EXFOR compilation: main steps.
(on the base of Guide for EXFOR compilers)

M.Mikhaylyukova, V.Pronyaev

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A. Main important steps of compilation:

1. Find and read **all References**.

a) Under REFERENCE give only publications to <u>pertain data</u> for this ENTRY , taking in mind, that all REFERENCEs will be automatically included in the bibliographical data base CINDA as the reference for all data of this Entry.

b) Other references (containing common details of experiment, method of analysis, etc.) should be compiled under REL-REF with proper code I,M,N,R and short explanation.

c) If the name of the **first author** of the second reference (or any subsequent references) differs from the name of the first author in the first (main) reference, this difference can be mentioned in the free text of these references.

Example:

```
AUTHOR     (A.P.Tonchev, Yu.P.Gangrskiy, A.G.Belov, V.E.Zhuchko)  41339  1    5
REFERENCE  (J,PR/C,58,(5),2851,199811) Main reference, data given 41339  1    8
           #doi:10.1103/PhysRevC.58.2851                          41339  1    9
           (J,YF,60,(11),1940,1997) First author A.G.Belov.       41339  1   10
            Same results.                                         41339  1   11
           (J,PAN,60,1773,1997) Engl.translation of J,YF,60,1940 .41339  1   12
           (C,97OBNIN,,61,1997) First author A.G.Belov.           41339  1   13
            Prelim. results of isomeric ratios.                   41339  1   14
REL-REF    (I,,A.G.Belov+,S,JINR-D15-93-80,12,1993)  Exp. details.41339  1   15
            Workshop on the Application of                        41339  1   16
            Microtrons in Nuclear Physics. Plovdiv, Bulgaria,1992.41339  1   17
           (R,,R.B.Firestone+,B,FIRESTONE,,1996)                  41339  1   18
            Reference for decay data.
```

2. Avoidance of duplications in input of data: first retrieve from the latest EXFOR database by author(s) name(s) and reactions, and compare numerical data in existing subentries with data in the paper. If the data are similar, you need to understand if the latest data are the result of new measurements, or a new analysis of the results of old measurements.

Example:
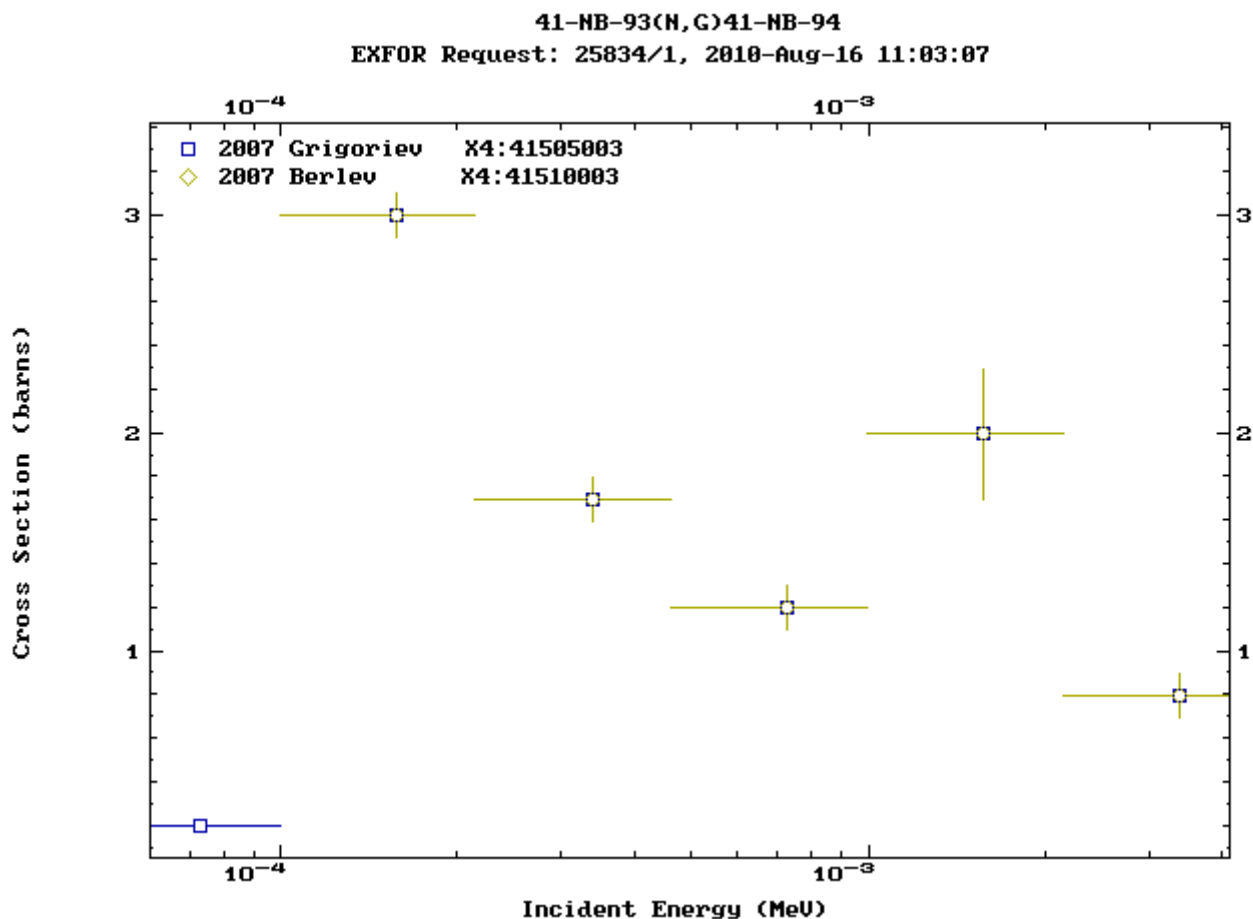

```
FACILITY    (REAC,4ZZZDUB) IBR-30 reactor., 10kW, 100Hz, 4microsec.41505001

FACILITY    (MESON,4RUSJIA) REPS (Resonance Experimental           41510001
            Transmissions and Cross-sections) exp.setup of Meson   41510001
            Facility at Institute for Nuclear Reseach of Russian    41510001
            Academy of Science.                                     41510001
```

