	29	6.36266E-01	6.36261E-01	**0.00**			
	30	6.19566E-01	6.19561E-01	**0.00**			
	31	5.89300E-01	5.89295E-01	**0.00**			

32	5.70018E-01	5.70014E-01	**0.00**
33	5.55699E-01	5.55695E-01	**0.00**
34	5.29615E-01	5.29611E-01	**0.00**
35	5.10747E-01	5.10743E-01	**0.00**
36	4.97289E-01	4.97285E-01	**0.00**
37	4.70306E-01	4.70303E-01	**0.00**
38	4.39968E-01	4.39964E-01	**0.00**
39	4.16286E-01	4.16283E-01	**0.00**
40	4.04633E-01	4.04630E-01	**0.00**
41	3.96073E-01	3.96070E-01	**0.00**
42	3.87695E-01	3.87693E-01	**0.00**
43	3.81235E-01	3.81232E-01	**0.00**
44	3.73643E-01	3.73640E-01	**0.00**
45	3.69742E-01	3.69739E-01	**0.00**
46	3.65742E-01	3.65739E-01	**0.00**
47	3.62307E-01	3.62305E-01	**0.00**
48	3.60019E-01	3.60017E-01	**0.00**
49	3.56958E-01	3.56956E-01	**0.00**
50	3.53676E-01	3.53673E-01	**0.00**
51	3.51582E-01	3.51579E-01	**0.00**
52	3.48575E-01	3.48572E-01	**0.00**
53	3.44224E-01	3.44221E-01	**0.00**
54	3.41141E-01	3.41138E-01	**0.00**
55	3.39234E-01	3.39060E-01	**-0.05**
56	3.36306E-01	3.36130E-01	**-0.05**
57	3.32855E-01	3.32853E-01	**0.00**
58	3.26879E-01	3.26876E-01	**0.00**
59	3.18398E-01	3.18395E-01	**0.00**
60	3.12129E-01	3.12127E-01	**0.00**
61	3.08155E-01	3.08153E-01	**0.00**
62	3.02404E-01	3.02142E-01	**-0.09**
63	2.96910E-01	2.96659E-01	**-0.08**
64	2.93929E-01	2.93927E-01	**0.00**
65	2.88395E-01	2.88393E-01	**0.00**
66	2.80885E-01	2.80882E-01	**0.00**
67	2.74044E-01	2.74042E-01	**0.00**
68	2.67503E-01	2.67501E-01	**0.00**
69	2.61182E-01	2.61180E-01	**0.00**
70	2.55126E-01	2.55124E-01	**0.00**
71	2.49851E-01	2.49849E-01	**0.00**
72	2.46575E-01	2.46573E-01	**0.00**
73	2.39447E-01	2.39445E-01	**0.00**
74	2.28875E-01	2.28873E-01	**0.00**
75	2.23333E-01	2.23332E-01	**0.00**
76	2.19860E-01	2.19858E-01	**0.00**
77	2.16473E-01	2.16471E-01	**0.00**
78	2.06303E-01	2.06301E-01	**0.00**
79	1.96309E-01	1.96308E-01	**0.00**
80	1.87042E-01	1.87040E-01	**0.00**
81	1.77834E-01	1.77833E-01	**0.00**
82	1.67981E-01	1.67938E-01	**-0.03**
83	1.57382E-01	1.57381E-01	**0.00**
84	1.49741E-01	1.49740E-01	**0.00**
85	1.37534E-01	1.37533E-01	**0.00**
86	1.27559E-01	1.27558E-01	**0.00**
87	1.21377E-01	1.21376E-01	**0.00**

88	1.16188E-01	1.16187E-01	**0.00**
89	1.10542E-01	1.10541E-01	**0.00**
90	1.01966E-01	1.01965E-01	**0.00**
91	9.34317E-02	9.34309E-02	**0.00**
92	8.56636E-02	8.56629E-02	**0.00**
93	7.85070E-02	7.85064E-02	**0.00**
94	7.37681E-02	7.37675E-02	**0.00**
95	7.01921E-02	7.01915E-02	**0.00**
96	6.68374E-02	6.68310E-02	**-0.01**
97	6.35726E-02	6.35609E-02	**-0.02**
98	6.05054E-02	6.05050E-02	**0.00**
99	5.79382E-02	5.79378E-02	**0.00**
100	5.51481E-02	5.51477E-02	**0.00**
101	5.26947E-02	5.26944E-02	**0.00**
102	5.10945E-02	5.10941E-02	**0.00**
103	4.93480E-02	4.93477E-02	**0.00**
104	4.61488E-02	4.61484E-02	**0.00**
