

## Pn Value Determined as Ratio of Neutron Yield to Fission Yield

(N. Otsuka, 2019-01-10, Memo 4C-3/414 Rev.)

PRELIM.2268 is specialized for transmission and retransmission of EXFOR entries for Pn values in old publications. Rudstam gives a very good review of such experimental data published in 1960s and 1970s [1].

### 1. Addition of an example of “derived data” in LEXFOR “Data Type”

An old method seen in PRELIM.2268 is to derive the Pn value by

1. measuring the yield of the delayed neutrons emitted from a specific fission product nuclide (precursor)  $v_d(Z,A)$ , and then
2. dividing  $v_d(Z,A)$  by the fission product yield, namely  $Pn(Z,A)=v_d(Z,A)/FPY(Z,A)$ .

Rudstam introduced this method as an “indirect method” in his presentation at 1979 Vienna meeting [1], and concluded that “Branching ratios determined by indirect methods involving estimated yields must be regarded with caution.” I suggest addition of the following example as derived data in LEXFOR “Data Type”:

Pn value obtained as the ratio of the measured delayed neutron yield to the estimated fission yield.

The Pn values obtained by this method are listed with “Estimated fission yields” in Ref. [1].

### 2. Yield of delayed neutrons emitted from a fission product nuclide specified

$v_d(Z,A)$  can be independent (i.e., neutrons emitted from the directly formed fission fragments) or cumulative (i.e., neutrons emitted from the directly or indirectly formed fission fragments). Therefore DL,NU must be accompanied with a branch code (e.g., IND, CUM) when it appears with a nuclide code (or ELEM/MASS) in REACTION SF4. The REACTION code of the following subentries in PRELIM.2268 must be corrected:

20521.002, 20879.007, 22047.005, 23349.002, 23350.004, 23351.002, 23353.003, 23353.005-006, 23354.006, 23356.002-005, 23357.004-007, 23357.009, 23360.015, 23362.003, 23362.004

The same comment is applied to 41300.002 and 41377.002-003.

Addition of these quantities in LEXFOR “Delayed fission neutrons” is proposed:

### Delayed Fission Neutron Yield for a Given Precursor Nuclide

The cumulative and independent delayed fission neutron yields are the delayed neutron yields from an individual precursor **including or excluding** its formation via radioactive decay and isomeric transition, respectively.

**REACTION Coding:** (...(N,F)....,DL/CUM,NU) or (...(N,F)....,DL/IND,NU)

### Reference

[1] G. Rudstam, INDC(NDS)-107, p69 (1979).

Addition to WP2019-29 (2019-03-29):

“NDS EXFOR Manual” (IAEA-NDS-0003 Ver.1996/11) gives the following description:

Yields of delayed neutrons associated with individual precursors

Data should be coded with the precursor nucleus as an independent variable given under the data headings ELEMENT and MASS, usually with units PC/FIS, as above.

a) Independent delayed neutron yield of an individual precursor:

REACTION coding: (...(N,F)ELEM/MASS,DL/IND,NU)

It is the same as the product of the Pn-value and the independent fission yield of the precursor.

b) Cumulative delayed neutron yield of an individual precursor:

REACTION coding: (...(N,F)ELEM/MASS,DL/CUM,NU)

It is the the same as the product of the Pn-value and the cumulative fission yield of the precursor.

The sentence “It is the same as the product of the Pn-value and the cumulative or independent fission yield of the precursor” could be added to LEXFOR.