3. Request and compile the **original measured data** if they are available (e.g. ratio of the cross sections, transmissions, etc.). It is obligatory to send experimental data request to the author. Digitized data can be put in Entry only if it is impossible to find tabulated data or get numerical data from authors. After compilation of the data received from authors, the digitized data should be deleted from the Entry.

Example:
```
HISTORY    (20070801C)      M.M./S.M.                        22969 1   47
           (20090318A) M.M. References were added:           22969 1   48
            C,2007NICE,1,471,200704  , J,NIM/B,261,941,2007 ,  22969 1   49
            J,NIM/B,261,(1-2),969,2007 . Authors names were added.22969 1   50
            BIB and COMMON information was added.             22969 1   51
            Digitized data were replaced by authors' data in  22969 1   52
            Subents 005, 006, 008.  Units were corrected in   22969 1   53
            Subent 007 .                                      22969 1   54
           (20090619A) Reference S,AIP-109O was added. M.M.  22969 1   55
            BIB information was added.                        22969 1   56
```

Sometimes it's very helpful to send the digitized data to author – author could see, that additional error due to digitizing was added in the measured data. It could help to receive authors' data.

4. Check data given in the **tables** and in the **text,** and compare them (in case of corrections) with data in **all Subentries** of Entry.

If there is a misprint or a mistake in one Subent of Entry, then the same misprint might be repeated in others Subents of this Entry.

For example, if in one Subent the data units have to be corrected B -> MB, then data units of other Subents of this Entry have to be checked for possible such misprint.

5. Check data given in **figures of publications** against their **correspondence to** the data in the **tables**, to the **data received from authors** and (in case of corrections) to the **data previously entered**. If data from figures are absent in EXFOR, they **can be digitized** and tabulated. The compiler should attempt to obtain the data from the corresponding author.