105	4.27732E-02	4.27729E-02	**0.00**
106	3.97565E-02	3.97562E-02	**0.00**
107	3.44785E-02	3.44783E-02	**0.00**
108	3.06445E-02	3.06443E-02	**0.00**
109	2.78910E-02	2.78908E-02	**0.00**
110	2.35978E-02	2.35976E-02	**0.00**
111	2.05634E-02	2.05633E-02	**0.00**
112	1.88222E-02	1.88221E-02	**0.00**
113	1.66168E-02	1.66167E-02	**0.00**
114	1.50387E-02	1.50386E-02	**0.00**
115	1.42440E-02	1.42440E-02	**0.00**
116	1.35409E-02	1.35408E-02	**0.00**
117	1.29544E-02	1.29543E-02	**0.00**
118	1.23946E-02	1.23945E-02	**0.00**
119	1.21406E-02	1.21406E-02	**0.00**
120	1.18907E-02	1.18902E-02	**0.00**
121	1.18291E-02	1.18291E-02	**0.00**
122	1.25758E-02	1.25759E-02	**0.00**
123	1.41497E-02	1.41499E-02	**0.00**
124	1.85398E-02	1.85402E-02	**0.00**
125	3.01423E-02	3.01435E-02	**0.00**
126	1.14582E-01	1.14593E-01	**0.01**
127	2.47167E-01	2.47155E-01	**0.00**
128	1.34218E-01	1.34216E-01	**0.00**
129	1.08935E-01	1.08941E-01	**0.01**
130	2.44248E-03	2.44235E-03	**-0.01**
131	1.33109E-03	1.33102E-03	**-0.01**
132	8.54913E-04	8.54902E-04	**0.00**
133	8.04963E-04	8.04963E-04	**0.00**
134	1.76971E-02	1.76979E-02	**0.00**
135	1.61302E-02	1.61309E-02	**0.00**
136	1.38641E-02	1.38368E-02	**-0.20**
137	6.88949E-03	6.88932E-03	**0.00**
138	1.39804E-02	1.38672E-02	**-0.82**
139	6.78910E-03	6.77337E-03	**-0.23**
140	1.14160E-02	1.13281E-02	**-0.78**
141	1.60091E-02	1.59786E-02	**-0.19**
142	1.58611E-02	1.56811E-02	**-1.15**
143	1.49476E-02	1.42799E-02	**-4.68**

	144	4.27010E-03	4.11753E-03	**-3.71**
	145	7.39684E-03	7.11970E-03	**-3.89**
	146	7.58482E-03	7.38963E-03	**-2.64**
	147	6.99063E-03	6.40945E-03	**-9.07**
	148	7.31357E-03	7.00108E-03	**-4.46**
	149	7.28901E-03	7.05832E-03	**-3.27**
	150	6.37620E-03	6.20759E-03	**-2.72**
	151	4.67737E-03	4.66914E-03	**-0.18**
	152	3.49757E-03	3.48918E-03	**-0.24**
	153	2.89263E-03	2.89254E-03	**0.00**
	154	2.87728E-03	2.87720E-03	**0.00**
	155	2.86031E-03	2.86024E-03	**0.00**
	156	2.19109E-03	2.18991E-03	**-0.05**
	157	1.72164E-03	1.72141E-03	**-0.01**
	158	1.56356E-03	1.56348E-03	**-0.01**
	159	1.44317E-03	1.44307E-03	**-0.01**
	160	1.23895E-03	1.23846E-03	**-0.04**
	161	1.01589E-03	1.01558E-03	**-0.03**
	162	8.63646E-04	8.63317E-04	**-0.04**
	163	7.63218E-04	7.62949E-04	**-0.04**
	164	7.15913E-04	7.15864E-04	**-0.01**
	165	6.88790E-04	6.88717E-04	**-0.01**
	166	6.56588E-04	6.56335E-04	**-0.04**
	167	6.34932E-04	6.34461E-04	**-0.07**
	168	6.40781E-04	6.40623E-04	**-0.02**
	169	7.00238E-04	6.99795E-04	**-0.06**
	170	8.18063E-04	8.18335E-04	**0.03**
	171	9.20179E-04	9.19382E-04	**-0.09**
	172	9.82897E-04	9.80521E-04	**-0.24**
(n,p)	1	1.00000E-10	1.00000E-10	**0.00**
	…	1.00000E-10	1.00000E-10	**0.00**
	154	1.00000E-10	1.00000E-10	**0.00**
	155	4.78514E-04	4.81522E-04	**0.62**
	156	1.85128E-03	1.85506E-03	**0.20**
