Memo 4C-3/140

To: Distribution

26 September 1975

From: K. Okamoto, M. Lammer, H.D. Lemmel

Subject: 1.) Proposed Lexfor entry on "Delayed Fission Neutron Data" (4th version)
2.) Better unit-codes for some fission quantities

Reference: 4C-3/123 of 2 June 1975
4C-1/61 of 9 June 1975

1.) The attached fourth version of the proposed Lexfor entry on "Delayed Fission Neutron Data" is the common denominator of our second version submitted in 4C-3/123 and the NNCSC counter-proposal (third version) submitted in 4C-1/61.

2.) We regret that the improved unit codes as suggested in 4C-3/123 were questioned. The inconsistency of the present unit codes is evident:

	present	proposed
neutrons per fission	NO-DIM	N/F
neutrons per 100 fissions	PC/FIS	N/100F
gammas per 100 neutrons	GAM/100N	GAM/100N
fission product nuclei per 100 fissions	PC/FIS	NUC/100F
neutrons per absorption	NO-DIM	N/ABS

We suggest to discuss the matter at the next 4C-Meeting.

Attachment

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DELAYED FISN 1)

Proposed Lexfor entry:

Delayed Fission Neutron Data

A fission-product nucleus decays by beta-decay into a daughter nucleus, of which an excited state may decay by neutron emission. The measured half-life of this (delayed) neutron emission is determined by the half-life of the preceding beta-decay, which is in the order of 0.1 to 60 sec. This is large compared to the period of prompt neutron emission ($\ll 4 \times 10^{-14}$ sec, see under Fission Yield).

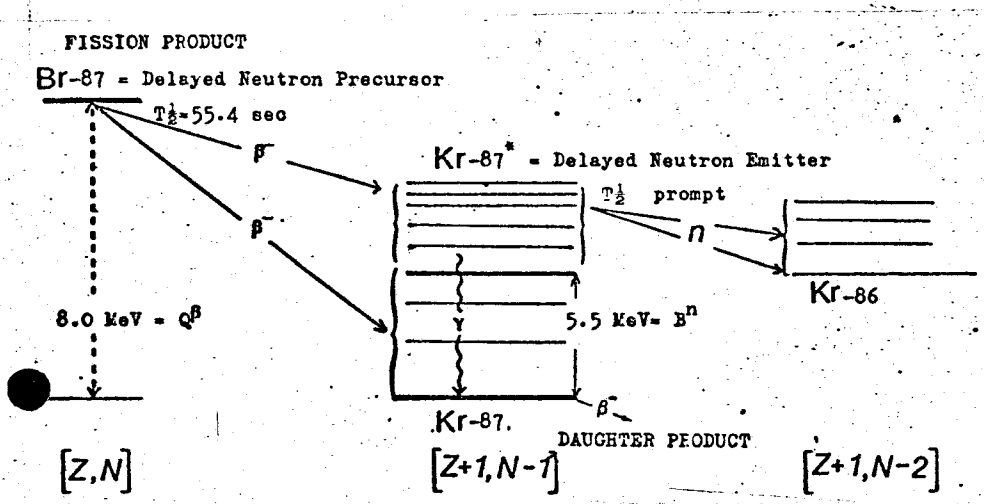

Fig. Schematic representation of Delayed neutron emission

B^n neutron binding energy
Q^β total β^--decay energy

For further detail see:

S. Amiel, Symp. on Physics and Chemistry of Fission, p. 569 (1969).
G.R. Keepin, Physics of Nuclear Kinetics (1965).
E.K. Hyde, The Nuclear Properties of Heavy Elements, Vol III. (1964)

For the quantities considered the nucleus to be entered is the target nucleus before the absorption of the incident neutron.

For spontaneous fission enter the fissioning nucleus, the quantity SF/NU instead of NU, and use the keyword NUC-QUANT instead of ISO-QUANT.

There are other delayed-neutron quantities which are not properties of the fissioning nucleus but decay properties of the fission-product nucleus which is the "precursor" of the delayed neutron. Although such quantities are closely related to the quantities given below, they are presently not coded in Exfor. Quantities of this category are in particular

- the delayed neutron emission probability, and
- the energy spectrum of the neutrons emitted by a specific precursor.

(For delayed neutron emission probabilities see for example:
Amarel+ JIN,31,577,69
Tomlinson+ JIN,33,3609,71
Asghar+ NP/A,247,359,75)

Definitions and codes of quantities:

1.) The total average delayed fission neutron yield $\bar{\nu}_d = \bar{\nu}_t - \bar{\nu}_p$

Quantity code: NU,,DL

Unit: neutrons per fission which is entered as NO-DIM

The delayed neutron fraction $\bar{\nu}_d / \bar{\nu}_t$

to be coded as: (Z-S-A,NU,,DL)/(Z-S-A,NU) with the unit NO-DIM.

2.) Partial delayed fission neutron yields

Quantity code: NU,,DL/PAR

There are two main types of data:

a.) delayed neutron groups. Usually 6 delayed neutron groups are distinguished by their half-lives. Each group is associated with, perhaps, several different precursor nuclides with similar half-life values (approximately 55 sec, 22 sec, 6 sec, 2 sec, 0.5 sec, 0.2 sec). Data should be coded using the average half-life of the group as independant variable under the data heading HL which need not be explained under the BIB keyword HALF-LIFE. Data may be presented as

- relative group yield coded as ratio ((Z-S-A,NU,,DL/PAR)/(Z-S-A,NU,,DL)) with the unit NO-DIM. The values for the 6 groups sum up to 1.
- absolute group yield coded as NU,,DL/PAR. The unit is either PC/FIS = neutrons per 100 fissions = percent per fission, or NO-DIM which stand in this case for neutrons per fission.

b.) delayed neutron yields from individual precursors. Data should be coded with the precursor nucleus as an independent variable given under the data headings ELEMENT and MASS. The unit is usually PC/FIS, as above. The half-life may be given as additional information under the data heading HL without requiring explanation under the BIB keyword HALF-LIFE. (For HALF-LIFE compare page VIII.24.)

3.) Energy spectra of delayed neutrons

a.) the energy spectrum of the delayed neutrons of a given group:

Quantity code: NU,DE,DL/PAR/REL
Unit: usually ARB-UNITS
Independent variables: HL and an energy range E-MIN to E-MAX.
(Other representations may be possible and should be considered whenever they occur.)

b.) The energy spectrum of all delayed neutrons together is time dependent, due to the contributions from the different half-life groups. This is presently not coded in Exfor.

The delayed-neutron equilibrium spectrum as found in a steady-state reactor is presently not coded in Exfor.