Examples:

1)

MM -> author:
"For reaction Mo-97(n,p)Nb-97 in last column (14.82 MeV) the value is "21(11)".
Is it mean that it is 21.+/-11.
Why is the error too large in comparison of data for other energies and other reactions? (>50%) May be, here is misprint?"
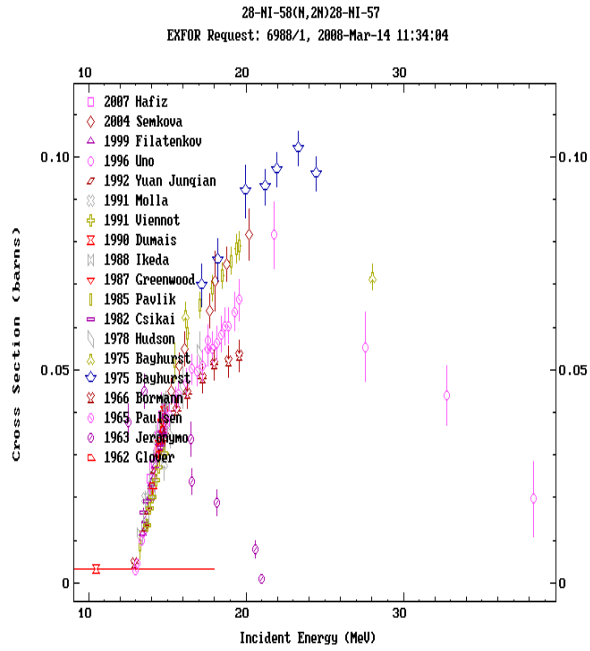
Author -> MM:
" Thank you for your very careful reading of our manuscript!
Indeed there is a typing error.The table entry should read 21.0(11) or in your notation 21.0+/-1.1! "

2)

Data of Jeronimo+ 1963

As they were in EXFOR (from table of article)   As they are on figure of the article
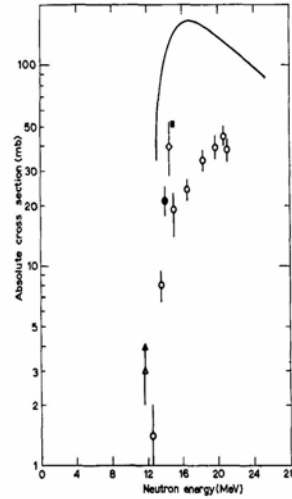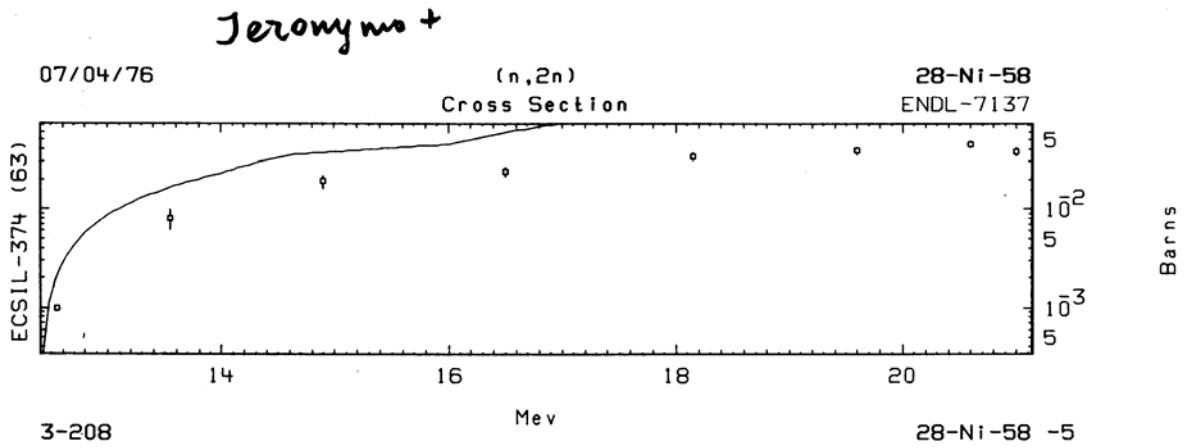

28-NI-58(N,2N)28-NI-57
EXFOR Request: 6988/1, 2008-Mar-14 11:34:04

Fig. 13. Total cross-section for Ni⁵⁸(n, 2n)Bi⁵⁷ reaction. ◊-Present data, ■-Preiss and Fink [19], ●-Howerton [20], △-Cohen [18], ◇-Paul and Clarke [17]. The full line is the theoretical estimate for the Ni⁵⁸(n, 2n)Ni⁵⁷+Ni⁵⁸(n, np)Co⁵⁷ reaction by Mani and Melkanoff.

