Memo 4C-3/198
CP-D/23

To: Distribution   1977-03-23

From: P.M. Attree

Subject: Proposed EXFOR Manual Section VIII

Reference: Memo 4C-3/195 = Memo CP-D/20

1. Attached are the remaining pages to complete Section VIII as proposed
   in my previous memo. Also attached are some pages previously trans-
   mitted, which have been corrected. Corrections and additions are
   marked with a vertical line in the left hand margin. The first page
   of the attachments contains a list of which pages have been included
   with each memo.

2. All the information from dictionaries 2 and 24 which concerned coding
   rules has been transferred into the proposed Section VIII, as well as
   information from the present Section VIII. There is information for
   REACTION, MONITOR and DECAY-DATA from present pages VIII.20a, 20b,
   20c, 24a which needs to be transferred to LEXFOR. The last two
   pages of the attachment contain these 'remains'.

3. The rules for keywords concerning codes and free text have been included
   in Section VIII where I believe they belong.

4. A paragraph has been added concerning embedded blanks in codes, which
   reflects current practice but was nowhere written down. In this
   connection a rule has been included for DECAY-DATA and MONITOR.

5. There is a contradiction between dictionary 2 (immediately following
   GEOMETRY), where it is implied that the keywords EN-SEC and HALF-LIFE
   may be used only with ISO-QUANT (i.e. for NND) and the present EXFOR
   Manual page VIII.3, where these keywords are not restricted to NND.
   Clarification needed.

6. It is stated on present EXFOR Manual page VIII.24 that the data-heading
   HL may be used for half-lives which function as an independent variable.
   It would be useful to have a list of reactions for which this is
   permitted.

                                                   (continued)

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Attachment

Note Holders of NDS EXFOR Manual should not revise their manuals with the
     attached pages until 4-centre approval has been obtained.

7. In memo 4C-1/109, NNCSC proposed that the keyword DECAY-DATA be used also for coding the decay information for the standard or monitor as well as for the reaction measured. This is reflected in the DECAY-DATA page. I dislike the idea of using a single keyword for two different purposes, but can accept it, provided that it is never necessary to pick up, by machine processing, the specific DECAY-DATA coding which pertains either to the REACTION (resp. ISO-QUANT) coding or the MONITOR (resp. STANDARD) coding. If this were necessary then the introduction of the keyword DECAY-MON would be preferable. To link the codes by matching the nuclide fields would be extremely cumbersome.

See also CP-B/8, page 2.

The following list shows which pages of the proposed EXFOR Manual
Section VIII were distributed with which memo.

Memo 4C-3/195   Memo 4C-3/198

Contents page   Contents page
VIII.1.1 , 2   VIII.1.2 , 3 , 4
VIII.2.1 , 2   VIII.2.1 , 2
                                       VIII.3.ANALYSIS
                                              ASSUMED

VIII.3.AUTHOR
       CMPD-QUANT
                                              DECAY-DATA.1,2,3
                                              DETECTOR
                                              EN-SEC

       ERR-ANALYS   EXP-YEAR
                                              FACILITY

       FLAG
       HALF-LIFE   HALF-LIFE
       HISTORY
                                              INC-SPECT
       INSTITUTE   INSTITUTE
       ISO-QUANT.1,2,3,4,5   ISO-QUANT.2
                                              METHOD
       MISC-COL
                                              MONITOR.1,2
       NUC-QUANT
       PART-DET
                                              RAD-DET
                                              REACTION.1,2,3,4,5,6
       REFERENCE.1,2,3
       REL-REF
       RESID-NUC   RESID-NUC
       STANDARD   STANDARD
       STATUS
VIII.4.1 , 2   VIII.4.1,2,3,4
VIII.5
VIII.6

General information about information-identifier keywords
and codes.

'1.   All valid information-identifier keywords are in Dictionary 2.
These keywords are used in the BIB section to identify
specific information; these may then be coded, with or without
free text explanation, or may have only free text associated with
them. Codes are used for retrieval purposes. Information in free
text cannot be used for retrieval purposes. The keywords may, in
general, appear in any order within the BIB section.

2.   Codes for use with a specific keyword are found in the
relevant dictionary. In general, codes may be used singly or
in conjunction with one or more codes from the same dictionary.
Two possibilities exist if more than one code is used:

a) Both codes within the same set of parentheses, separated by
    a comma, for example:

        KEYWORD   (CODE1,CODE2) + free text   , or

b) Each code enclosed in own set of parentheses followed by
    free text, with the stipulation that each new code entry
    start in column 12, for example:

        KEYWORD   (CODE1) + free text ...

                     free text ...,

                     (CODE2) + free text

Both of these possibilities, or a combination of the two, are allowed,
although for some keywords only b) is permitted.

For some keywords the coded string (i.e. between the parentheses) may include
retrievable information, other than a code from a dictionary.

3. See part 3 of this Section for the explicit coding format and rules
    for each keyword, other than those listed below.

4. For the following keywords there are no special rules and information
    is given in free-text only:

        TITLE
        SAMPLE
        CORRECTION
        COMMENT

5. For the following keywords there are no special rules and coded
    information may be in either of the general forms given in §2
    above.

        N-SOURCE   codes from dictionary 19,
        ADD-RES   codes from dictionary 20.

Refer to page IV.3 for information on pointers, which may be used with
    some keywords.
Refer to LEXFOR for the information to be included for each keyword.

