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To : Distribution

From : S. Webster

Subject : Update Dictionary 6, Type 3 Data, CINDA Manual

Update dictionary 6 :

AEA-TRS- AEA Thermal Reactor Services reports
AEA Technology, Winfrith, UK
(2UK WIN)

Type 3 evaluated data :

The following two evaluated files have recently been coded in CINDA as reference type 3 data : JEF-1, UKFY2.

The latter is the evaluated fission yield library from Winfrith, U.K. These codes start in column 28 of the reader format record. In the case of JEF-1 the material number is added in columns 38-41.

CINDA Manual :

I enclose the latest updated pages to the CINDA Manual

Distribution : Dr. V. Manokhin, CJD
Dr. S. Pearlstein, NNDC
Dr. J.J. Schmidt, NDS

TARGET

Format

Columns 1 - 2 Chemical symbol of the target element, left ajusted for single letter symbols.

Columns 3 - 5 Isotope mass number, right adjusted with leading zeros. Leave blank for natural elements containing a mixture of isotopes.

Coding rules

1. Single isotopes

Experiments and calculations giving information for specific isotopes, either using isotopically enriched target, or by identification of isotopes from the reactions themselves, should be coded with the specific isotope numbers.

Monoisotopic and nearly monoisotopic elements should be coded with the appropriate isotope number. A list of elements in this category is given below.

Inclusion of an element in this list implies that an experiment using a natural element target will only yield useful information about neutron reactions with the dominant element.

Examples

Isotope	Code
A1-27	AL027
W-186	W 186

SYMBOL	Z	ELEMENT	SYMBOL	Z	ELEMENT
AR	18	ARGON	MN	25	MANGANESE
AC	89	ACTINIUM	MO	42	MOLYBDENUM
AG	47	SILVER	N	7	NITROGEN
AL	13	ALUMINIUM	NA	11	SODIUM
AM	95	AMERICIUM	NB	41	NIOBIUM
AS	33	ARSENIC	ND	60	NEODYMIUM
AT	85	ASTATINE	NE	10	NEON
AU	79	GOLD	NI	28	NICKEL
B	5	BORON	NN	0	NEUTRON
BA	56	BARIUM	NO	102	NOBELIUM
BE	4	BERYLLIUM	NP	93	NEPTUNIUM
BI	83	BISMUTH	O	8	OXYGEN
BK	97	BERKELIUM	OS	76	OSMIUM
BR	35	BROMINE	P	15	PHOSPHORUS
C	6	CARBON	PA	91	PROTACTINIUM
CA	20	CALCIUM	PB	82	LEAD
CD	48	CADMIUM	PD	46	PALLADIUM
CE	58	CERIUM	PM	61	PROMETHIUM
CF	98	CALIFORNIUM	PO	84	POLONIUM
CL	17	CHLORINE	PR	59	PRASEODYMIUM
CM	96	CURIUM	PT	78	PLATINUM
CO	27	COBALT	PU	94	PLUTONIUM
CR	24	CHROMIUM	RA	88	RADIUM
CS	55	CESIUM	RB	37	RUBIDIUM
CU	29	COPPER	RE	75	RHENIUM
DY	66	DYSPROSIUM	RH	45	RHODIUM
ER	68	ERBIUM	RN	86	RADON
ES	99	EINSTEINIUM	RU	44	RUTHENIUM
EU	63	EUROPIUM	S	16	SULFUR
F	9	FLUORINE	SB	51	ANTIMONY
FE	26	IRON	SC	21	SCANDIUM
FM	100	FERMIUM	SE	34	SELENIUM
FR	87	FRANCIUM	SI	14	SILICON
GA	31	GALLIUM	SM	62	SAMARIUM
GD	64	GADOLINIUM	SN	50	TIN
GE	32	GERMANIUM	SR	38	STRONTIUM
H	1	HYDROGEN	TA	73	TANTALIUM
HE	2	HELIUM	TB	65	TERBIUM
HF	72	HAFNIUM	TC	43	TECHNECIUM
HG	80	MERCURY	TE	52	TELLURIUM
HO	67	HOLMIUM	TH	90	THORIUM
I	53	IODINE	TI	22	TITANIUM
IN	49	INDIUM	TL	81	THALLIUM
IR	77	IRIDIUM	TM	69	THULIUM
K	19	POTASSIUM	U	92	URANIUM
KR	36	KRYPTON	V	23	VANADIUM
KU	104	KURCHATOVIUM	W	74	TUNGSTEN
LA	57	LANTHANUM	XE	54	XENON
LI	3	LITHIUM	Y	39	YTTRIUM
LR	103	LAWRENCIUM	YB	70	YTTERBIUM
LU	71	LUTETIUM	ZN	30	ZINC
MD	101	MENDELEVIUM	ZR	40	ZIRCONIUM
MG	12	MAGNESIUM			