As they are in R,UCRL-50400:

Correction was made according to data of Figures.

6. Check the **physical meaning** of data. There are only a few reactions types that can be measured directly (in some approximation) as absolute (no further normalization is needed). Most data are obtained as a ratio to a known standard or even from shape or shape of ratio measurements type. The questions should be answered:

What was measured (primarily **measured quantity**)?

If relevant, how was the **normalization** of the cross sections carried out, which **standard cross section(s)** or **monitor reaction(s)** were used?

It is useful to communicate on these problems with evaluators and physicists, and make a plot to compare with other data for the same reaction. These plots can be sent to authors for comments if their data differ too much from other data in the EXFOR database.

7. Check if the **REACTION code used is correct**. It is very useful to produce a plot from the EXFOR database and the evaluated data libraries for data comparison. Large differences compared with data from other entries or evaluations may also show that the reaction code is incorrect (e.g., "inelastic collision" used by authors does not mean inelastic scattering cross section, but non-elastic cross section, etc.) or data units are incorrect.

Example: Data of 1973 Lippincott have to be corrected B -> MB.
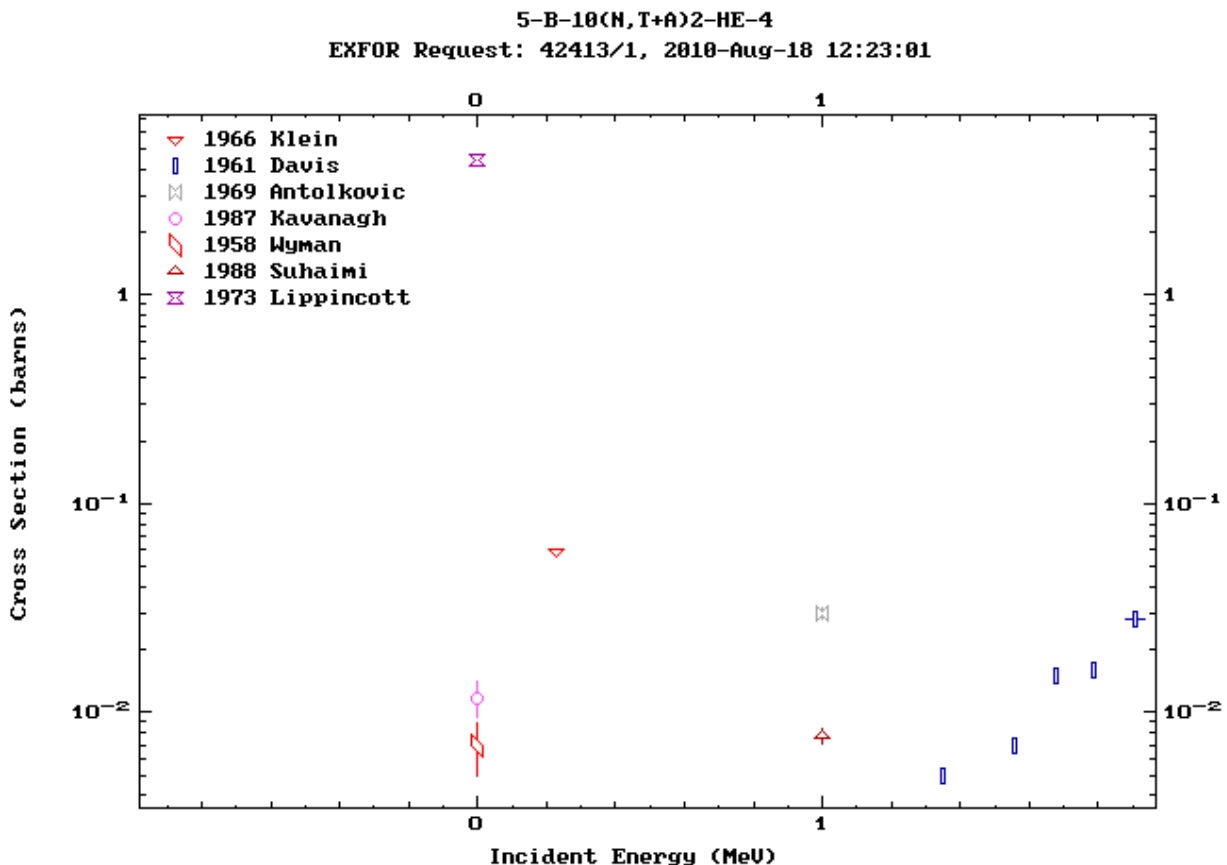
8. Measured data, for which REACTION is not exist at present time, have to be inserted as MISC data or in free text of ADD-RES lines. Incident particle spectrum if available has to be inserted as free text of INC-SPECT, could be digitized, if given on figures.