Codes and free text

1. In general, coded information given with keywords is for retrieval purposes and the free text should be self-explanatory. That is, coded information should be expanded into clear English and amplified as necessary in the free text. However for some keywords, such an expansion of the codes is expressly forbidden, on the assumption that such expansion will be done by an editing program. For some other keywords an indication can be given whether or not the coded information is expanded in the free text.

2. For the following keywords the coded information must <u>not</u> be expanded in the free text:

   > INSTITUTE
   > REFERENCE
   > REL-REF
   > ISO-QUANT, CMPD-QUANT, NUC-QUANT, REACTION
   > STANDARD, MONITOR
   > RAD-DET
   > HALF-LIFE
   > DECAY-DATA

3. For the following keywords coded information may or may not be expanded in free text:

METHOD	PART-DET
FACILITY	RESID-NUC
DETECTOR	ADD-RES
ANALYSIS	STATUS
N-SOURCE	

   <u>Either</u>   a point imediately following the closing parenthesis,

       <u>or</u>   a completely blank field between the closing parenthesis and column 66,

   indicates that the code is not expanded.

4. For the remaining keywords which do not contain codes from dictionaries the free text must be self explanatory:

AUTHOR	MISC-COL
EXP-YEAR	ASSUMED
ERR-ANALYS	FLAG
	HISTORY

Embedded blanks

Embedded blanks are explicitly forbidden in the coding for many information-identifier keywords — see part 3 of this section. With these exception, embedded blanks in the coding are tolerated if they <u>follow</u> a code from a dictionary, although this is not recommended. They are <u>not</u> permitted <u>before</u> any code.

<u>Examples</u>	STATUS	(DEP)	Yes
	STATUS	(DEP ,COREL)	Yes
	STATUS	(COREL, DEP)	No
	STATUS	(DEP, 10048007)	No

Coding for nuclides

Nuclides appear in the coding of many keywords. The general format
is Z-S-A-X

where
    Z is the mass number, up to 3 digits, no leading zeroes;
    S is the element symbol; 1 or 2 characters;
    A is the atomic weight; up to 3 digits, no leading zeroes;
    a single zero denotes natural isotopic composition;
    X is an isomer code denoting the isomeric state. This
    subfield may be omitted.
    X may have the following values:
     G for ground state,
     M if only one metastable state is regarded,
     M1 for the first metastable state,
     M2 for the second, etc.

Exceptions to this coding are noted on the pages for each keyword.

Keyword categories:

In the following list of information-identifier keywords certain flags indicate which keywords must, or need not, be present and which keywords must, or need not, be followed by coded information:

Bibliographic keywords

Use of keyword presently restricted to:

	O	TITLE
	*	AUTHOR (( ))
	*	INSTITUTE ((3))
		EXP-YEAR (( ))
	*	REFERENCE ((4,5/6/7))
CPND		REL-REF ((17, Author, Ref.))

Data Specification keywords

CPND	X	REACTION ((Z-S-A(P,N+P)Z-S-A, 31,32,33,34,35))
NND	X	ISO-QUANT ((Z-S-A,14))
NND	X	NUC-QUANT ((Z-S-A,14))
NND	X	CMPD-QUANT ((Z-S-9,14))
CPND	O	MONITOR ((Reaction, Acc#, Author, Ref.))
NND	O	STANDARD (Z-S-A, 14)
CPND		RAD-DET ((Z-S-A-MX, 13))
CPND		DECAY-DATA ((Z-S-A-MX, HL, 13, E, abund.))
		PART-DET ((13)) or (Z-S-A)
		EN-SEC
NND		RESID-NUC (Z-S-A-M)
		HALF-LIFE (HL, Z-S-A-M)

Experimental and data description keywords

	−O	METHOD (21)+
	−O	FACILITY (18)+
	−O	DETECTOR (22)+
	−O	ANALYSIS (23)+
		N-SOURCE (19)+
		INC-SPECT
		SAMPLE
CPND		ADD-RES (20)
		CORRECTION
	O	ERR-ANALYS (DATA-ERR)

Miscellaneous keywords

	COMMENT
	MISC-COL ((MISC1))
	ASSUMED (ASSUM1)
	FLAG ((1.))
O	STATUS (15)+ or (CODE, Acc#)
*	HISTORY (( ))

Obsolete keywords

GEOMETRY ⎫ These keywords are obsolete but
TABLE-NR ⎭ may still exist in old entries.

For explanation of flags see next page.

Explanations:

* This keyword must always be present. (Incidentally, all of these keywords must always be followed by coded information in parantheses as indicated by (( )).)

X One of these   keywords must be present; they are mutually exclusive.

— At least one of these keywords must be present; if a pertinent code in the relevant dictionary exists, then keyword and code should be given. It is advisable that all four of these keywords be given except when not relevant. For example: FACILITY is "not relevant" for spontaneous fission data.

O This keyword must always be present except when it is not relevant. For explanation of "not relevant" see in LEXFOR. For example: ERR-ANALYS is "not relevant" for quantum-numbers.

(( )) If the keyword is present, coded information in parentheses must be given. ((3)) refers to the relevant dictionary, No. 3. In other cases an example of coded information is shown in the table.

(19)+ Either free text or coded information in parentheses plus possibly free text may be given. The number refers to the relevant dictionary. If a pertinent code in the relevant dictionary exists, then keyword and code should be given. The "+" sign indicates that the coded information in parentheses must be repeated in the free text. Except when a point is entered in the position following the closing parenthesis, or when the free-text field up to col.66 is totally blank.

NOTES. deleted.

ANALYSIS

1. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS
   must be present with coded information. Within this restriction,
   coded information for ANALYSIS is optional.