Monoisotopic or effectively monoisotopic elements

**NN001	*O 016	CO059	PR141
H 001	F 019	AS075	TB159
H 002	NA023	Y 089	HO165
H 003	AL027	NB093	TM169
*HE004	P 031	RH103	*TA181
BE009	SC045	I 127	AU197
*C 012	*V 051	CS133	BI209
*N 014	MN055	*LA139	TH232

*nearly monoisotopic

**artificial code for 'neutron' as target

2. Natural elements and their isotopes

If a measurement was performed on a sample consisting of a natural isotopic mixture, but properties of some of the isotopes of that element are deduced, prepare entries for both the natural element and the appropriate isotopes.

The value of this convention is more obvious for some older works reported in CINDA. Current measuring techniques allow reactions on individual isotopes to be distinguished without necessarily accumulating comparative data for all constituents of the target. However, the convention is kept in order to preserve the consistency of the file.

3. Isotopes far from the stability line

The relation between Z and A of isotopic targets is checked on input, so as to eliminate misprint errors.

When entries are made for unusual target isotopes (multiple neutron capture, some fission products, some theoretical calculations) it is possible that these entries too will be rejected on a first check. Please repeat the designation of such targets in the right-hand margin of your entry sheet, to make it clear that the unusual isotope was not generated by a slip of the pen or a misprint error.