	157	1.20684E-02	1.20892E-02	**0.17**
	158	3.08478E-02	3.08596E-02	**0.04**
	159	4.90701E-02	4.90860E-02	**0.03**
	160	9.30100E-02	9.31423E-02	**0.14**
	161	1.91667E-01	1.91895E-01	**0.12**
	162	2.73686E-01	2.73935E-01	**0.09**
	163	3.97995E-01	3.98388E-01	**0.10**
	164	4.85260E-01	4.85323E-01	**0.01**
	165	5.01073E-01	5.01085E-01	**0.00**
	166	5.21564E-01	5.21549E-01	**0.00**
	167	5.30000E-01	5.29627E-01	**-0.07**
	168	5.34660E-01	5.34438E-01	**-0.04**
	169	4.84011E-01	4.82210E-01	**-0.37**
	170	3.36258E-01	3.35911E-01	**-0.10**
	171	2.36958E-01	2.35573E-01	**-0.59**
	172	1.50328E-01	1.49673E-01	**-0.44**
(n,d)	166	1.00992E-07	1.04751E-07	**3.59**
	167	2.25180E-04	2.31189E-04	**2.60**
	168	2.85950E-03	2.87483E-03	**0.53**
	169	5.83742E-03	5.85374E-03	**0.28**

	170	9.58678E-03	9.59473E-03	**0.08**			
	171	1.31502E-02	1.31609E-02	**0.08**			
	172	2.11489E-02	2.11600E-02	**0.05**			
(n,t)	169	1.54698E-07	1.62184E-07	**4.62**	2.71331E-08	2.85423E-08	**4.94**
	170	3.52592E-05	3.55900E-05	**0.93**	1.68136E-05	1.70056E-05	**1.13**
	171	3.52614E-04	3.55354E-04	**0.77**	3.89861E-04	3.94247E-04	**1.11**
	172	6.08444E-04	6.07926E-04	**-0.09**	8.16888E-04	8.16634E-04	**-0.03**
(n,h)	166	2.41778E-09	2.51459E-09	**3.85**			
	167	1.01144E-07	1.01803E-07	**0.65**			
	168	2.67422E-07	2.68033E-07	**0.23**			
	169	6.12767E-07	6.20395E-07	**1.23**			
	170	4.17061E-06	4.18937E-06	**0.45**			
	171	1.56775E-05	1.58302E-05	**0.96**			
	172	5.46306E-05	5.48131E-05	**0.33**			
(n,a)	1	3.90420E-05	3.90235E-05	**-0.05**			
	2	2.51359E-05	2.51244E-05	**-0.05**			
	3	2.06287E-05	2.06192E-05	**-0.05**			
	4	1.73194E-05	1.73113E-05	**-0.05**			
	5	1.42563E-05	1.42497E-05	**-0.05**			
	6	1.20475E-05	1.20418E-05	**-0.05**			
	7	1.06228E-05	1.06179E-05	**-0.05**			
	8	9.60746E-06	9.60273E-06	**-0.05**			
	9	8.83598E-06	8.83205E-06	**-0.04**			
	10	8.12443E-06	8.12065E-06	**-0.05**			
	11	7.43454E-06	7.43087E-06	**-0.05**			
	12	6.86009E-06	6.85665E-06	**-0.05**			
	13	6.37781E-06	6.37461E-06	**-0.05**			
	14	5.94277E-06	5.94018E-06	**-0.04**			
	15	5.68126E-06	5.67807E-06	**-0.06**			
	16	5.40110E-06	5.39834E-06	**-0.05**			
	17	5.09779E-06	5.09599E-06	**-0.04**			
	18	4.86073E-06	4.86699E-06	**0.13**			
	19	4.51776E-06	4.52831E-06	**0.23**			
	20	4.29928E-06	4.29912E-06	**0.00**			
	21	4.11431E-06	4.12412E-06	**0.24**			
	22	3.86348E-06	3.87210E-06	**0.22**			
	23	3.70591E-06	3.70565E-06	**-0.01**			
	24	3.52482E-06	3.54340E-06	**0.52**			
	25	3.29324E-06	3.29160E-06	**-0.05**			
	26	3.10038E-06	3.09902E-06	**-0.04**			
	27	2.95625E-06	2.95469E-06	**-0.05**			
	28	2.87138E-06	2.87002E-06	**-0.05**			
	29	2.82537E-06	2.82403E-06	**-0.05**			
	30	2.75124E-06	2.74974E-06	**-0.05**			
	31	2.61655E-06	2.61550E-06	**-0.04**			
	32	2.53056E-06	2.52932E-06	**-0.05**			