2. If coded information is given it may be in either of the general
   forms, see page VIII.1.2, with code(s) from Dictionary 23.

ASSUMED ´(proposed in CP-D/21 item V)

1. This keyword is used to define the meaning of columns in the COMMON- or DATA-sections headed by ASSUM and its derivatives. The keyword is obligatory when such headings are present. The keyword may be used with free text only, if these headings are not present.

2. The format of the code is

    (ASSUM,reaction,quantity)

    The coding for the reaction-field and the quantity-field are exactly the same as for the keyword REACTION.

    Two or more columns of assumed data.

3. Each code must start in col.12.

4. ASSUM is replaced by ASSUM1, ASSUM2 etc as they appear in the data-headings.

DECAY-DATA   (used only for CPND, it is foreseen for NND)

1. Keyword is optional, except that when the keyword RAD-DET is
    present, DECAY-DATA must also be present. Coded information is
    obligatory, with or without free text.

2. This keyword is used to give the decay data for any nuclide occurring
    in the reaction measured or in the reaction used for normalization.
    The reaction measured is defined under the keyword REACTION for CPND
    and under the keyword ISO-QUANT (or CMPD-QUANT or NUC-QUANT) for NND.
    The reaction used for normalization may be defined under the keyword
    MONITOR for CPND or the keyword STANDARD for NND.

3. The general format of the code consists of three major fields,

                (nuclide, half-life, radiation)

    The detailed coding for each field is given on the next page.

4. If decay data is given in coded form for more than one nuclide, then
    each must be coded separately, starting in col.12. The coded
    information can then be linked to the corresponding REACTION,
    ISO-QUANT, MONITOR or STANDARD codes by using pointers, although
    this will not generally be done.

5. Note that if the half-life values are given in the COMMON section
    or as a variable in the DATA section, they must not be coded under
    DECAY-DATA; the keyword HALF-LIFE must be used.

6. The general format of the code is

    (nuclide, half-life, radiation).

Embedded blanks are permitted in the code if this simplifies the readability and the coding for the compiler. See example f) on the next page.

7. <u>Nuclide field.</u> The general format of the code is Z-S-A-X.
    See page VIII.1.4.

8. <u>Half-life field.</u> This field contains the actual half-life of the nuclide specified.

This field may be omitted, in which case the following comma must be included, unless the radiation-field is also omitted, in which case the closing parenthesis immediately follows the nuclide.

The format is n.nUNITS, where n.n is a valid floating-point number, see page VIII.6, but note that no blanks are permitted;
    UNITS is a code from dictionary 25 having the dimension TIME. This code follows the numeric values without a blank in between.

Example: 2.45MIN

9. <u>Radiation field.</u> This field may be omitted, in which case the closing parenthesis immediately follows the half-life. This field may also be repeated; each radiation field being separated by a comma. Absence of any subfield must be indicated by including the separating comma; trailing commas need not be included.

The field consists of three subfields

    (nuclide, half-life, SF3, SF4, SF5)

10. <u>SF3. Type-of-radiation.</u>

A code from dictionary 13.

11. <u>SF4. Energy.</u>

This gives the energy of the radiation in <u>keV</u>. It is coded as a floating-point number (see page VIII.6, but no blanks); no units are given in the code.

Two or more energies may be given, each separated by a slash.

12. <u>SF5. Abundance.</u>

This gives the abundance of the observed radiation per decay.

It is coded as a floating-point number (see page VIII.6, but no blanks).

See next page for examples.

13. Examples of coding for DECAY-DATA

    a. DECAY-DATA (40-ZR-89-M)   (half-life and radiation omitted)

    b. DECAY-DATA (60-ND-140,3.3D)   (radiation-field omitted)
                 (59-PR-140,,B+,,0.500) (half-life and radiation-SF2 omitted)

    c. DECAY-DATA (25-MN-50-G,0.286SEC,B+,6610.) (radiation-SF3 omitted)

    d. DECAY-DATA (25-MN-50-M,1.76MIN,DG,785.,,B+) (two radiation-fields, the
                                      second with SF2 & SF3 omitted)

    e. DECAY-DATA (60-ND-138,5.04HR,DG,328.,0.065) (all fields and subfields
                                      present)

    f. DECAY-DATA (60-ND-139-G,30.0MIN,B+,,0.257,DG,405.,0.055) (two
                                              radiation fields)

        (60-ND-139-M,5.5HR,DG,738.,0.37,DG,982.,0.29,
      DG,708.,0.27,DG,403.,0.03,B+,,0.006) (five radiation-fields,
                                    extending over 2 records)

This last example could also be entered in the following way:

    DECAY-DATA (60-ND-139-G,30.0MIN,B+,,0.257,
                          DG,405.,0.055)
        (60-ND-139-M,5.5HR,DG,738.,0.37,
                          DG,982.,0.29,
                          DG,708.,0.27,
                          DG,403.,0.03,
                          B+,,0.006)

(Note that if no embedded blanks are permitted and the coding will not fit
onto one line, then the break may come in the middle of a numerical value!)

DETECTOR

1. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for DETECTOR is optional.

2. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 22, but see exception below.

3. If the code 'COIN' is used, then the codes for the detectors used in coincidence must follow within the same parentheses;
    e.g. (COIN,NAICR,NAICR).
   In this case any other detectors used must be coded separately starting in col.12.

EN-SEC

This keyword is used optionally to give information about secondary energies.

It is obligatory when the data-heading keywords E1, E2 etc are used in the COMMON- or DATA- section. Free text only.

However, see memo 4C-3/200.