Examples:

1)
```
INC-SPECT   Fast neutron flux between two Li-6-D converters was   22214  7   10
            measured by Al-27(n,a) reaction to be 2.5E+5 n/cm**2/s.22214  7   11
            Conversion factor - 1.7E-04 .                         22214  7   12
             The average neutron energy was measured to be 14.05+/-22214  7   13
            0.07 MeV by using the Zr/Nb method. The scattered     22214  7   14
            neutrons were evaluated by Monte Carlo calculations,  22214  7   15
            using MCNP code. MCNP calculated  spectrum agrees     22214  7   16
            satisfactorily with spectrum unfolded by NEUPAC code  22214  7   17
            by using variance and covariance data together with   22214  7   18
            reaction rates, summarized in Table II.               22214  7   19
             Calculated (NEUPAC, MCNP) incident neutron spectra   22214  7   20
            are given on Fig.5. NEUPAC spectrum digitized:        22214  7   21
               EN, MeV       Neutron flux per unit per energy.    22214  7   22
             1.592  -  1.752      478.1                           22214  7   23
             1.752  -  1.952      465.5                           22214  7   24
             1.952  -  2.112      448.4                           22214  7   25
             ...
             13.10  -  13.33      3910.                           22214  7   66
             13.33  -  13.58      8944.                           22214  7   67
             13.58  -  13.79      36100.                          22214  7   68
             13.79  -  14.08      95990.                          22214  7   69
             14.08  -  14.36      1.3700E+05                      22214  7   70
             14.36  -  14.57      93510.                          22214  7   71
             14.57  -  14.84      30710.                          22214  7   72
             14.84  -  15.05      4633.0                          22214  7   73
             15.05  -  15.26      423.6                           22214  7   74
             15.26  -  15.55      22.44                           22214  7   75
```

2)
```
MISC-COL    (MISC)  Reduced multiplicity defined by (multiplicity)/22982 10    6
             (B+<En>), where B - neutron binding energy, <En> -    22982 10    7
             averaged neutron energy in CM system.                 22982 10    8
             Averaged over incident neutron energy spectrum.       22982 10    9
             Units: gamma-rays/(1 MeV excitation energy)/capture   22982 10   10
```

3)
```
MISC-COL    (MISC1) Factor of correction for low energy neutrons.  22655  7   16
             (MISC2) Factor of correction for scattering .         22655  7   17
             (MISC3) Factor of correction for breakup.             22655  7   18
```

9. **Ask authors** (if possible) any questions **about observed disagreements and possible misprints**. Give compiler comments under CRITIQUE (about data quality) or COMMENT. Make sure they are labeled as "Comment by Compiler".

Example:

1)

```
COMMENT     -Of authors, JAERI-C-2003-006,144,2003.This measurement22839 1   24
            was done to check the experimental method to measure   22839 1   25
            energy spectrum of two neutrons emitted through n,2n    22839 1   26
            reaction. Method is basically successful, but there is 22839 1   27
            a problem of statistical accuracy.                     22839 1   28
            -Of compiler M.M. Really, two experiments were made,   22839 1   29
            described respectively in S,JAERI-C-2003-006,144,2003  22839 1   30
            and in J,NIM/A,595,439,2008 .                          22839 1   31
            Both were compiled in this one Entry according to      22839 1   32
            recommendation of NDS IAEA (N.Otsuka).                 22839 1   33
```

2)

```
CRITIQUE    *By compiler*.Compiler believe that data at Ang(cm)=40 O1782 4    5
            degree, reported by authors on fig.6 is mistaken.       O1782 4    6
            According subent002, this data must be corresponded to  O1782 4    7
            Ang-cm=140 degree.                                      O1782 4    8
```

10. Old data (published before 1976) can also be checked by comparison with data in the figures and tables given in **UCRL-50400** report (several volumes). Experimental data from many journals, reports and private communications were analyzed by a group of evaluators from the LLNL (USA) and clear mistakes (misprints in publications) were also corrected. Corrected data are presented in the figures and tables, and can be found on the basis of reaction, author's name and reference.