	33	2.46689E-06	2.46577E-06	**-0.05**			
	34	2.35121E-06	2.34996E-06	**-0.05**			
	35	2.26758E-06	2.26666E-06	**-0.04**			
	36	2.20791E-06	2.20671E-06	**-0.05**			
	37	2.08824E-06	2.08732E-06	**-0.04**			
	38	1.95361E-06	1.95258E-06	**-0.05**			
	39	1.84805E-06	1.84729E-06	**-0.04**			

40	1.79595E-06	1.79527E-06	**-0.04**
41	1.75804E-06	1.75721E-06	**-0.05**
42	1.72093E-06	1.72021E-06	**-0.04**
43	1.69230E-06	1.69118E-06	**-0.07**
44	1.65866E-06	1.65837E-06	**-0.02**
45	1.64137E-06	1.64063E-06	**-0.05**
46	1.62364E-06	1.62261E-06	**-0.06**
47	1.60841E-06	1.60759E-06	**-0.05**
48	1.59827E-06	1.59782E-06	**-0.03**
49	1.58470E-06	1.58434E-06	**-0.02**
50	1.57014E-06	1.56919E-06	**-0.06**
51	1.56086E-06	1.55972E-06	**-0.07**
52	1.54752E-06	1.54645E-06	**-0.07**
53	1.52823E-06	1.52779E-06	**-0.03**
54	1.51456E-06	1.51418E-06	**-0.03**
55	1.50610E-06	1.50456E-06	**-0.10**
56	1.49312E-06	1.49130E-06	**-0.12**
57	1.47781E-06	1.47686E-06	**-0.06**
58	1.45130E-06	1.45081E-06	**-0.03**
59	1.41367E-06	1.41309E-06	**-0.04**
60	1.38586E-06	1.38517E-06	**-0.05**
61	1.36822E-06	1.36713E-06	**-0.08**
62	1.34269E-06	1.34100E-06	**-0.13**
63	1.31830E-06	1.31643E-06	**-0.14**
64	1.30507E-06	1.30419E-06	**-0.07**
65	1.28045E-06	1.27998E-06	**-0.04**
66	1.24679E-06	1.24607E-06	**-0.06**
67	1.21621E-06	1.21569E-06	**-0.04**
68	1.18723E-06	1.18658E-06	**-0.05**
69	1.15923E-06	1.15872E-06	**-0.04**
70	1.13239E-06	1.13199E-06	**-0.04**
71	1.10902E-06	1.10834E-06	**-0.06**
72	1.09450E-06	1.09373E-06	**-0.07**
73	1.06291E-06	1.06239E-06	**-0.05**
74	1.01603E-06	1.01560E-06	**-0.04**
75	9.91420E-07	9.91251E-07	**-0.02**
76	9.76001E-07	9.75403E-07	**-0.06**
77	9.60967E-07	9.60243E-07	**-0.08**
78	9.15564E-07	9.15236E-07	**-0.04**
79	8.70539E-07	8.70324E-07	**-0.02**
80	8.30055E-07	8.29698E-07	**-0.04**
81	7.89227E-07	7.89009E-07	**-0.03**
82	7.45347E-07	7.44888E-07	**-0.06**
83	6.98240E-07	6.98035E-07	**-0.03**
84	6.64443E-07	6.64107E-07	**-0.05**
85	6.10159E-07	6.09863E-07	**-0.05**
86	5.65827E-07	5.65619E-07	**-0.04**
87	5.38324E-07	5.38034E-07	**-0.05**
88	5.15220E-07	5.14979E-07	**-0.05**
89	4.90167E-07	4.89914E-07	**-0.05**
90	4.52018E-07	4.51797E-07	**-0.05**
91	4.14057E-07	4.13870E-07	**-0.05**
92	3.79452E-07	3.79264E-07	**-0.05**
93	3.47594E-07	3.47426E-07	**-0.05**
94	3.26485E-07	3.26334E-07	**-0.05**
95	3.10566E-07	3.10419E-07	**-0.05**

96	2.95358E-07	2.95279E-07	**-0.03**
97	2.80954E-07	2.80878E-07	**-0.03**
98	2.67325E-07	2.67180E-07	**-0.05**
99	2.55843E-07	2.55731E-07	**-0.04**
100	2.43417E-07	2.43284E-07	**-0.05**
101	2.32442E-07	2.32356E-07	**-0.04**
102	2.25303E-07	2.25209E-07	**-0.04**
103	2.17492E-07	2.17375E-07	**-0.05**
104	2.03057E-07	2.03006E-07	**-0.03**
105	1.87993E-07	1.87890E-07	**-0.05**
106	1.74445E-07	1.74359E-07	**-0.05**