EXP-YEAR

1. This keyword is optional, but if present it must be coded.

2. The format of the code is (yy) where yy is the two digits of the year in which the experiment was performed; e.g. (65).

FACILITY

1. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for FACILITY is optional.

2. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 18.

3. For CPND only. The facility code from Dictionary 18 may be followed by an institute code from Dictionary 3; e.g. (ISOCY,2GERKFK). When this form of coding is used and more than one facility is given, then each piece of coded information must be entered separately, starting in col.12.

HALF-LIFE

1. Keyword optional, with or without coded information. However coded information __must__ be included when the corresponding data is given in the COMMON- or DATA-sections.

2. The general coding format is (HLn, Z-S-A-X), where

> n may have the values 1, 2, 3 etc., corresponding to the data-headings HL1, HL2, HL3 etc in the COMMON- or DATA-sections.

> Z-S-A-X, see page VIII.1.4. A may not have the value zero.

3. The data-columns headed by HL1, HL2, etc then each contains the numerical value of the half-life of the nucleus specified in the second part of the code.

4. If two or more half-lives are given, each must be coded separately starting in col.12.

See Example 17. *See also* VIII.5.

5. For CPND half-life values may be entered under the keyword DECAY-DATA.

INC-SPECT

1. This keyword must be present when the data-heading keyword
    EN-DUMMY is used with the quantity modifiers MXW, FIS or SPA.

2. Free text only.

INC-SPECT

<u>INSTITUTE</u> *   Keyword obligatory and must have coded information.

One or more codes from dictionary 3.

In cases where the institute-code is less than 7 characters, trailing blanks may be omitted, however embedded blanks must be included, as they are considered part of the code.

For which codes to enter, see LEXFOR.

8. The isoquant-unit consists of two major fields,

     (isotope, quantity)

   Embedded blanks within an isoquant-unit are not permitted.

9. Isotope field. The isotope compiled is the target nucleus.

   The general format of the code is Z-S-A-X.

   See page VIII.1.4. X may not have the value G.

   Examples of isotope coding: 1-H-1
                                   1-H-2
                                   6-C-12
                                   40-ZR-90
                                   92-U-234
                                   94-PU-239
                                   95-AM-242-M1

10. Deleted.

METHOD

1. At least one of the keywords METHOD, FACILITY, DETECTOR, ANALYSIS must be present with coded information. Within this restriction, coded information for METHOD is optional.

2. If coded information is given it may be in either of the general forms, see page VIII.1.2, with code(s) from Dictionary 21.

MONITOR (used only for CPND)

1. For NND, where the data are specified under ISO-QUANT, CMPD-QUANT or NUC-QUANT, the keyword STANDARD is used instead of MONITOR. The keywords MONITOR and STANDARD are mutually exclusive.

2. Keyword obligatory, except when not relevant. Information may be entered either in free text only or in coded form with or without free text. However, coded information must be included when the corresponding data is given in the COMMON- or DATA-sections.

3. If coded information is given, the numerical data of the monitor used may be entered in the COMMON- or DATA-sections under the data-heading keyword MONIT, or in another cross-referenced subentry.

4. The general format of the code is

    (reaction,quantity,data-type,author,reference,subacc#)*

No embedded blanks are permitted within the code. However, if the coding will not fit onto one line, the break should be made after the comma separating any of these fields.**

5. Reaction, quantity and data-type are coded in exactly the same way as for the keyword REACTION. Note however that if data-type is omitted, the following comma and any trailing commas in the quantity field must be included as data-type is no longer the last field in the code.

   Author is the family name of the author of the reference in the next field. If more than one author, the name is followed by '+'.

   Reference is coded in exactly the same way as for the keyword REFERENCE.

   Subacc# is the 8 character identification of the subentry containing the monitor data. This field may be omitted. If this field is included, data for the same monitor cannot be given in the data-table under the heading MONIT.

6. Two or more monitors given in coded form.

   Each monitor must be coded separately, starting in col.12.

   The coded information can then be linked to the COMMON- or DATA-sections by using pointers and the repeated data-heading keyword MONIT, as for multiple reactions.

<center>See next page for examples</center>

* As proposed in memo CP-D/21, page 6 10.

** The coding for this keyword is very long and will almost never fit onto one line. The coding for the keywords REACTION and REFERENCE forbid embedded blanks. Therefore the rule about where to make the break.

Examples

a) MONITOR (29-CU-63(P,N)30-ZN-63,,SIG,,,,GOSHAL,J,PR,80,939,50,
B0017005)

b) MONITOR (29-CU-65(P,N+P)29-CU-64,,SIG,,,,MEGHIR,T,MEGHIR,62,
B0016002)

c) MONITOR (92-U-238(P,F)47-AG-111,CUM,SIG,,,EXP,PANONTIN+,
J,JIN,30,2017,68,B0019007)
(92-U-238(P,F)49-IN-111,CUM,SIG,,,EXP,PANONTIN+,
J,JIN,30,2017,68,B0019010)

d) MONITOR 1(92-U-238(P,F)47-AG-111,CUM,SIG,,,EXP,PANONTIN+,
J,JIN,30,2017,68)
2(92-U-238(P,F)49-IN-111,CUM,SIG,,,EXP,PANONTIN+,
J,JIN,30,2017,68)

RAD-DET (used only for CPND, it is foreseen for NND)

1. This keyword is not compulsory but must be included if the nuclide
    observed is not obvious from the REACTION code or the DECAY-DATA
    code. (If the keyword is present then the keyword DECAY-DATA must
    also be present.) Coded information is obligatory.

2. The general format of the code is

             (nuclide,radiation)

    No embedded blanks are permitted in the code.