UCRL−50400
Volume 7 Part B Revision 1

An Integrated System for Production of
Neutronics and Photonics Calculational Constants

Volume 7 Part B Revision 1

MAJOR NEUTRON-INDUCED INTERACTIONS (Z > 55):
GRAPHICAL, EXPERIMENTAL DATA

D. E. Cullen, R. J. Howerton, M. H. MacGregor,
and S. T. Perkins

July 4, 1976

Prepared for U.S. Energy Research & Development
Administration under contract No. W-7405-Eng-48

LAWRENCE
LIVERMORE
LABORATORY
University of California/Livermore

11. **Use Nuclear Wallet Cards, Table of Isotopes, and NuDat** for retrievals to understand **decay properties** and compile decay radiation **characteristics used by authors**. Compile only decay data as given in the article. If decay data are not given in article, <u>request decay data from author</u>. This approach may help to renormalize the results using modern values of the decay radiation characteristics.

12. **Monitor** reaction cross section used in the measurements should be compiled if given, direct and full reference on the standards or monitor reaction used should be provided to help renormalize the measured values to new standard or monitor reaction cross section.

    Data used for normalization have to be inserted as MONITOR and/or ASSUMED.

    Examples:
    ```
    MONITOR    (92-U-238(N,F),,SIG) Evaluation by M.G.Sowerby+,      20416 1   39
                AERE-R-7373(1973).                                   20416 1   40
    MONIT-REF  (,M.G.Sowerby+,R,AERE-R-7373,1973)                    20416 1   41
                The liquid scintillator efficiency of 75 % was       20416 1   42
                determined using NU-BAR of CF-252 = 3.732.           20416 1   43
    ASSUMED    (ASSUM,98-CF-252(0,F),PR,NU)                          20416 1   44
    ```

13. **Uncertainties** have to be given in ERR-ANALYS including the partial components of the total uncertainty with a free text explanation of the source of the uncertainty component. The partial components of the uncertainties should be compiled according to the existing compilation rules. This information will help the evaluators to build the covariance matrix of the uncertainty for this data set.

14. **Source of data** should be clarified as much as possible (including free text) under **STATUS.**

    To define STATUS use proper codes and proper reference as it's given in REFERENCE lines. Data (of REFERENCES of this Entry), which are given in others Entries, have to be mentioned by COREL or DEP.

    Examples:
    1)
    ```
    STATUS     (TABLE) Request for the data was sent to B.Fursov and 41532 2   44
               V.Shorin 02.02.2010.                                  41532 2   45
               Data were received 02.02.2010 from V.Shorin.         41532 2   46
               Data presented on Fig.2,3 of J,AE,107,(2),86,2009;    41532 2   47
                           Fig.1 of R,INDC(CCP)-0451, page 20.       41532 2   48
                           Fig.13, 14 of R,JIA-1231.                 41532 2   49

    STATUS     (TABLE) Table of J,AE,107,(2),86,2009.                41532 3   15
                   Text of R,JIA-1231, page 10                       41532 3   16
               (DEP,41532002) Derived by using 41532002 data c-s     41532 3   17
                       in 29-62 milli-eV region.                     41532 3   18
    ```

    2)
    ```
    STATUS     (COREL,M0786001) Data of (gamma,n) given.             41339
    ```

15. **HISTORY** should be given as a detailed free text description of any corrections introduced in the ENTRY/SUBENT.

   Do not delete HISTORY lines, they could be useful in future to see, what corrections were done before.

16. Check **ERRATA** or **CORRIGENDUM** lists that are usually published in the last issue of the journal volume for possible corrections of the data.