CINDA CROSS SECTION QUANTITY SCHEMES

```
|________________________________________
|          |                              |
TSL       SCT                            SNE*
           |                              |
           |      ________________________|____________________
           |     |                                             |
           |     |                                           ABS*
           |     |                                             |
      _____|_____|    _________________________________________|________________________________________
     |          ||   |      |      |      |      |      |      |      |      |      |      |      |      |
   SEL*      SIN*   NF*    N2N    NXN    NNP    NND    NNT    NNA    NHE    NP     ND     NT     NA    NG*
     |_____________________________________________________________|
                                   NEM
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* In contrast to the unmarked quantities, these reactions have separate codes for partial cross-sections (SEL/POL, SIN/DIN), differential data (SEL/DEL, SIN/DIN), gamma-emission data (DIN/DNG, SNE/NEG, NG/SNG) or resonance integrals (ABS/RIA, NF/RIF, NG/RIG or RIA).

Note : the following quantities include or are deduced from (measurements of) (several) other quantities: EVL, POL, RES, STF, LDL, NX.

Associated fission quantities

ALF, ETA, NU, SFG, SFN, NUD, NUF, NFY, FRS, FPB, FPG

Charged particle emission quantities

PEM, DEM, TEM, AEM

These are sums of processes from which emergent charged particles can be detected, weighted for the number of charged particles produced. The code PEM, representing proton emission, may include the summed quantities NP and NNP; similarly for the other three charged particle emission codes given above.

Forbidden ZAQ Combinations

In addition to fission quantities and RIG, the following combinations are forbidden for Z < 6 :

H 001	ABS
	AEM
	DEM
	DIN
	DNG
	GN
	NA
	ND
	NEG
	NEM
	NHE
	NNA
	NND
	NNP
	NNT
	NP
	NT
	NXN
	N2N
	PEM
	SCT
	SIN
	SNE
	TEM
H 002	AEM
	DEM
	DIN
	NA
	ND
	NHE
	NNA
	NND
	NNP
	NNT
	NP
	NT
	NXN
	SIN
	TEM
	PEM
H 003	AEM
	NA
	ND
	NHE
	NNA
	NND
	NNP
	NNT
	NP
	NT
	TEM
HE 003	AEM
	NA
	NHE
	NNA
	NND
	NNT
	NT
	NXN
HE 004	AEM
	NA
	NHE
	NNA
	NNT
	NP
	NT
	NXN
LI	NA
	ND
	NHE
	NNA
	NND
	NT
LI 006	NA
	ND
	NHE
	NNA
	NNP
	NXN
LI 007	NA
	NHE
	NNA
	NND
	NP
	NT
BE 009	NNA

Reaction (Goldstein notation)	Code	Expansion in CINDA book	
$\sigma_{n,n'}(E,\Theta)$	DIN	Diff Inelast	Definition : Angular distributions or energy spectra of inelastically scattered neutrons.
$\sigma_{n,n'}(E;E')$ $\sigma_{n,n'}(E;E',\Theta)$			Examples of use : 1) cross-sections for scattering to the 6.14 MeV level in O-16, the reaction O-16(n,n')O-16; 2) the angular distribution of inelastically scattered 14 MeV neutrons from Ca-40; 3) the energy spectrum recorded at 90° scattering angle for inelastically scattered neutrons. Note : As for Tot Inelastic, the category covers only nuclear scattering. Associated quantities : SIN, DNG.

Reaction (Goldstein notation)	Code	Expansion in CINDA book	
$\sigma_{n,n'}(E;E_\gamma)$ $\sigma_{n,n'}(E;E_\gamma,\Theta)$	DNG	Inelastic γ	Definition : Information on production cross-section, angular distributions or energy spectra for gamma rays following the inelastic scattering of neutrons. This code is used in the case of hydrogen only when Bremsstrahlung production is involved. Note 1 : The comment Bremsstrahlung production should be included in the comment field. Note 2 : Many inelastic scattering experiments measure the production cross-section for a specific gamma ray. This cross-section will in general differ from the cross-section for excitation of its state of origin, but will be equal if gamma-ray cascades to and from the level can be excluded. In this case, prepare a second entry for DIN = Diff Inelast. Associated quantities : SIN, DIN.
$\sigma_{nG}(E)$ $\sigma_{nG}(E,E_\gamma)$ $\sigma_{nG}(E;E_\gamma,\Theta)$	NEG	Nonelastic γ	Definition : Information on gamma rays from unseparated nonelastic processes. Use : Covers production cross sections distributions and energy spectra. Do not use for gamma rays which can be assigned to one of the definite processes a) Inelastic scattering (use DNG) b) Fission or fission fragments (use SFG or RPG c) Radiative capture (use SNG) d) Gamma rays following (n,p) or other charged-particle reactions (use NP, etc.). Associated quantities : SNE, DNG, SFG, FPG, SNG.

Reaction (Goldstein notation)	Code	Expansion in CINDA book	
			Special quantities
	EVL	Evaluation	Definition : A complete and consistent set of cross sections in some energy ranges. Use : Only for complete sets, of evaluated data : a separate entry may be prepared for each quantity given in the evaluation. Note : An "evaluation" can be distinguished either by use of the worktype 'D' with a normal quantity code. For example, a "best value" derived from comparing different $\bar{\nu}$ measurements would be entered under "NU" only, with "D" in column 18. The quantity 'EVL' implies that a (near) complete set of cross sections has been evaluated.
	TSL	Thermal Scat	Definition : Information on the energy and angular dependence of the elastic and inelastic scattering of slow neutrons from molecules in gases, liquids, crystals, etc., especially as expressed in the Egelstaff $S(\alpha,\beta)$ formalism. Use : This quantity should only be used when the nuclear environment influences neutron scattering. When nuclear scattering is distinguished from effects of the environment the quantity codes SEL, DEL, or SCT should be used. Coherent scattering amplitudes of compounds and bound atoms should be coded under TSL. Neutron diffraction measurements are not usually coded in CINDA, unless nuclear scattering information is given.

d) Separated Energy Ranges

If an article covers two or more distinct energy ranges with separate discussions of the deduced quantities, separate entries should be made for CINDA.

For example, a measurement at thermal energy and a separate measurement between 5 keV and 400 keV should be entered twice with energy codes :

Energy	Code
0.025 eV (thermal)	25-2
5 keV to 400 keV	50+3 40+5

This philosophy should not be taken to the extreme to make separate entries for each of a range of monochromatic incident neutron energies.

e) No information given

The alphabetic code NDG (columns 19-21) should be used only if it is impossible to give even an order of magnitude estimate of the neutron energy range.

For the quantity LDL, for which an incident neutron energy is meaningless, a slash "/" may be entered in column 19 of the E-MIN field.

f) Useful formulae

$$E_{ev} = 0.5 \times 10^{12} (V\ cm/s)^2$$
$$E_{ev} = 81.8 \times 10^{-3} / (\lambda/\mathring{A})^2$$
$$2200\ m/s = 0.025\ eV = 1.8\ \mathring{A}$$

For Inverse Reactions

$$E_n = E_a + Q - ((M_B - M_A)/M_B)E_a$$

where the reaction is A(a,n)B

E_a is the energy of a in the laboratory frame

M_A, M_B are the masses of A and B

Q is the Q value for aA $\rightarrow$ Bn