3. Nuclide field. The general format of the code is Z-S-A-X, see page VIII.1.4.

4. Radiation field consists of one or more codes from dictionary 13
    each separated by a comma.

5. Two or more nuclides. The coded information for each nuclide must be
    given separately, each code starting in col.12. Pointers may be used
    to link the RAD-DET codes with the REACTION codes and the DECAY-DATA
    codes.

6. Examples: a) RAD-DET   (96-CM-240,A)

             b) RAD-DET   (25-MN-52-G,DG)

             c) RAD-DET   (25-MN-52-M,DG,B+)

             d) RAD-DET   (48-CD-115-G,B-)
                             (49-IN-115-M,DG)

             e) RAD-DET   1(94-PU-237-M1,SF)
                            2(94-PU-237-M2,SF)

REACTION (used only for CPND, it is foreseen for NND)

1. This keyword is obligatory for CPND and must have coded information. For NND the keywords ISO-QUANT, CMPD-QUANT or NUC-QUANT, which are mutually exclusive, are used instead.

2. This keyword is used to specify the data which is presented in the data-table in columns headed by DATA, RATIO and SUM (and similar headings such as DATA-MIN, DATA-MAX etc.)

3. A reaction-unit consists of three major fields,

    (reaction, quantity, data-type)

    The detailed coding for each field is given starting on the next page.

4. In most cases a single reaction-unit is sufficient to specify the data, however in order to deal with experimental data sets referring to complex combinations of materials and reactions, reaction-units can be connected into a single machine-retrievable field, with appropriate separators and properly balanced parentheses. In all cases of combined reaction-units, parentheses are used in exactly the same manner as in FORTRAN to define algebraic operations. The permitted separators are:

    Plus +   Minus −
                    Times *
    Over /   Also   =

5. The complete reaction-combination must be enclosed in parentheses.

    As reaction-unit may not be broken for continuation on the next line. The separator should appear last on any line, with the first parenthesis of the next reaction-unit beginning in column 12 of the next line. Thus blanks may follow a separator if the reaction-combination is continued on the next line.

    Examples of reaction-combinations are given on page VIII.3.REACTION.5.

6. Pointers may be used with this keyword, in which case the coding associated with each pointer may be a reaction-unit or a reaction-combination. These are then referred to as multiple reactions.

    See page IV.3 for general information on pointers.

    Examples of multiple-reactions are given on page VIII.3.REACTION.6.

7. The <u>reaction-unit</u> consists of three major fields,

(reaction, quantity, data-type)

Embedded blanks within a reaction-unit are not permitted.

8. <u>Reaction field.</u> The reaction field consists of 4 subfields, separated by commas or parentheses (not interchangeable).

(SF1(SF2,SF3)SF4,quantity,data-type)

9. <u>SF1.   Target nucleus.</u>   The general format of the code is

either   Z-S-A-X, see page VIII.1.4.   X may not have the value G.
or   Z-S-CMP (not for CPND; foreseen for NND).

CMP is either the code 'CMP'
or Z-S-CMP is replaced by a code from dictionary 9.

10. An extension to the coding of the target nucleus is foreseen but <u>not yet implemented.</u>   Namely ions may be coded in the form $(n \pm)$ immediately following the isotope code; e.g. $8-\emptyset-16(3+)$.   This extension will also apply to SF2, SF3 and SF4.

11. <u>SF2.   Incident particle.</u>   This subfield contains

either   a particle code from dictionary 33;

or   for particles heavier than alpha, a code in the form Z-S-A-X, see page VIII.1.4.   (Can X have the value G?)

12. <u>SF3.   Process.</u>   This subfield contains

either   a) a process code from dictionary 30;

or   b) a particle code from dictionary 33, which may be preceded by a multiplicity factor;

or   c) for particles heavier than alpha, a code in the form Z-S-A-X, see page VIII.1.4.

or   d) for more than one outgoing particle, any combination of b) and c), with the codes connected by '+'. Outgoing particles are ordered starting with the lightest at the left of the subfield (i.e. in the same order as in dictionary 33) followed by the Z-S-A-X formatted codes, in Z, A order.   The exception to this order is if SF5 contains the code 'SEQ', which indicates that the particles are ordered in the sequence as the reaction proceeds.

Examples of SF3 coding: TOT
                            A
                            4A
                            $8-\emptyset-16$
                            N+HE3+4A
                            $8-\emptyset-16+8-\emptyset-16$
                            HE3+$8-\emptyset-16$

13. **SF4.** **Residual nucleus.** This subfield contains

either   a) a code in the form Z-S-A-X, see page VIII.1.4.   ,

or   b) a special code in the case of fission (i.e. SF3 contains the code 'F'); (Note that which codes under which conditions has not been settled).

or   c) it must be omitted if SF3 contains the process codes 'TOT', 'ABS', or 'NON'. It may be omitted if SF3 contains the particle code 'X'. It may also be omitted for NND. The following comma must be included.

14. An extension to the coding of the residual nucleus is foreseen but <u>not yet implemented</u>.

If Z occurs as a variable in the data-table under the heading 'ELEMENT' then the characters 'Z' and 'EL' are included in the nuclide code. Similarly if A occurs as a variable in the data-table under the heading 'MASS' then the character 'A' is included in the nuclide code.