17. **Use CHEX code** in TRANS mode to detect format and coding errors.

   Also **Janis trans checker** and **Victor Zerkin's checking tool** by internet http://nds121.iaea.org/exfor2/x4up1.htm

18. **Use Spellcheckers** to correct free text language errors and misprints.

19. **Corrected Entries: Use FLAG C or I in column 11** in ENTRY/SUBENT lines. **Optional:** use **FLAG in column 80** in EXFOR Entry by marking lines with I (line inserted) or C (line corrected) even if this requirement is optional (as at present).

C. Check list for compilation of new or correction of old entries:

□ – Check duplication.

□ – Search for all related references.

□ – Check for ERRATA or CORRIGENDUM to the original references.

□ – Selection of all data (physical quantities) appropriate for compilation (primarily measured data – type of ratios, data normalized using monitor reactions or standards, derived quantities, etc.).

□ – Determination of the reaction string coding for data as defined in the Manuals, Dictionaries and "good" examples compiled in EXFOR.

□ – Data check on consistency (between figures and tables in publications, authors' data and figures and against data retrieved from EXFOR database using Quick Plot).

□ – If data deviate significantly (outliers) check if correct codes used for REACTION or appropriate units are used. Contact authors when clear problems exist.

□ – Compile data with as much information as possible given under ERR-ANALYS, STATUS and HISTORY; produce compiler comments needed under CRITIQUE or COMMENTS, especially if some problems were not resolved.

□ – Check by checking tools (CHEX, JANIS, Victor's) and Spellchecker and send to the authors for approval.

D. Manuals to be used:

1. **LEXFOR –** Quantity definitions and detailed compilation guidelines
2. **EXFOR** Exchange Format Manual
3. **NRDC Protocol -** Procedures for EXFOR exchange and compilation scope
4. **EXFOR/CINDA Dictionary Manual**
5. **Guide for EXFOR compilers**

E. Main Web-sites with information for compilers' access:

1. http://www-nds.iaea.org/nrdc/ - International Network of Nuclear Reaction Data Centres (NRDC).
2. http://www-nds.iaea.org/ - EXFOR, CINDA, ENDF, NSR, NuDat and other data libraries.
3. http://www-nds.iaea.org/exfor-master/x4compil/ - EXFOR status compilation Webpage.
4. http://nds121.iaea.org/ndsx4/trans/ - dictionaries, manuals, preliminary and final TRANSES, codes for EXFOR compilation.
5. http://www-nds.iaea.org/nrdc/error/exfor_err1.html - collection of mistakes found by EXFOR users and NRDC members; format errors in EXFOR found by database administrators in NEA-DB, NDS and JCPRG.
6. http://www-nds.iaea.org/nrdc/error/exfor_err3.html - suspicious entries submitted from WPEC SG-30 members after NRDC 2007 meeting.

F. Main codes to be used:

Collected in http://www-nds.iaea.org/nrdc/nrdc_sft/

1. Retrieval systems:

   a) software developed by V. Zerkin, adopted on web-sites of NDS, NNDC, mirror web-sites;

   b) JANIS –developed and adopted in NEA Data Bank.

2. Special editors for compilation in EXFOR:

   a) EXFOR-editor (ExfData.exe) developed in NPDC, VNIIEF, Sarov, Russia, http://cnpd.vniief.ru/load;

   b) HENDEL, developed in JCPRG, Sapporo, Japan, http://www.jcprg.org/hendel/

3. Digitizing codes:

   a) InpGraf.exe, developed in NPDC, VNIIEF, Sarov, Russia;

   b) GSYS, developed in JCPRG, Sapporo, Japan, http://www.jcprg.org/gsys/.

4. Checking codes: CHEX – to check TRANSes.

5. http://nds121.iaea.org/exfor2/x4up1.htm - tool of web-service for compilers to check and compare the data of preliminary trans and the data from EXFOR data base and evaluated libraries on plots, using Quick plot and Advanced plot, to avoid duplications, disagreements and misprints in compiled data.

Under improvement.

6. www.nea.fr/janis/trans-checker - JANIS-TRANS Checker code to check preliminary transes -

7. SpellCheckers – standalone or built in text editors and redactors.

8. Additional code: ORDER – to run before sending to NDS.