107	1.50632E-07	1.50578E-07	**-0.04**
108	1.33294E-07	1.33227E-07	**-0.05**
109	1.20718E-07	1.20666E-07	**-0.04**
110	1.00971E-07	1.00936E-07	**-0.03**
111	8.68010E-08	8.67676E-08	**-0.04**
112	7.85502E-08	7.85106E-08	**-0.05**
113	6.76759E-08	6.76592E-08	**-0.02**
114	5.96483E-08	5.96159E-08	**-0.05**
115	5.53534E-08	5.53255E-08	**-0.05**
116	5.13342E-08	5.13119E-08	**-0.04**
117	4.76357E-08	4.76191E-08	**-0.03**
118	4.36418E-08	4.36215E-08	**-0.05**
119	4.15008E-08	4.14855E-08	**-0.04**
120	3.80606E-08	3.80444E-08	**-0.04**
121	3.44127E-08	3.43954E-08	**-0.05**
122	3.04107E-08	3.04012E-08	**-0.03**
123	2.71271E-08	2.71219E-08	**-0.02**
124	2.45740E-08	2.45716E-08	**-0.01**
125	2.19320E-08	2.19314E-08	**0.00**
126	1.98612E-08	1.98609E-08	**0.00**
127	1.75182E-08	1.75181E-08	**0.00**
128	1.58511E-08	1.58510E-08	**0.00**
129	1.39959E-08	1.39957E-08	**0.00**
130	1.26536E-08	1.26533E-08	**0.00**
131	1.11845E-08	1.11840E-08	**0.00**
132	9.85501E-09	9.85444E-09	**-0.01**
133	9.45193E-09	9.45172E-09	**0.00**
134	8.08931E-09	8.08812E-09	**-0.01**
135	5.72092E-09	5.72047E-09	**-0.01**
136	3.76176E-09	3.76157E-09	**-0.01**
137	2.16281E-09	2.16278E-09	**0.00**
138	1.40001E-09	1.40001E-09	**0.00**
139	8.20930E-10	8.20891E-10	**0.00**
140	5.23150E-10	5.23103E-10	**-0.01**
141	3.12780E-10	3.12779E-10	**0.00**
142	1.44140E-10	1.44133E-10	**0.00**
143	9.18480E-11	9.18466E-11	**0.00**
144	7.38970E-11	7.38962E-11	**0.00**
145	4.85920E-11	4.85914E-11	**0.00**
146	3.09640E-11	3.09642E-11	**0.00**
147	2.49130E-11	2.49126E-11	**0.00**
148	2.00440E-11	2.00438E-11	**0.00**
149	1.61260E-11	1.61264E-11	**0.00**
150	1.06060E-11	1.06042E-11	**-0.02**
151	6.76060E-12	6.74680E-12	**-0.20**

	152	5.44150E-12	5.43148E-12	**-0.18**
	153	1.04140E-11	1.04910E-11	**0.73**
	154	3.83310E-11	3.85693E-11	**0.62**
	155	1.41170E-10	1.41788E-10	**0.44**
	156	1.22985E-09	1.23221E-09	**0.19**
	157	1.64838E-08	1.65253E-08	**0.25**
	158	9.51251E-08	9.51783E-08	**0.06**
	159	3.50203E-07	3.50363E-07	**0.05**
	160	2.96115E-06	2.97209E-06	**0.37**
	161	2.82374E-05	2.83442E-05	**0.38**
	162	2.13520E-04	2.14458E-04	**0.44**
	163	1.37567E-03	1.38353E-03	**0.57**
	164	6.07534E-03	6.08644E-03	**0.18**
	165	1.35994E-02	1.36199E-02	**0.15**
	166	2.60062E-02	2.60885E-02	**0.32**
	167	4.32465E-02	4.33023E-02	**0.13**
	168	5.82652E-02	5.83134E-02	**0.08**
	169	7.29588E-02	7.29405E-02	**-0.03**
	170	8.41034E-02	8.41115E-02	**0.01**
	171	8.69923E-02	8.67644E-02	**-0.26**
	172	7.35287E-02	7.31762E-02	**-0.48**
(n,2p)	166	4.91563E-07	5.06970E-07	**3.04**
	167	8.70630E-06	8.75100E-06	**0.51**
	168	5.44064E-05	5.54899E-05	**1.95**
	169	9.78120E-04	9.90690E-04	**1.27**
	170	3.34883E-03	3.35626E-03	**0.22**
	171	7.65013E-03	7.69259E-03	**0.55**
	172	1.78526E-02	1.78706E-02	**0.10**