      Examples of such coding: Z-EL-106
                                                 Z-EL-O
                                                 54-XE-A
                                                   Z-EL-A

15. **Examples of reaction-field coding:**
```
(39-Y-89(P,3N+P)39-Y-86-G,.......
(51-SB-121(18-AR-40,12N+2P)69-TM-153,......
(92-U-238(P,F)46-PD-103,......
(92-U-0(D,F)FF,......          (special code in SF4 for fission)
(92-U-235(N,TOT),.....          (SF4 omitted, 'TOT' in SF3)
(62-SM-147(P,X)4-BE-7,.....
(62-SM-147(P,T+X),......          (SF4 omitted, 'X' in SF3)
```

16. Quantity field. The coding consists of 4 subfields each separated by a comma.

> (reaction,SF5,SF6,SF7,SF8,data-type)

Any subfield may contain a combination of codes from the same dictionary, separated by a slash.

If a subfield is omitted, the extra separating comma must be included.

> e.g. (reaction,,SF6,,SF8,data-type)

17. Only certain combinations of codes in the quantity field are meaningful. These are listed in dictionary 36. Note that if two or more codes are entered in a subfield, they must be in the same sequence as in dictionary 36.

18. SF5. Branch.
Code(s) from dictionary 31.
This subfield indicates a partial reaction if, for example, only one of several energy levels or particle groups has been considered.

19. SF6. Parameter.
Code(s) from dictionary 32.
This subfield contains information about the reaction-parameter given, such as integral or differential cross-section.

20. SF7. Particle considered.
Code(s) from dictionary 33.
This subfield provides particle code(s) indicating to which of several outgoing particles the quantity refers.

The particle-designator can be omitted if there is no ambiguity. For integral data this subfield will usually be empty.

For a quantity describing the correlation between outgoing particles, two particle-designators are entered, separated by a slash.

It should be noted that the particle-considered is not necessarily identical with the particle-detected if, for example, the angular distribution of an outgoing particle has been deduced from a recoil particle detected.

21. SF8. Modifier.
Code(s) from dictionary 34.
This subfield contains information on the representation of the data, for example relative data, fitting coefficients, etc.

22. Data-type field.

This field contains codes from dictionary 35.
If two or more codes are given they are separated by a slash.

This field may be omitted, in which case the trailing commas, indicating omitted subfields in the quantity-field, may also be omitted. E.g. (reaction,,SF6).

This field indicates whether the data given are experimental, theoretical, evaluated etc. If the field is omitted, the data are experimental.

Reaction-combinations.

Examples of reaction-combinations

1. <u>Single target nucleus</u>; sum or ratio of 2 or more reactions.

((39-Y-89(P,2N+P)39-Y-87-M,,SIG,,,EXP)+
(39-Y-89(P,2N+P)39-Y-87-G,,SIG,,,EXP))   a sum

((39-Y-89(P,3N+P)39-Y-86-M,,SIG,,,EXP)/
(39-Y-89(P,3N+P)39-Y-86-G,,SIG,,,EXP))   a ratio

(((28-NI-58(N,N+P),,SIG)+(28-NI-58(N,D),,SIG))/
(13-AL-27(N,A),,SIG))   a sum and a ratio

2. <u>Single target nucleus</u>; "tautologies".   See VIII.3.ISO-QUANT.4.

3. <u>More than one target nucleus and more than one reaction.</u>   (Not necessarily a mathematical sum.)

((28-NI-58(N,P),,SIG)+(28-NI-60(N,T),,SIG))

4. Note that the reaction-combination formalism is not used for certain frequently occurring sums and ratios for which specific quantity codes have been introduced.

Also sum reactions such as "absorption" or (Z-S-O(P,X)Z'-S'-A,,SIG) where the individual competing reactions may not be known, cannot be coded in the explicit formalism ((...)+(...)).

Multiple reactions

The coding associated with each pointer may be a reaction-unit
or a reaction-combination.

The use of multiple-reactions is presently restricted to:

    a) resonance parameters of the same isotope

       e.g. REACTION 1(92-U-235(N,TOT),,WID)
                    2(92-U-235(N,EL),,WID)
                    3(92-U-235(N,0),,J)

with the pointers being repeated in the data-headings DATA 1,
DATA 2, DATA 3, respectively, and perhaps elsewhere.

    b) multiple representations of the same reaction

       e.g. REACTION 1(92-U-235(N,F),,SIG,,REL)
                    2(92-U-235(N,F),,SIG)

with the pointers being repeated in the data-headings DATA 1
and DATA 2, and perhaps elsewhere.

       or REACTION 1((92-U-235(N,F),,SIG)/(79-AU-197(N,G),,SIG))
                    2(92-U-235(N,F),,SIG)

with the pointers being repeated in the data-headings RATIO 1
and DATA 2, and perhaps elsewhere.

    c) for CPND only, for isomeric branches and ratios of the same
       reaction

            total reaction cross-section,
            partial cross-sections leading to isomeric states,
            sums and ratios of partial cross-sections

may all be entered in a single subentry, provided that the target nucleus,
the incident particle and the outgoing particles are the same.

RESID-NUC   (used only for NND)

1.   Keyword optional with coded information and/or free text.

2.   This keyword is used to specify the nucleus of the residual nucleus.

3.   The general format of the code is (Z-S-A-X), see page VIII.1.4.

        A may not have the value zero.

Two or more residual nuclei

4.   If the residual nuclei refer to a single isoquant-unit they
     may be coded together or on separate lines. (For the meaning
     of isoquant-unit see ISO-QUANT in this section.)

        e.g. either RESID-NUC (CODE1,CODE2) free text

              or   RESID-NUC (CODE1) free text
                             (CODE2) free text

5.   The residual nuclei pertaining to isoquant-units in an
     isoquant-combination should be coded on separate lines, in the
     same order as the corresponding isoquant-units. (For the meaning
     of isoquant-combination see ISO-QUANT in this section.)

6.   Pointers may be used to link the residual nucleus codes to the
     corresponding isoquant-units and/or isoquant-combinations if
     multiple isoquants have been used. (For the meaning of
     multiple-isoquants see ISO-QUANT in this section.) See also
     page IV.3.

7.   In the COMMON- or DATA-section, data given in a column headed by 'HL'
     gives the half-life life of the residual nucleus.

8.   For CPND the residual nucleus is coded in SF4 under REACTION.

STANDARD   (used only for NND)

1. For CPND, where the data are specified under the keyword REACTION, then the keyword MONITOR is used instead of STANDARD. The keywords MONITOR and STANDARD are mutually exclusive.

2. Keyword obligatory, except when not relevant. Information may be entered either in free text only or in coded form with or without free text. However, coded information must be included when the corresponding data is given in the COMMON- or DATA-sections.

3. If coded information is given the coding rules for STANDARD are all identical to those for ISO-QUANT.

4. If coded information is given, the numerical data of the standard used may be entered in the COMMON- or DATA-sections under the data-heading keyword STAND.

   Two or more standards given in coded form.

5. Each standard must be coded separately, starting in col.12.

6. The coded information can then be linked to the COMMON- or DATA-sections by:

   either using pointers and the repeated data-heading keyword STAND, as for multiple isoquants;

   or using the data-heading keywords STAND1, STAND2 etc., where the 1 will refer to the first code entered under STANDARD, the 2 will refer to the second code, etc.

Links between data-heading keywords and information-identifier keywords

In the COMMON- and DATA-sections some data-heading keywords require specific keywords and codes in the BIB-section. These are listed below. See also part 3 of this section for further information about the keywords, and page IV.3 for information about pointers.

DATA, RATIO, SUM

The data-heading keywords DATA, RATIO, SUM, and their derivatives such as DATA-MAX etc., are defined in the BIB-section under ISO-QUANT, NUC-QUANT, CMPD-QUANT, or REACTION. The use of RATIO and SUM is restricted to explicit ratios or sums expressed in the form

REACTION   ((...)/(...))
   or   ((...)+(...)) respectively.

Any implicit ratios, such as the quantity "alpha"(capture-to-fission cross-section ratio), and implicit sums, such as a total cross-section deduced from partial cross-sections, are coded with the data-heading DATA.

Note: The data-heading keyword SUM is at present used only in combination with REACTION. When ISO-QUANT is used, SUM is replaced by DATA.

Pointers are used to link the data columns to the relevant codes in the BIB-section.

STAND

The data-heading keyword STAND and its derivatives STAND1, STAND2 etc are defined in the BIB-section under STANDARD. (This is used only in combination with ISO-/NUC-/CMPD-QUANT.)

STAND is used when only one standard is given. STAND1, STAND2 etc are used when two or more standards are given. STAND1 refers to the first standard entered, STAND2 to the second, etc.

Instead of using STAND1, STAND2 etc, pointers may be used to link the data columns to the relevant codes in the BIB-section.

MONIT

The data-heading keyword MONIT is defined in the BIB-section under MONITOR. (This is used only in combination with REACTION).
Pointers may be used to link the data columns to the relevant codes in the BIB-section.

EN

This data-heading keyword and its derivatives (e.g. EN-APRX, EN-MIN) are used for the energy of the incident particle.

For the keywords ISO-QUANT and CMPD-QUANT the incident particle is a neutron (N).

For the keyword REACTION the incident-particle code is in SF2.

EN-DUMMY

This is used for the numerical equivalent of an incident particle spectrum when the quantity-field contains the modifier codes MXW,FIS or SPA. Explanation must be given under the keyword INC-SPECT.

E

This data-heading keyword and its derivatives e.g. E-APRX, E-MIN, (exceptions below) are used for the energy of the outgoing particle considered. Refer to ISO-QUANT, CMPD-QUANT, NUC-QUANT and REACTION.

When two or more particles are considered the headings E1, E2 etc are used. These are explained under the keyword EN-SEC in free text only.

E-NRM

This data-heading keyword is used for the energy of the outgoing gamma-ray or particle group for which the normalization value of a particle cross-section is given under the data-headings STAND or MONIT.

ANG,COS

These data-heading keywords and their derivatives are used for the angles when angular differential data are given.

Under the keywords ISO-QUANT, CMPD-QUANT and NUC-QUANT, SF2 contains the code DA.

Under the keyword REACTION, SF6 contains the code DA.

When two or more angles are considered, the headings ANG1, ANG2 etc are used. These are explained somewhere in the BIB-Section.

ELEMENT, MASS

These data-heading keywords, and the derivatives of MASS, are used
to give the nuclides from a fission-product or fission-fragment
reaction.

Under the keywords ISO-QUANT and NUC-QUANT, SF2 contains the code
YLD or SF4 contains the code FF.

Under REACTION the coding for these reactions is not yet settled.

NUMBER

This data-heading keyword and its derivative are used to give the
coefficient-number of Legendre or cosine coefficients. Under the
keywords ISO-QUANT, CMPD-QUANT and NUC-QUANT, SF2 contains the code
LEG or COS.

Under the keywords REACTION, SF8 contains the code LEG or COS.

HL

A data-column headed by HL contains the half-life of the residual nucleus, which may or may not be coded under RESID-NUC. (see also VIII.5)

Note that for certain data-types the half-life functions as an independant variable to be coded under the data-heading HL without an explanation under the BIB keyword HALF-LIFE. Compare in Lexfor under Delayed Fission Neutron Data.
==============================

HL1, HL2 etc.

Data columns headed by HL1, HL2 etc contain the half-lives of the nuclei specified with these headings in the codes under HALF-LIFE. See example 17. (See also VIII.5)

-ERR

Free text explanation can be given for any data-heading keyword having the modifier -ERR by repeating the data-heading as a code with the keyword ERR-ANALYS. If the modifiers -ERR1,-ERR2 etc are used, then the keyword ERR-ANALYS must be present.

FLAG

This data-heading may not be used in the COMMON- section, nor may it be used in a DATA-section containing only one data point.

The columns headed by FLAG contains numbers (in fixed point format). These numbers are repeated as codes with the keyword FLAG, where free text explains their meaning.

Flags are used to supply information to specific lines in a data-table. (They should not be used for entire sub-works).

There may be more than one column in the DATA-section with the heading FLAG, see VIII.5.

MISC

This data-heading and its derivatives MISC1, MISC2 etc are used for miscellaneous numerical data. Free text explanation for such data can be given by repeating the data-heading as a code with the keyword MISC-COL.

ASSUM

This data-heading and its derivatives ASSUM1, ASSUM2 etc are used for data assumed by the author for the derivation of the experimental results. The data-heading is repeated in the first field of the code with the keyword ASSUMED.

REACTION   (For a summary of coding rules see Dictionary 2.)

The information coded under the keyword REACTION has the fol...

2. The residual nucleus is usually defined as the heaviest of the reaction products. For certain processes the residual nucleus is not defined. For fission, see in Lexfor under Fission. In the second example under 10. below, the residual nucleus is not necessarily the heaviest reaction product.

7. In SF3, gammas are coded only for a capture process, e.g. (P,G). When other particles are produced gammas are self-evident and therefore not coded. Write (P,N) and not (P,G+N), even if the gammas from this reaction have been detected. Compare the "particle-considered" in SF7 below. This consistency is needed for retrieval purposes: otherwise one has to retrieve for (P,N) and (P,G+N) if one wants complete information on the (P,N) reaction.

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9. Certain processes like total or absorption cross-sections are coded by entering in SF3, instead of outgoing-particle codes, a process-code from Dictionary 30. In such cases the residual nucleus, in general, cannot be coded. Fission is coded as (Z-S-A(P,F)...; scattering may be coded as (Z-S-A(P,P)Z-S-A, but when elastic, inelastic or other types of scattering must be distinguished, the corresponding process-codes from Dictionary 30 must be used.

10. Unidentified complex reactions are denoted with an X, for example:

(Z-S-A(P,T+X),   — emission of tritons and possibly other unidentified particles after proton absorption; this formalism is used when the emitted particle considered is an alpha particle or lighter;

(Z-S-A(P,X)4-BE-7,   — emission of 4-Be-7 particles and possibly other unidentified (perhaps even heavier) particles after proton absorption; this formalism is used when the emitted particle considered is heavier than an alpha particle;

(Z-S-O(P,X)Z'-S'-A,   — competing processes from different isotopes of the target element lead to the same residual nucleus.

All existing combinations of codes in subfields SF5-SF8 are entered in Dictionary 36. This serves as a guide to compilers in order that complex quantities are coded in a consistent manner, provides a useful tool for an input checking program, and provides expansions for an edited listing to be readable by customers without consultation of dictionaries. New quantities (code combinations in SF5-SF8) introduced by compilers should be communicated to NDS for inclusion in Dictionary 36. If more than one code is given in a subfield (separated by a slash), the combination must be given in the sequence listed in Dictionary 36.

For examples of quantity codes see in particular Dictionary 36 but also Lexfor entries such as Cross-Sections, Isomeric States, Sequence of outgoing particles, etc.

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MONITOR

If possible, the monitor reaction should always be given in coded form; to give author and reference is obligatory; the Exfor accession-number of the monitor reaction should be given whenever possible (that means: if the data of the monitor reaction do not yet exist in Exfor, they should be compiled immediately).

DECAY-DATA

SF4: the energy of the radiation in keV, coded as a floating-point number without a unit-code. In cases where unresolved doublets (or multiplets) of γ-rays were used in the publication, the energies of all involved γ-rays should be given, separated by a slash. If only two energies are given, this can also mean the borders of an energy range containing all (unresolved) γ-rays which were used for analysis on the whole. - Example:

$$\text{DECAY-DATA } (Z-S-A, n.HRS, DG, E_1/E_2, I_{12})$$

Here I_{12} means the total abundance of the two γ-rays E_1 and E_2, or of all γ-rays lying in between the limits E_1 and E_2, respectively.

SF5: the abundance of the observed radiation per decay, given as a floating-point number.

SF3, SF4, SF5 may be repeated as often as necessary in order to give the data for additional competing decay modes. Trailing empty subfields are omitted.

Decay-data may be entered for any nuclide occurring in the reaction measured or in the reaction used for normalization,

- in order to define a metastable state,

- when used as basic parameters for deducing the data given in the DATA section,

- or as additional information resulting from or related to the experiment.

Free text explanation will often be desirable, for example to state whether the decay data were obtained from the experiment or quoted from another source.

The compiler has the choice whether he prefers to code a half-life value under DECAY-DATA or using the keyword HALF-LIFE. In many case the use of the keyword DECAY-DATA will be preferable. However, if half-life values are given in the COMMON section or as a variable in the DATA section, the keyword HALF-LIFE must be used.

At present, the keyword DECAY-DATA is not accepted for NND.